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Preliminary Phyto-profile and Pharmacological Evaluation of some Extracts of *Cenchrus* grass against Selected Pathogens.

Dr. Premlata Singariya*[1], Dr. Krishan Kumar Mourya[2] and Dr. Padma Kumar[3]

1.Dr. D.S. Kothari Post doctoral fellow, Laboratory of Tissue Culture and Secondary Metabolites, Department of Botany, University of Rajasthan, Jaipur- 302004.

2. Nodal Officer, Animal Husbandry Department, Pahari (Bharatpur) Rajasthan.

3. Professor, Department of Botany, University of Rajasthan, Jaipur-302004

Abstract

Aim: The aim of present study is to investigate the antimicrobial activity of *Cenchrus ciliaris* (CAZRI-358) and *Cenchrus setigerus* (CAZRI-76) extracts in order to use it as a possible source for new antimicrobial substances against important human pathogens.

Methods and Results: Crude extracts of different parts of both species of *Cenchrus* were evaluated against three medically important bacteria viz. *Pseudomonas aeruginosa* (Gram-ve), *Bacillus Subtilis* (Gram +ve), *Enterobacter aerogens* (Gram-ve) and one fungi *Aspergillus flavus*. The dried and powdered parts (root, stem, leaf and seed) were successively extracted with petroleum ether (PE), ethyl acetate (EA) and glacial acetic acid (GAA) using soxhlet assembly. The antimicrobial activity assay was done by both disc diffusion and serial dilution methods. The highest yield was found in root extract in different polar solvents. Maximum antibacterial activities were observed by GAA extracts of seed in both species of *Cenchrus* against *Bacillus Subtilis* and antifungal activity by root extract of *C. ciliaris*.

Conclusion: *Cenchrus* grass easily grows in harsh climatic conditions or xeric conditions and requires less care, hence its use as raw material for preparing drugs would definitely be economical.

Significance and Impact of Study: The present investigation provides a scientific basis for the use of these plant extracts in home-made remedies and their possible application against micro-organisms.

Keywords: *Aspergillus flavus*, Antibacterial, *Cenchrus*, glacial acetic acid extract and *Pseudomonas aeruginosa*.

INTRODUCTION

The use of plant antimicrobials started [1] in antibiotic era in the 1950s and from then onwards. Plants can produce a large number of secondary metabolites that may exceed a hundred thousand molecules [2]. Over the last three centuries, intensive efforts have been made to discover clinically useful antimicrobial drugs [3, 4, 5]. Plant extracts have been used for a wide variety of purposes for many thousands of years [6]. But on the other hand, the development of resistant strains of pathogenic bacteria to antibiotics currently in use is a problem of continuing concern to public health [7, 8], which have led to the emergence of new bacterial strains that are multi-drug resistant. Nowadays there are various type of antibiotics are available, but number of factors such as low potency, poor solubility, emergence of resistant strains and drug toxicity [9, 10], non-availability and high cost of new generation antibiotics with limited effective span have resulted in increase in morbidity and mortality, Therefore, there is a need to look for substances from other sources with proven antimicrobial activity [11, 12].

C_4 grasses are gaining attention in various field of research, as they are best suited to the present environmental conditions. C_4 grasses are more competitive under the conditions of high temperature, solar radiation and low moisture [13]. C_4 grasses are more efficient at gathering Carbon dioxide and utilizing nitrogen from the atmosphere and recycled N in the soil [14, 15]. *Cenchrus* L. (Poaceae) is highly nutritious grass and considered excellent for pasture in hot, dry areas and is valued for its production of palatable forage and intermittent grazing during droughty periods in the tropics. The grass, fed green, turned into silage, or made into hay is said to increase flow of milk in cattle and impart a sleek and glossy appearance. This grass has excellent soil binding capacity which helps to conserve soil in desert areas [16]. However, *Cenchrus* is most suitable and highly nutritive grasses for desert environmental conditions; this plant is not well studied from phytochemical & pharmacological point of view. The present investigation evaluated the antibacterial and antifungal effects of crude extracts of *Cenchrus* grass (root, stem, leaf, and seeds).

Pseudomonas aeruginosa is a common bacterium that can cause disease in animals, including humans. It is found in soil, water, skin flora, and most man-made environments throughout the world. It thrives not only in normal atmospheres but also in hypoxic atmospheres and has colonized in many natural and artificial environments. If such colonization occurs in critical body organs, such as the lungs, the urinary tract, and kidneys, the results can be fatal. *Bacillus subtilis* bacteria and *Aspergillus flavus* fungi contaminate food and produce food poisoning. They are used on plants as a fungicide. *E. aerogens* is a nosocomial and pathogenic bacterium that causes opportunistic infections includes most type of infections. *Enterobacter* species can also cause various community-acquired infections.

MATERIAL AND METHODS

Experimental design: Crude extracts of different parts *of Cenchrus ciliaris* (CAZRI-358) *and Cenchrus setigerus* (CAZRI-76) were prepared with a series of non polar to polar solvents by hot extraction method in soxhlet assembly [17], First screened for antimicrobial activity by disc diffusion method [18] against a few medically important bacteria and fungi. The fraction showing best activity was then used for assay of minimum inhibitory concentration (MIC) by tube dilution method [19].

Collection of plant material: Different parts of *C. ciliaris* (CAZRI-358) *and C. setigerus* (CAZRI-76) (root, S, leaf, and seed) were collected in the month of August from the Central Arid Zone Research Institute, Jodhpur, Rajasthan. These grass varieties were released from CAZRI, Jodhpur. The collected plant materials were transferred immediately to the laboratory cleaned with deionized water and selected plant parts were separately shade dried for one week. Each shade dried plant parts were powdered with the help of grinder. Fine powder of each sample was stored in clean container to be used for Soxhlet extraction following the method of Subramanian and Nagarjan, (1969) [20] in different polar solvents selected.

Extraction procedure:

The dried plant material was pulverized into fine powder using a grinder (mixer). About 10 gm of powdered material was extracted in soxhlet extraction apparatus successively [21] with different solvents (250 ml) according to their increasing polarity (petroleum ether < ethyl acetate < glacial acetic acid) for 18 hours at a temperature not exceeding the boiling point of the respective solvent. The obtained extracts were filtered by using Whatman No. 1 filter paper and then concentrated at 40^0C by using an evaporator. The residual extracts were stored in refrigerator at 4^0C in small and sterile glass bottles. Percent extractive values were calculated by the following formula and are listed in table-1.

$$\text{Percent Extractive} = \frac{\text{Weight of dried extract}}{\text{Weight of dried plant material}} \times 100$$

Drugs and chemicals:

The following drugs namely Gentamycin (for bacteria), Ketoconazole (for yeast) and chemicals petroleum ether, ethyl acetate and glacial acetic acid, Nutrient Agar (NA), Sabouraud Dextrose Agar (SDA) were used during the experimental study.

Micro-organisms:

(a) Bacteria:

Pseudomonas aeruginosa (Gram-ve) (MTCC-1934), *Bacillus subtilis* (Gram +ve) (MTCC-121), *Enterobacter aerogens* (Gram-ve) (MTCC-111)

(b) Fungi: *Aspergillus flavus* (MTCC-277).

Screening of antimicrobial activity:

Test pathogenic microorganisms were procured from Microbial Type Culture Collection, IMTECH, Chandigarh, India. Bacterial strains were grown and maintained on Nutrient Agar medium, while yeast was maintained on Sabouraud Dextrose Agar medium. Disc diffusion assay [18] was performed for screening. NA and SDA base plates were seeded with the bacterial and fungal inoculum, respectively inoculum size 1×10^8 CFU/ml for bacteria and 1×10^7 cell/ml for yeast [22]. Sterile filters paper discs (Whatman no. 1, 5mm in diameter) were impregnated with 100 µl of each of the extract (10 mg/ml) to give a final concentration of 1 mg/disc and left to dry in *vaccuo* so as to remove residual solvent, which might interfere with the determination. Petri plates were pre-seeded with 15 ml of growth agar medium and 1.0 ml of inoculum [23, 24]. Extract discs were then placed on the seeded agar plates. Each extract was tested in triplicate with gentamycin (10mcg/disc) and ketoconazole (10mcg/disc) as standard for bacteria and fungi, respectively. The plates were kept at 4°C for 1 h for diffusion of extract, thereafter were incubated at 37°C for bacteria (24 h) [25] and 27°C for fungi (48 h). This method was followed by various researchers [26, 27, 28, 29]. The inhibition zones were measured and compared with the standard reference antibiotics [24]. Activity index for each extract was calculated (Table 1).

$$\text{Activity index (AI)} = \frac{\text{Inhibition Zone of the sample}}{\text{Inhibition Zone of the standard}}$$

Determination of minimum inhibitory concentration (MIC): The fractions that showed antibacterial potential were further assessed for the minimum inhibitory concentration (MIC), which is the minimal concentration of plant extract, or fraction thereof that inhibits the bacterial growth [19, 30, 31]. To measure the MIC values, various concentrations of the stock, 15, 7.5, 3.75, 1.875, 0.938, 0.469, 0.234, 0.117, 0.059, 0.029 mg/ml were assayed against the test pathogens. Plant extracts were re-suspended in acetone (which has no activity against test microorganisms) to make 15mg/ml final concentration and then two fold

serially diluted; 1 ml of each extract was added to test tubes containing 1 ml of sterile NA media. The tubes were then inoculated with a drop of microbial suspension (for bacteria 1×10^8 CFU/ml and 1×10^7 cell/ml for yeast) and the tubes were incubated at 37°C for 24 h for bacteria and 28°C for 48 h for yeast in a BOD incubator and observed for change in turbidity after 24 h comparison with the growth and sterility controls [32]. A tube containing nutrient broth without extract was taken as control. The least extract concentration which inhibited the growth of the test organisms was taken as MIC [33, 34]. Bacterial and fungal suspensions were used as negative control, while broth containing standard drug was used as positive control. Each extract was assayed in duplicate and each time two sets of tubes were prepared, one was kept for incubation while another set was kept at 4°C for comparing the turbidity in the test tubes. The MIC values were taken as the lowest concentration of the extracts in the test tubes that showed no turbidity after incubation. The turbidity of the test tube was interpreted as visible growth of microorganisms.

Determination of Minimum bactericidal/ fungicidal concentration (MBC/MFC):

It is defined as the concentration of the antimicrobial that results in a 99.9% reduction in CFU/ml compared with the organism concentration in the original inoculum [35]. Equal volume of the various concentration of each extract and Nutrient broth were mixed in micro-tubes to make up 0.5ml of solution. 0.5ml of McFarland standard of the organism suspension was added to each tube [31]. The tubes were incubated aerobically at 37^{o}C for 24 h. Two control tubes were maintained for each test batch. These include tube-containing extract without inoculum and the tube containing the growth medium and inoculum. The MBC was determined by sub culturing the test dilution on Mueller Hinton Agar and further incubated for 24 h. The highest dilution that yielded no single bacterial colony was taken as the Minimum bactericidal Concentration [36]. This was carried out on some of the extracts with high antimicrobial activity and some of the highly sensitive organisms.

Total activity (TA) determination: Total activity is the volume at which test extract can be diluted with the ability to kill microorganisms. It is calculated by dividing the amount of extract from 1 g plant material by the MIC of the same extract or compound isolated and is expressed in ml/g [37].

$$\text{Total Activity} = \frac{\text{Extract per gram dried plant part}}{\text{MIC of extract}}$$

Statistical Analysis: Mean value and standard deviation were calculated for each test bacteria. Data were analyzed by one-way ANOVA and p values were considered significant at $p > 0.005$ [33].

RESULTS

1. Preliminary phyto–profiling: The preliminary phyto–profiling for the different parts of *Cenchrus* extracts were carried out wherein the consistency was found to be sticky in the high polar solvent extracts whereas the low polar solvent extracts were found to be nonsticky. The percentage yield w/w of the extracts was also analyzed wherein the highest yield was found in root extract in different polar solvents (52.7 mg/g in ethyl acetate extract of *C. ciliaris* and 48 mg/g in glacial acetic acid extracts of *C. setigerus*) (Table no- 4).

2. Antimicrobial activity: Antimicrobial activity (assessed in terms of inhibition zone and activity index) of the plant extracts, tested against selected microorganisms were recorded (Table 1). In the present study total 24 extracts of different parts of selected plants were tested for their bioactivity. Twenty extracts showed significant antimicrobial potential against test microbes. However, 4 extracts showed no activity against any of the selected microorganisms at the tested concentration (all the petrolium ether extract from *C. setigerus*).

(i) Antibacterial activity:

(a) *Inhibition Zone and Activity Index*:

Most susceptible organism in the investigation was *B. subtilis* against which, most of the plant extracts showed inhibition zone. Maximum antibacterial activities were recorded for glacial acetic acid extracts of both the species of *Cenchrus. C. ciliaris* showed IZ of 34.83±0.24 mm, AI 1.161 and *C. setigerus* showed IZ of 29.83±0.24 mm, AI 1.065, against *B. subtilis* by seed extract, followed by stem extract against *P. aeruginosa* (by *C. ciliaris*) and *E. aerogens* (by *C. setigerus*) i.e. IZ of 28.67±0.22 mm, AI 1.593 and IZ of 25.5±0.64 mm, AI 1.275 respectively.

(b) MIC and MBC:

MIC and MBC values (Table 2) were evaluated for those plant extracts, showing activity in diffusion assay. The range of MIC and MBC of extracts recorded was 0.117- 15 mg/ml. In the present investigation lowest MIC value 0.117 mg/ml was recorded by GAA extract of seed in *C. ciliaris* against *B. subtilis* and *E. aerogens* as well as in *C. setigerus* against *B. subtilis.* Followed by 0.234 mg/ml *E. aerogens* (for 5 extracts) and *B. subtilis* (for 4 extracts) indicating significant antimicrobial potential of test extracts. MIC and MBC values were found equal for 12 values of *C. ciliaris* and

11 values of *C. setigerus* which produce the bactericidal effect.

(c) Total activity:

GAA extract of seed showed highest values of TA against *B. subtilis* and *E. aerogens* by *C. setigerus* were 378.03 and 189.32; 366.08 by *C. ciliaris* for both bacteria respectively.

(B) Maximum antifungal activity:

(a) Inhibition Zone and Activity Index:

Best results were presented by GAA extract. 20.67±0.26 mm of IZ, AI 1.725 by root extract of *C. ciliaris* and 14.33±0.26 mm of IZ, AI 1.102 by stem extract of *C. setigerus*. PA and EA extracts of both the species of *Cenchrus* showed no bioactivity against the fungi (table-1).

(b) MIC and MFC:

Lowest MIC value 0.469 mg/ml was recorded for root extract of *C. ciliaris*, followed by 0.938 mg/ml in stem and leaf extract of *C. ciliaris* as well as in stem and seed extract of *C. setigerus* (table-2). MIC and MFC values were found equal in stem extract of *C. setigerus* and leaf extract of *C. ciliaris* which produce the fungicidal effect.

(c) Total activity:

Maximum TA values calculated 90.17 in root extract of *C. ciliaris* and 46.19 in stem extract of *C. setigerus* (table-3).

DISCUSSION:

Antibiotics were medical miracles during the Second World War but are now becoming impotent bacterial weaponry. This has caused an urgent need for the research of new and innovative ways to control bacterial invasions especially by multi-resistant pathogens such as *B. subtilis* (Gram +ve) and *P. aeruginosa* [38]. Resistance in microorganisms to many antibiotics has resulted in morbidity and mortality from treatment failure and increased health care costs (Bindu and Kumar, 2009). Natural alternative treatments for bacterial infections may provide a pathway for the development of new antimicrobial agents.

Antimicrobial activity: Results of the present study revealed that 20/24 plant extracts tested inhibited the growth of selected bacteria and 8/24 plant extracts tested inhibited the growth of selected fungi, indicating broad spectrum bioactive nature of selected two plants (12/12 in *C. ciliaris* and 8/12 in *C. setigerus*). It indicates that *C. ciliaris* is more potential than *C. setigerus* as far as bio-activity in concerned. GAA extracts in both the species of *Cenchrus* express maximum antibacterial and antifungal activities by suppressing the growth of all microbes under investigation.

Table 1: Inhibition zone (mm)* and Activity index by different parts of *Cenchrus* grass in different polar solvents against tested pathogens.

Solvents	*Polarity of Solvents*	*Plant Part*	*Test microorganisms*							
			Pseudomonas aeruginosa		*Bacillus subtilis*		*Entrobactor aerogens*		*Aspergillus flavus*	
			IZ±S.D.	*AI*	*IZ±S.D.*	*AI*	*IZ±S.D.*	*AI*	*IZ±S.D.*	*AI*
Cenchrus setigerus (CAZRI-76)										
Petrolium Ether	0.1	Root	-	-	-	-	-	-	-	-
		Stem	-	-	-	-	-	-	-	-
		Leaf	-	-	-	-	-	-	-	-
		Seed	-	-	-	-	-	-	-	-
Ethyl Acetate	4.4	Root	7.50±0.64	0.375	22.6±0.217	0.945	-	-	-	-
		Stem	7.17±0.24	0.359	18.5±0.64	0.771	-	-	-	-
		Leaf	7.33±0.25	0.367	20.67±0.23	0.861	-	-	-	-
		Seed	7.17±0.26	0.359	12.17±0.24	0.507	-	-	-	-
Glacial Acetic Acid	6.2	Root	18.83±0.24	0.897	12.33±0.28	0.440	17.5±0.64	0.875	8.17±0.21	0.628
		Stem	16.33±0.29	0.778	11.5±0.64	0.411	25.5±0.64	1.275	14.33±0.26	1.102
		Leaf	24.83±0.23	1.182	22.67±0.24	0.810	22.83±0.26	1.142	12.5±0.64	0.961
		Seed	18.67±0.24	0.889	29.83±0.242	1.065	22.67±0.25	1.134	12.17±0.27	0.936
***Cenchrus ciliaris* (CAZRI-358)**										
Petrolium Ether	0.1	Root	-	-	20.83±0.27	0.694	-	-	-	-
		Stem	-	-	7.17±0.24	0.239	-	-	-	-
		Leaf	-	-	12.5±0.64	0.417	-	-	-	-
		Seed	-	-	9.17±0.26	0.306	-	-	-	-
Ethyl Acetate	4.4	Root	-	-	12.67±0.26	0.453	7.33±0.27	0.367	-	-
		Stem	-	-	12.83±0.21	0.458	7.17±0.26	0.359	-	-
		Leaf	-	-	10.5±0.64	0.375	-	-	-	-
		Seed	-	-	10.67±0.27	0.381	8.17±0.23	0.409	-	-
Glacial Acetic Acid	6.2	Root	22.83±0.24	1.268	30.33±0.24	1.011	21.5±0.64	1.075	20.67±0.26	1.722
		Stem	28.67±0.22	1.593	30.17±0.23	1.006	19.67±0.27	0.984	15.5±0.64	1.292
		Leaf	27.50±0.64	1.528	32.67±0.27	1.089	10.33±0.25	0.517	14.17±0.22	1.181
		Seed	25.67±0.28	1.426	34.83±0.24	1.161	25.83±0.24	1.292	16.33±0.23	1.361

*All values are mean ± SD, n=3 ($p>0.005$).

Table 2: Minimum inhibitory concentration and (MBC/MFC) of different parts of *Cenchrus* in different solvents against tested pathogens.

Solvents	Plant Part	Test microorganisms							
		P. aeruginosa		*B. subtilis*		*E. aerogens*		*A. flavus*	
		MIC	MBC	MIC	MBC	MIC	MBC	MIC	MFC
***Cenchrus setigerus* (CAZRI-76)**									
PE	R	-	-	-	-	-	-	-	-
	S	-	-	-	-	-	-	-	-
	L	-	-	-	-	-	-	-	-
	Se	-	-	-	-	-	-	-	-
EA	R	7.5	15	0.469	0.469	-	-	-	-
	S	7.5	15	0.469	0.938	-	-	-	-
	L	7.5	15	0.938	0.938	-	-	-	-
	Se	15	15	1.875	1.875	-	-	-	-
GAA	R	1.875	1.875	0.938	0.938	0.469	0.469	1.875	3.75
	S	1.875	3.750	1.875	1.875	0.234	0.234	0.938	0.938
	L	0.938	0.938	0.234	0.469	0.234	0.469	0.938	1.875
	Se	1.875	3.750	0.117	0.234	0.234	0.469	1.875	3.75
***Cenchrus ciliaris* (CAZRI-358)**									
PE	R	-	-	1.875	3.75	-	-	-	-
	S	-	-	15	15	-	-	-	-
	L	-	-	3.75	7.5	-	-	-	-
	Se	-	-	7.5	15	-	-	-	-
EA	R	-	-	3.75	7.5	7.5	15	-	-
	S	-	-	3.75	3.75	7.5	15	-	-
	L	-	-	3.75	7.5	-	-	-	-
	Se	-	-	3.75	7.5	7.5	15	-	-
GAA	R	0.938	0.938	0.234	0.469	0.234	0.234	0.469	0.938
	S	0.469	0.469	0.234	0.469	0.234	0.469	0.938	1.875
	L	0.469	0.938	0.234	0.234	3.75	3.75	1.875	1.875
	Se	0.938	0.938	0.117	0.117	0.117	0.117	0.938	0.938

PE- Petrolium Ether; EA- Ethyl Acetate; GAA- Glacial Acetic Acid
R- Root; S- Stem; L- Leaf; Se- Seed
MIC - Minimum inhibitory concentration (mg/ml)
MBC - Minimum bactericidal concentration (mg/ml)
MFC - Minimum fungicidal concentration (mg/ml)

Table 3: Total activity of different parts of *Cenchrus* in different solvents against tested pathogens.

Solvents	Plant Part	Total Activity against different Test microorganisms							
		P.aeruginosa		*B. subtilis*		*E. aerogens*		*A. flavus*	
		C. c.	C. s.	C. c.	C. s.	C. c.	C. s.	C. c.	C. s.
PE	R	-	-	13.33	-	-	-	-	-
	S	-	-	1.88	-	-	-	-	-
	L	-	-	5.60	-	-	-	-	-
	Se	-	-	4.24	-	-	-	-	-
EA	R	-	2.03	14.05	32.43	7.03	-	-	-
	S	-	1.92	11.15	30.72	5.57	-	-	-
	L	-	3.17	11.57	25.39	-	-	-	-
	Se	-	2.57	11.87	20.59	5.93	-	-	-
GAA	R	45.01	25.60	180.34	51.20	180.34	102.40	90.17	25.60
	S	73.16	23.09	146.58	23.09	146.58	185.04	36.59	46.19
	L	101.96	44.59	204.27	178.63	12.75	178.63	25.49	44.59
	Se	45.76	23.63	366.08	378.03	366.08	189.32	45.76	23.63

PE- Petrolium Ether; EA- Ethyl Acetate; GAA- Glacial Acetic Acid
R- Root; S- Stem; L- Leaf; Se- Seed
C. c.- *Cenchrus ciliaris* (CAZRI-358)
C. s.- *Cenchrus setigerus* (CAZRI-76)

In the present study, most of the extracts of *C. ciliaris* were found to be potent inhibitor of tested organisms but PE and EA extract against *P. Aeruginosa* (Gram-ve), *E. aerogens* (Gram-ve) and *A. flavus.* Excellent antibacterial activities were observed by GAA extracts of seed in both the species of *Cenchrus.*

MIC and MBC/MFC: MBC/MFC values were found higher than the MIC values of the extracts against microorganisms tested; indicate the

Table 4: Phyto-profile for different parts of *Cenchrus* grass in different polar solvents

Solvents	Boiling point of solvents	Solubility in Water (%)	Plant Parts	Total Yield (mg/g)		Color		Consistency	
				C. c.	*C. s.*	*C. c.*	*C. s.*	*C. c.*	*C. s.*
PE	60-80 °C	7.5	R	25.00	28.70	Light Yellow	Very light Yellow	Ns	Ns
			S	28.20	24.50	Very light Yellow	Light Yellow	Ns	Ns
			L	21.00	19.30	Yellowish green	Light green	Ns	Ns
			Se	31.80	26.00	Light cream	Light cream	Ns	Ns
EA	76-77.5 °C	8.7	R	52.70	15.20	Light Yellow	Yellow	Ns	Ns
			S	41.80	14.40	Light green	Yellowish green	Ns	Ns
			L	43.40	23.80	Green	Dark green	Ns	Ns
			Se	44.50	38.60	Dark green	Green	Ns	Ns
GAA	118.1 °C	100	R	42.20	48.00	Very dark green	Dark green	St	St
			S	34.30	43.30	Very dark green	Dark green	St	St
			L	47.80	41.80	Very dark green	Dark green	St	St
			Se	42.90	44.30	Brick red	Brick red	St	St

PE- Petrolium Ether; EA- Ethyl Acetate; GAA- Glacial Acetic Acid
R- Root; S- Stem; L- Leaf; Se- Seed; Ns- Nonsticky; St- Sticky
C. c.- *Cenchrus ciliaris* (CAZRI-358)
C. s.- *Cenchrus setigerus* (CAZRI-76)

bacteriostatic/fungistatic effects of the extracts where as equal values indicate the bactericidal effect. 12 values of *C. setigerus* and 11 values of *C. ciliaris* were found to be bactericidal in nature. Glacial acetic acid extracts of seed in both species of *Cenchrus* were act as bactericidal against *B. subtilis.* On the other hand, stem extract of *C. setigerus* and leaf extract of *C. ciliaris* which produce the fungicidal effect against *A. flavus*. Gram positive bacteria *B. subtilis* was the most susceptible organism which supported the finding that plant extracts are usually more active against Gram positive bacteria than Gram negative [39, 40]. Susceptibility differences between Gram-positive and Gram-negative bacteria may be due to cell wall structural differences between these classes of bacteria. The Gram-negative bacterial cell wall outer membrane appears to act as a barrier to many substances including synthetic and natural antibiotics [41].

Extracts under study not only inhibit the bacterial/fungal growth but the IZ developed, was more or less permanent when compared with the IZ developed by the standard drug used, as after sometime bacterial/fungal colonies could be easily seen in IZ developed by standard drugs. In the light of the fact that microorganism are becoming resistant against the drugs in use, present investigation is of great significance, as far as the future drugs are concerned and uses of selected plants by the pharmaceutical industries for preparing plant based antimicrobials drugs.

CONCLUSION

In the present study total 24 extracts of different parts of desert grasses were tested for their bioactivity, among which 20 extracts showed significant antimicrobial potential against test microbes. This paper thus provides a scientific basis for the use of these plant extracts in home-made remedies and their possible application against microorganisms such as *E. aerogens, B. subtilis, P. aeruginosa* and *A. flavus* that cause nosocomial infections. Further studies may lead to their use as safe alternatives to synthetic antimicrobial drugs.

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