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Antimicrobial Activity of *Suaeda monoica* (Forsst ex Geml) against Human and Plant Pathogens

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ABSTRACT

Antimicrobial activity of the halophyte *Suaeda monoica* (Forsst ex Geml) was studied using leaf and shoot extracts, on the various test microorganisms, including multiple antibiotic resistant bacteria and phytopathogens. Antimicrobial activity of the extracts was determined by the Well Diffusion Method. The experimental results concluded that the hexane, methanol and water extracts of *S. monoica* leaves have greater potential as antimicrobial compounds against microorganisms and they can be used in the treatment of infectious diseases caused by resistant pathogenic microorganisms.

Keywords: Antimicrobial Activity, Multiple Antibiotic Resistant Bacteria, Well Diffusion Method, *Suaeda monoica.*

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INTRODUCTION

Many infectious diseases are known to be treated with herbal remedies throughout the history of mankind. Even today, plant materials continue to play a major role as therapeutic remedies in many developing countries [1, 2]. Halophytes are the specialized group of plants adopted for high saline conditions which include mangroves, sea grass, and blue green algae. They are also proven to have rich source of structurally diverse bioactive potential [3-7]. Mangroves have been reported to contain compounds like tannins, alkaloids and polyphenols [8], which have antimicrobial activity [9-11]. Halophytes are rich in proteins, oils and fats that are suitable for human consumption [12].

Suaeda monoica (Forsst ex Geml) annual herb belongs to Chenopodiaceae family and adapted to saline soil and lives in salt marshes or arid saline soil. This family includes about 1300 species world wide range from annual herbs to trees. Investigations revealed that they contain triterpenoid saponins [13-14], coumarins [15], phenolic compounds [16] and alkaloids [17]. In this present study an attempt was made on antimicrobial activity of halophytic plant *Suaeda monoica* on some pathogenic microbes.

MATERIALS AND METHODS

Plant Material

Plant materials of *Suaeda monoica* were collected from mangrove habitats near the Naval dock yard region of Visakhapatnam. Plant parts such as leaves and shoots were cleaned properly and shade dried, cut into small pieces and powdered in a mixer grinder the residues (crude extracts) obtained were finally dried under vacuum.

Extraction of Plant Material:

The extraction method employed was a known amount of coarsely powdered plant materials of different plant parts such as leaves and shoots were successively extracted with organic solvents like hexane, chloroform, methanol and water basing on order of their polarity using Soxhlet apparatus. The different extracts obtained were subsequently concentrated under reduced pressure to get their corresponding residues. The extracts were screened for antimicrobial activity using the method described under the section.

Organisms Used In This Study

The antimicrobial activity of *Suaeda monoica* stem and leaf extracts was tested against *Bacillus subtilis, Bacillus megaterium, Lactobacillus acidophilus, Escherichia coli, Enterobacter aerogenes, Enterobacter cloace, Klebsiella pneumonia, Candida albicans, Mucar recemosus, Rhizoctonia solani, Rhizopus stolonifer* and *Saccharomyces cerevisiae*. These microorganisms were collected from the Department of Microbiology and Department of Pharmacy, Andhra

University, India. The strains are maintained and tested on Nutrient Agar (NA) for bacteria and Potato Dextrose Agar (PDA) for fungi.

Determination of Antimicrobial Activity

The crude extracts of different plant parts of different species were subjected to antimicrobial assay using the Agar Well Diffusion Method of Murray *et al.* 1995 [19] modified by Olurinola, 1996 [20]. 20ml of nutrient agar was dispensed into sterile universal bottles these were then inoculated with 0.2 ml of cultures mixed gently and poured into sterile Petri dishes. After setting, a number 3-cup borer (6mm) diameter was properly sterilized by flaming and used to make three to four uniform wells in each Petri dish. A drop of molten nutrient agar was used to seal the base of each cup.

The wells were filled with 50µl of the extract concentration of 100mg/ml, 300mg/ml and 500 mg/ml so final drug concentration will be 5 mg/well, 15 mg/well and 25 mg/well respectively and allow diffusing of plant extract into the medium for 45 minutes. The plates were incubated at 37^{o} C for 24hr for bacteria. The above procedure is allowed for fungal assays but except the media Potato Dextrose Agar instead of Nutrient Agar and incubates at 25^{o} C for 48 hours. The Zones of Inhibition were measured with antibiotic Zone Scale in mm and the experiment was carried out in duplicates.

RESULTS AND DISCUSSION

In the present study, hexane, chloroform, methanol and water extracts of leaves and shoots of *S. monoica* exhibited the different degrees of growth inhibition against tested bacterial and fungal strains (Table-1 & Table-2). According to Table-1, and Table-2 hexane, methanol and water extracts of leaves at 500 mg/ml exhibited considerable antimicrobial activity than the shoot extracts, against tested microbial strains. Significant highest level of antimicrobial activity was found with the water extracts of leaves against fungal strains such as *R. stolonifer* (26 mm) followed by *M. recemosus* (24 mm) and *S. cerevisiae* (22 mm), whereas moderate level of antimicrobial activity of water extract was found against bacterial strains such as *B. subtilis* (19 mm) followed by *K. pneumonia* (19 mm), *B. megaterium* (18 mm), *L. acidophilus* (18 mm), *E. coli* (17 mm), *E. cloace* (17 mm) and *E. aereogenes* (16 mm) whereas fungal strains such as *R. solana* (18 mm). Highest level of antimicrobial activity was found with the methanol extracts observed against bacterial strains such as *B. megaterium* (21 mm) where as moderate level of antimicrobial activity observed against bacterial strain such as *L. acidophilus* (16 mm). Hexane extracts showed highest level of antimicrobial activity against bacterial strains such as *B. subtilis* (21 mm) and *L. acidophilus* (21 mm), where as moderate level of antimicrobial activity observed against bacterial strains such as *B. megaterium* (20 mm) followed by *E. coli* (20 mm), *E. aereogenes* (20mm), *E. cloace* (20 mm) and *K. pneumonia* (20 mm). On the other hand, the extracts of chloroform did not show any anti-microbial activity in the case of *Bacillus subtilis, Bacillus megaterium, Lactobacillus acidophilus, Escherichia coli, Enterobacter aerogenes, Enterobacter cloace.*

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Table-1: Antimicrobial activity of hexane, chloroform, methanol and water extracts of *Suaeda monoica* leaves:

Microorganisms	100mg/ml				300mg/ml				500 mg/ml			
	H	C	M	W	H	C	M	W	H	C	M	W
Bacillus subtilis	15	-	13	14	19	-	15	16	21	-	17	19
Bacillus megaterium	14	-	15	12	18	-	18	14	20	-	21	18
Lactobacillus acidophilus	15	-	14	13	19	-	17	16	21	-	19	18
Escherichia coli	13	-	13	13	19	-	17	15	20	-	19	17
Enterobacter aerogenes	14	-	13	12	18	-	16	14	20	-	19	16
Enterobacter cloace	13	-	14	12	18	-	16	15	20	-	18	17
Klebsiella pneumonia	15	13	10	12	18	15	14	16	20	18	16	19
Candida albicans	11	-	-	11	17	-	-	13	19	-	-	15
Mucar recemosus	11	-	-	15	13	-	11	23	14	-	13	24
Rhizoctonia solani	-	-	-	12	-	13	-	14	14	15	-	18
Rhizopus stolonifer	-	12	-	17	-	15	13	21	-	16	14	26
Saccharomyces cerevisiae	13	11	-	17	14	14	-	20	17	16	-	22

Volume per well: 50µl; Borer size used: 6mm; **H**-Hexane, **C**-Chloroform, **M**-Methanol and **W**-Water, No zone (-).

Table-2: Antimicrobial activity of hexane, chloroform, methanol and water extracts of *Suaeda monoica* shoots:

Microorganisms	100mg/ml				300mg/ml				500 mg/ml			
	H	C	M	W	H	C	M	W	H	C	M	W
Bacillus subtilis	12	-	-	15	14	-	-	19	15	-	-	21
Bacillus megaterium	10	-	-	16	13	-	-	18	13	-	13	18
Lactobacillus acidophilus	14	-	-	14	21	-	-	17	21	-	-	20
Escherichia coli	14	-	-	12	21	-	-	16	21	-	-	23
Enterobacter aerogenes	15	-	-	15	21	-	-	18	21	-	14	20
Enterobacter cloace	14	-	-	15	23	-	-	17	23	-	-	18
Klebsiella pneumonia	13	-	-	14	22	-	-	17	22	-	13	20
Candida albicans	-	-	-	14	-	-	-	19	-	-	-	21
Mucar recemosus	-	-	11	14	15	-	12	16	15	-	14	22
Rhizoctonia solani	-	-	-	12	-	-	-	14	-	-	14	16
Rhizopus stolonifer	-	-	-	15	14	13	14	18	14	15	16	22
Saccharomyces cerevisiae	11	-	-	12	14	13	12	14	14	16	17	16

Volume per well: 50µl; Borer size used: 6mm; **H**-Hexane, **C**-Chloroform, **M**-Methanol and **W**-Water, No zone (-).

India has a great diversity of plants used in folk medicine and only few of these have been studied for antimicrobial studies [21]. *Suaeda monoica* is used in treats the wounds [22]. Polyphenols from *Suaeda maritima* and *S. monoica* and *S. maritima* cures hepatitis and it has antiviral activity [23]. Several mangroves and halophytes are extensively used in traditional medicine, only some of them were tested for biological activities [24]. The antimicrobial activity exhibited by the mangrove plant parts could be due to the presence of phytochemicals like alkaloids, tannins, flavonoids and sugars present in the plant extract [25]. The variation of

antimicrobial activity of present study might be due to distribution of antimicrobial substances, which varied from fraction to fraction of the crude extract. Further studies are needed to identify the pure component and establish the exact mechanism of action for antibacterial action of the plant extract.

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