World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

POTENTIAL ROLES OF AQUEOUS AND ORGANIC EXTRACTS OF *ZIZIPHUS JUJUBA* AS AN ANTI-BACTERIAL AND ANTI-OXIDANT AGENT

Mansoor Shazia[1]* and Mustafa Huma[2]

[1] Department of Research, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal.
[2]Council of Science and Technology, Lucknow.

Corresponding Author: Mansoor Shazia
Department of Research, Jawaharlal Nehru Cancer Hospital and Research Centre, Bhopal.

Article Received on 16/08/2020 **Article Revised on 06/09/2020** **Article Accepted on 27/09/2020**

ABSTRACT

Ziziphus jujuba is an economically important tropical fruit tree, which is grown all over the dry parts of the Indian sub-continent. The aim of the study was to examine anti-microbial and anti-oxidant property in leaf extract of *Z. jujuba* extract (aqueous, cyclohexane, benzene, chloroform, acetone, ethyl acetate, ethanol and methanol). The methanollic extract showed considerable anti-microbial activity against *S. aureus* and the zone of inhibition was found to be 18 mm and 15 mm at the concentration of 40 mg/ml concentration of plant extract by well and disc diffusion method respectively. The anti-oxidant activity by different methods were screened and the strongest activity were shown by methanol extract and gave IC_{50} value of 134.6 ± 0 µg/ml by DPPH method. The IC_{50} value of 26.07 ± 2.75 µg/ml and 43.2 ± 1.55 µg/ml were obtained in methanollic extract by Alkaline DMSO and Nitric oxide scavenging assay respectively. Whereas, hydroxyl radicals were strongly scavenged by benzene extract and gave IC_{50} value of 18.3 ± 11.51 µg/ml.

KEYWORDS: *Ziziphus jujuba*, DPPH, anti-microbial activity and anti-oxidant activity.

INTRODUCTION

Ziziphus jujuba is an economically important tropical fruit tree belongs to the family of Ramnaceae, which is grown all over the dry parts of the Indian sub-continent. The fruit of the plant has a nutritious value, which is rich in the B group of vitamins (thiamine, riboflavin and niacin), vitamin C and β-carotene, a precursor to vitamin A. *Z. jujuba* plant is found in the form of either a deciduous tree growing to a height of 12 m or sometimes as a large shrub. The plant is distributed in the warm temperate and subtropical regions throughout the world. It is anti-pyretic and reduces obesity and its bark is a remedy in diarrhoae and cures boil.[1] The crude extract of *Z. jujuba* showed potent anti-microbial activity against *B. pumalis, P. aeruginosae, S. epidermidis, S. typhi, P. aerugenosa, B. pumalis, E. aerogenes* and *L. minor* [2] *S. aureus* and *S. typhimurium*[3] A number of scientists have reported anti-oxidant activity in *Z. jujuba* shoots extracts for DPPH scavenging assay.[4,5] The present study includes the separation of crude aqueous and organic extracts (aqueous, cyclohexane, benzene, chloroform, acetone, ethyl acetate, ethanol and methanol) of *Ziziphus jujuba*. The extracts were screened for anti-microbial activity against different bacterial strains by well and disc diffusion method. The anti-oxidant activity of *Z. jujuba* extracts were analyzed by DPPH, alkaline DMSO, nitric oxide and hydroxyl radical by Deoxyribose scavenging assay.

MATERIALS AND METHODS

Collection and Identification of Plant

The leaves of plant were collected from in and around the campus of Integral University and were authenticated and sample vouchers were stored in NBRI, Lucknow. The identified plant parts were washed and air dried at room temperature and was powdered with the help of mortar and pestle. The plant extracts prepared using Soxhlet apparatus in different solvents.

Anti-microbial Activity

The anti-microbial activity was screened in extracts by disc diffusion and well diffusion method. The bacterial strains used were *Staphylococcus aureus* 2079, *Escherichia coli* 2065, *Proteaus vulgaris* 2027, *Bacillus cereus* 2156, *Bacillus subtilis* 296, *Staphylococcus epidermis* 2493 and *Sacchromyces cereviceae* 3090. All the strains were obtained from the National Chemical Laboratory (NCL), Pune, India. Dried filter paper discs (4 mm) impregnated in known amount of test samples and for well diffusion method, the extracts were inoculated in well prepared using well cutter (0.6 cm). The dried plant extracts were prepared in dimethyl sulfoxide at a concentration of 40 mg/ml, 30 mg/ml, 20mg/ml, 10 mg /ml and 5 mg/ml. The plates were incubated at 37°C for 24 h. Microbial growth was determined by measuring the diameter of zone of inhibition. For each bacterial strain, controls were maintained in which dimethyl sulfoxide was used as a negative control, instead of the extract and the discs of Tetracycline (30 mcg/disc), Penicillin G (10 units/disc), Streptomycin (10 mcg/disc) and Amoxicillin (30 mcg/disc) were used as a positive control. The experiment was done three times and the mean values are presented.[6]

Anti-oxidant Assay

The different anti-oxidant assays used for the study were by DPPH method, Superoxide Radical with the Alkaline DMSO (dimethyl sulfoxide) method, Nitric Oxide Radial Inhibition assay and Hydroxyl Radical in the Deoxyribose Method. L-ascorbic acid, butylated hydroxy toluene and quercetin were used as standard, while methanol or dimethyl sulfoxide was used in place of plant extract as control. The crude plant extracts were prepared at different concentrations varying from 1000 µg/ml to 0.46 µg/ml.

DPPH (2, 2 – Diphenyl – 1- Picryl Hydrazyl) Radical Scavenging Activity Method

DPPH radical scavenging activities of all the fractions were determined by the method of Blois (1958)[7] with some modification. Initially 10 µl of plant extracts was mixed with 200 µl of 100 mM DPPH (dissolved in methanol). The reaction mixtures were incubated for 30 min at 37° C under dark condition. The absorbance was measured at 490 nm spectrophotometrically.[8]

$$\text{Scavenging activity (\%)} = \frac{\text{Absorbance of control} - \text{Absorbance of extract)}}{\text{Absorbance of control}} \times 100$$

Scavenging of Superoxide Radical with the Alkaline DMSO (dimethyl sulfoxide) Method

Alkaline DMSO radical scavenging assay were determined by the method of Kunchandy, and Rao, (1990)[9] with slight modification. The reaction mixture prepared of 0.1 ml of nitro blue tetrazolium (1 mg/ml in DMSO) and 1 ml of alkaline DMSO (1 ml of DMSO containing sodium hydroxide 5 mM in 0.1 ml of water). To the reaction mixture 0.3 ml of the crude extract prepared in DMSO was added. To give a final volume of 1.4 ml and the absorbance was measured at 560 nm spectrophotometrically.[10,11]

$$\text{Percentage super oxide scavenging activity} = \frac{\text{Test absorbance - Control absorbance}}{\text{Test absorbance}} \times 100$$

Anti-oxidant Assay by Nitric Oxide Radial Inhibition Assay

The 1 ml of plant extracts was mixed with 1 ml phosphate buffer saline and 4 ml (10 mM) sodium nitroprusside and was kept for incubation at room temperature at 25° C for 150 min. After incubation, 0.5 ml of reaction mixture and 1 ml sulphanilic acid reagent (0.33% in 20% glacial acetic acid) were added and incubated for 5 min at room temperature (for diazotization reaction). Then 1 ml N-(1-naphthyl) ethylenediamine dihydrochloride was added and kept in diffused light for 30 min and absorbance was measured at 540 nm.[12]

$$\text{Scavenging activity (\%)} = \frac{\text{Absorbance of control} - \text{Absorbance of extract}}{\text{Absorbance of control}} \times 100$$

Scavenging of Hydroxyl Radical in the Deoxyribose Method

Scavenging of hydroxyl free radical was measured by the method of Halliwell and co-workers (1987) [13] with minor changes. The reaction mixture prepared containing deoxyribose (3mM) 0.2 ml, ferric chloride (0.1mM) 0.2 ml, ethylenediaminetetraacetic acid disodium salt (EDTA) (0.1 mM) 0.2 ml, ascorbic acid (0.1 mM) 0.2 ml and hydrogen peroxide (2 mM) 0.2 ml in phosphate buffer (pH, 7.4, 20 mM). To the reaction mixture was added 0.2 ml of various concentrations of the extract or standard in DMSO to give total volume of 1.2 ml. The solution was then incubated for 30 min at 37° C. After incubation, ice-cold trichloroacetic acid (0.2 ml, 15% w/v), and thiobarbituric acid (0.2 ml, 1% w/v) in 0.25 N hydrochloric acid were added. The reaction mixture was then kept in a boiling water bath for 30 min, cooled, and the absorbance was measured at 532 nm.[14,11]

Scavenging activity (%) = $\frac{\text{Absorbance of control} - \text{Absorbance of extract}}{\text{Absorbance of control}} \times 100$

RESULTS

Ziziphus jujuba plant and its fruit had a value in herbal medicine for the treatment of different diseases. The crude extracts were prepared in different solvents and extracts showed potent anti-microbial and anti-oxidant activity.

Anti-microbial Activity of *Ziziphus jujuba* Extract

The *Ziziphus jujuba* aqueous and organic extracts showed significant anti-microbial activity against *B. subtilis*, *E. coli*, *S. epidermis*, *S. cereviceae*, *P. vulgaris*, *B. cereus* and *S. aureus*. The anti-bacterial activity by well diffusion method was found to be in the order of methanol > ethyl acetate > aqueous > cyclohexane > acetone > benzene extract. The chloroform and ethanol extracts did not showed any activity against any of the strains used. The results of anti-microbial activity of *Z. jujuba* showing zone of inhibition by well diffusion and disc diffusion method are given in Table 1 and Table 2 respectively. The methanolic extract showed considerable activity against *S. aureus* and the zone of inhibition by well diffusion method was found to be 18 mm at the concentration of 40 mg/ml of plant extract. The anti-bacterial activity by disc diffusion method was found to be in the order of methanol > aqueous > ethyl acetate > benzene > acetone > cyclohexane extract. The chloroform and ethanol extracts did not showed any activity against any of the strains used. The methanolic extract showed considerable activity against *S. aureus* and the zone of inhibition was found to be 15 mm at the concentration of 40 mg/ml by disc diffusion method. The plant extracts when compared with the antibiotics for their anti-bacterial activity showed significant activity and zone of inhibition in them were found equivalent to standard antibiotics. The zone of inhibition of standard antibiotics and negative control dimethyl sulfoxide were given in Table 3.

Table 1: Zone of inhibition (mm) of *Ziziphus jujuba* extract in different solvents by agar well diffusion method.

Plant extract	Conc. of extract	Zone of Inhibition (mm)						
		B. subtilis	***E. coli***	***S. epidermis***	***S. cereviceae***	***P. vulgaris***	***B. cereus***	***S. aureus***
Aqueous	40 mg/ml	11 ±1.67	NZ	NZ	13 ±5.44	14 ±4.52	NZ	NZ
	30 mg/ml	10 ±0	NZ	NZ	12±2.1	13 ±4.41	NZ	NZ
	20 mg/ml	9 ±0.1	NZ	NZ	12 ±8.45	12 ±5.43	NZ	NZ
	10 mg/ml	8 ±0.5	NZ	NZ	11 ±0.99	11 ±3.22	NZ	NZ
	5 mg/ml	2 ±0.2	NZ	NZ	2 ±0.05	2 ±0	NZ	NZ
Cyclohexane	40 mg/ml	NZ	13 ±0	14 ±0.1	NZ	NZ	NZ	NZ
	30 mg/ml	NZ	12 ±2.8	12 ±0.2	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	11 ±0.6	11 ±0.2	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	10 ±0	10 ±0.2	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Benzene	40 mg/ml	10 ±0.22	NZ	12 ±0.5	NZ	NZ	NZ	NZ
	30 mg/ml	9 ±0.11	NZ	11 ±0.5	NZ	NZ	NZ	NZ
	20 mg/ml	8 ±0.22	NZ	10 ±3.44	NZ	NZ	NZ	NZ
	10 mg/ml	7 ±0	NZ	9 ±0.05	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Chloroform	40 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	30 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Acetone	40 mg/ml	NZ	13 ±5.6	NZ	NZ	NZ	10 ±2.22	NZ
	30 mg/ml	NZ	12 ±4.3	NZ	NZ	NZ	9 ±0.05	NZ
	20 mg/ml	NZ	10 ±3.2	NZ	NZ	NZ	6 ±0.05	NZ
	10 mg/ml	NZ	9 ±0.5	NZ	NZ	NZ	2 ±0.09	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Ethyl acetate	40 mg/ml	15 ±4.56	11 ±3.2	16 ±3.22	NZ	NZ	NZ	9 ±0.05
	30 mg/ml	14 ±3.44	10 ±3.6	14 ±0.05	NZ	NZ	NZ	8 ±5.34
	20 mg/ml	11 ±2.90	10 ±4.4	10 ±0.1	NZ	NZ	NZ	7 ±2.45
	10 mg/ml	4 ±0	9 ±0.2	9 ±0.05	NZ	NZ	NZ	5 ±2.33
	5 mg/ml	NZ	NZ	3 ±0.05	NZ	NZ	NZ	NZ
Ethanol	40 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ

	30 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Methanol	40 mg/ml	NZ	15 ±4.2	NZ	10 ±0	12 ±5.63	NZ	18 ±0.5
	30 mg/ml	NZ	14 ±7.6	NZ	9 ±0.5	10 ±4.32	NZ	16 ±0.5
	20 mg/ml	NZ	12 ±5.7	NZ	8 ±0.05	5 ±2.33	NZ	12 ±3.2
	10 mg/ml	NZ	5 ±0.5	NZ	5 ±0.05	NZ	NZ	9 ±0.05
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	2 ±0.05

The bacterial strains used were *B. subtilis*, *E. coli*, *S. epidermis*, *S. cereviceae*, *P. vulgaris*, *B. cereus* and *S. aureus* at the concentration of 40 mg/ml, 30 mg/ml, 20 mg/ml, 10 mg/ml and 5 mg /ml (NZ- No Zone). The values are mean ± standard deviation (n=3).

Table 2: Zone of inhibition (mm) of *Ziziphus jujuba* extract in different solvents by disc diffusion method.

Plant extract	Conc. of extract	Zone of Inhibition (mm)						
		B. subtilis	***E. coli***	***S. epidermis***	***S. cereviceae***	***P. vulgaris***	***B. cereus***	***S. aureus***
Aqueous	40 mg/ml	11 ±0.5	NZ	NZ	13 ± 0.3	14 ± 0.11	NZ	NZ
	30 mg/ml	10 ±0.5	NZ	NZ	12 ± 0.5	13 ± 0.31	NZ	NZ
	20 mg/ml	9 ±0.5	NZ	NZ	10 ± 0.5	12 ± 0.20	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Cyclohexane	40 mg/ml	NZ	10 ±0.3	NZ	NZ	NZ	NZ	NZ
	30 mg/ml	NZ	9 ±0.1	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	8 ±0.2	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	7 ±0.2	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Benzene	40 mg/ml	10 ±2.1	NZ	12 ± 0	NZ	NZ	NZ	NZ
	30 mg/ml	9 ± 0	NZ	11 ± 1	NZ	NZ	NZ	NZ
	20 mg/ml	8 ± 0.1	NZ	10 ± 0	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Chloroform	40 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	30 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Acetone	40 mg/ml	NZ	10 ±3.4	NZ	NZ	NZ	10 ± 5.0	NZ
	30 mg/ml	NZ	9 ± 0.2	NZ	NZ	NZ	9 ± 2.0	NZ
	20 mg/ml	NZ	7 ± 0.2	NZ	NZ	NZ	6 ± 0.05	NZ
	10 mg/ml	NZ	5 ± 0.1	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Ethyl acetate	40 mg/ml	12 ± 0.3	11 ±2.3	NZ	NZ	NZ	NZ	NZ
	30 mg/ml	10 ± 0.11	10 ±3.4	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	7 ± 0.25	8 ± 0.2	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	4 ± 0.5	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Ethanol	40 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	30 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	20 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	10 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	NZ
Methanol	40 mg/ml	NZ	10 ±0.3	NZ	10 ± 0.2	9 ± 0	NZ	15 ± 0.5
	30 mg/ml	NZ	9 ± 0.5	NZ	9 ± 0.1	7 ± 6.0	NZ	12 ± 0.5
	20 mg/ml	NZ	7 ± 0.5	NZ	8 ± 0.5	5 ± 4.1	NZ	10 ± 0
	10 mg/ml	NZ	5 ± 0.2	NZ	5 ± 0.05	NZ	NZ	9 ± 0.2
	5 mg/ml	NZ	NZ	NZ	NZ	NZ	NZ	2 ± 0.05

The bacterial strains used were *B. subtilis*, *E. coli*, *S. epidermis*, *S. cereviceae*, *P. vulgaris*, *B. cereus* and *S. aureus* at the concentration of 40 mg/ml, 30 mg/ml, 20 mg/ml, 10 mg/ml and 5 mg /ml (NZ- No Zone). The values are mean ± standard deviation (n=3).

Table 3: The data represents zone of inhibition (mm) of the standards.

Standards	***B. subtilis***	***E. coli***	***S. epidermis***	***S. cereviceae***	***P. vulgaris***	***B. cereus***	***S. aureus***
Amoxicillin	NZ	NZ	12 ±3.21	NZ	NZ	NZ	NZ
Penicillin G	NZ	NZ	NZ	NZ	20 ±0.91	NZ	NZ
Tetracycline	27 ± 0.05	24 ± 0.1	28 ±0	23 ±0.2	25 ±0.43	16 ±0.5	25 ±0.1
Streptomycin	20 ±0.5	16 ±0	NZ	20 ±0.05	20 ±0.1	21 ±0.63	15 ±0.11
Dimethyl Sulfoxide	NZ	NZ	NZ	NZ	NZ	NZ	NZ

The antibiotics used as a positive control are Amoxicillin, Penicillin G, Tetracycline and Streptomycin. Dimethyl sulphoxide was used as a negative control. The values are mean ± standard deviation (n=3).

Table 4: Comparative chart of IC_{50} values of aqueous and organic extracts of *Ziziphus jujuba* and standard L-ascorbic acid, BHT and quercetin.

Plant name	**Extract in different solvents**	**IC_{50} values ± SD (µg/ml) of different anti-oxidant assay**				
		DPPH	**Alkaline DMSO**	**Nitric oxide**	**Total Antioxidant Assay**	**Deoxyribose**
Z. jujuba	Aqueous	-	-	-	-	574.9±2.85*
	Cyclohexane	-	-	-	-	25.37±9.12
	Benzene	-	-	-	-	18.3±11.51
	Acetone	-	-	359.7±7.54	-	364.6±3.30*
	Chloroform	-	-	-	315.3±11.03	-
	Ethyl acetate	-	-	-	110.3±1.55*	-
	Ethanol	-	204.4±5.20	391±4.29*	302.2±3.46*	367.4±4.96*
	Methanol	134.6 ± 0	26.07±2.75	43.2±1.55	-	-
L-ascorbic acid		61.4±1.55	537.7±14.33	54.97±4.73	432.9±5.02	865.2±1.50*
BHT		50.8±3.85	801.5±0	461.3±2.54*	-	958.8±0
Quercetin		27.9±1.55	316.5±1.21*	47.57±10.68	-	419.9±1.2*

Unit for IC_{50} for all the activities are µg/ml. Data are expressed as mean ± SD (n=3). *p< 0.0001 vs 0 µg/ml.

Comparative IC_{50} values of aqueous and organic extracts by different anti-oxidant assay

The IC_{50} values of the aqueous and organic extracts were calculated by different anti-oxidant assay. The crude extracts of *Z. jujuba* showed 50 percent inhibition by different anti-oxidant assays as shown in Table 4. The data reveals *Z. jujuba* methanolic extract showed considerable scavenging activity of DPPH free radicals and gave IC_{50} value of 134.6 ± 0µg/ml by DPPH method. The superoxide radicals were scavenged strongly by *Z. jujuba* ethanol and methanol extracts and the methanolic extract gave IC_{50} value of 26.07 ± 2.75µg/ml. The nitric oxide radicals were scavenged strongly by *Z. jujuba* acetone, ethanol and methanol extracts and the methanol extract gave IC_{50} value of 43.2 ±1.55 µg/ml by Nitric oxide method. The hydroxyl radicals were strongly scavenged by *Z. jujuba* aqueous, cyclohexane, benzene, acetone and ethanol extracts and the benzene extract gave IC_{50} value of 18.3 ± 11.51 µg/ml. The data obtained from scavenging assay clearly establish the anti-oxidant potency of all the extracts.

DISCUSSIONS

The efficient free radical scavenging activity in fruits and vegetables, especially in *Z. jujuba* is due to the presence of appreciable concentrations of flavonoids, phenolic acids and some other anti-oxidant phytochemicals. There was dissimilarity of phyto-constituents found in different species of *Ziziphus* which may be due to the various ecological conditions.[15] The present studies showed potent anti-bacterial activity of *Ziziphus jujuba* extracts against *B. subtilis*, *E. coli*, *S. epidermis*, *S. cereviceae*, *P. vulgaris*, *B. cereus* and *S. aureus*. The *Z. jujuba* cyclohexane extract showed considerable activity against gram negative bacteria *E. coli* with MIC value of 50 µg/ml. and methanolic extract of *Z. jujuba* showed anti-microbial activity with MIC value of 55 µg/ml against yeast *S. cereviceae*. Naz and co-workers (2013).[5] performed studies on different species of *Ziziphus* and reported anti-bacterial activity in them as well. The anti-bacterial activity of *Z. jujuba* showed inhibition against *E. coli*, *S. aureus*, and *P. multocida*. Udayakumar and Begum (2002)[16] reported anti-bacterial activity in extract of *Z. jujuba* against *E. coli*, *K. pneumoniae* and *S. typhi*. The methanolic extract of *Ziziphus jujuba* showed significant anti-oxidant activity by Deoxyribose method

with IC_{50} value of 18.3 ± 11.51 µg/ml. Prakash and his team (2013)[15] reported anti-oxidant activity in *Z. jujuba* and was 69.7 ± 4.3 percent in fruits of *Z. jujuba*, the activity was reported due to the presence of phenols. As compared with the present study showed potent anti-oxidant activity in methanollic extracts by different scavenging assay.

CONCLUSIONS

The present study showed potent anti-microbial and anti-oxidant activity in *Z. jujuba* extracts. The methanollic extract was found to have the maximum activity and can be used as a therapeutic agent for curing number of diseases due to its anti-oxidant property. Further studies could be carried out for further purification and characterization of its compounds.

ACKNOWLEDGMENTS

We acknowledge Integral University for providing necessary facilities to perform research work. This work was supported financially by UGC Maulana Azad National Fellowship.

REFERENCES

1. Singh PK, Kumar V, Tiwari RK, Sharma A, Rao CV and Singh RH. Medico-Ethnobotany of 'Chatara' block of District Sonebhadra, Uttar Pradesh, India. Adv in Biological Res., 2010; 4(1): 65-80.
2. Ahmad B, Khan I, Bashir S, Azam S and Hussain F. Screening of *Ziziphus jujuba* for antibacterial, phytotoxic and haemagglutination activities. African J Biotechnol, 2011; 10(13): 2514-2519.
3. Zamin I, Shah JA, Khan I, Majid A, Rehman MM, Malik Z, Hyder H, Bib J, Mahnoor and Naz B. In – Vitro Efficacy of Crude Extract of *Ziziphus jujuba* against Selected Bacterial Strains. Int J Scientific Res Publication, 2014; 4(2): 2250-3153.
4. Rasool N, Rızwan K, Zubaır M, Gulzar T and Bukhari IH. Antioxidant activity of various extracts and organic fractions of *Ziziphus jujuba*. Int J Phytomedicine, 2011; 3: 346-352.
5. Naz S, Sultana B, Shahid M and Khalil-ur-Rehman. Alteration in antioxidant and antimicrobial attributes of leaves of *Ziziphus* species in response to maturation. J Med Plant Res., 2013; 7(2): 61-70.
6. Kamaraj C, Rahuman AA, Siva C, Iyappan M and Kirthi AV. Evaluation of antibacterial activity of selected medicinal plant extracts from South India against human pathogens. Asian Pac J Trop Dis., 2012; S296-S301.
7. Blois MS. Antioxidant determinations by the use of a stable free radical. Nature, 1958; 181: 1199-1200.
8. Ara N and Nur H. *In vitro* antioxidant activity of methanolic leaves and flowers extracts of *Lippia Alba*. Res J Med Med Sci., 2009; 4(1): 107-110.
9. Kunchandy E and Rao MNA. Oxygen radical scavenging activity of curcumin. Int J Pharm, 1990; 58(3): 237-240.
10. Sanja SD, Sheth NR, Patel NK, Patel D and Patel B. Characterization and evaluation of antioxidant activity of *Potulaca oleracea*. Int J Pharm Pharm Sci., 2009; 1(1): 74-84.
11. Vaijanathappa J, Badami S and Bhojraj S. *In vitro* antioxidant activity of *Enicostemma axillare*. J Health Sci., 2008; 54(5): 524-528.
12. Badami S, Rai SR and Suresh B. Antioxidant activity of *Aporosa lindleyana* root. J Ethnopharmacol, 2005; 101(1-3): 180-184.
13. Halliwell B, Gutteridge JMC and Aruoma OJ The deoxyribose method: A simple "test tube" assay for determination of rate constants for reactions of hydroxyl radicals. Anal Biochem, 1987; 165(1): 215-219.
14. Hinneburg I, Dorman HJD and Hiltunen R. Antioxidant activities of extracts from selzzected culinary herbs and spices. Food Chem, 2006; 97: 122-129.
15. Prakash D, Upadhyay G and Gupta C. Total phenol and antioxidant activity of some fruits and their under-utilized parts. Int Food Res J., 2013; 20(4): 1717-1724.
16. Udayakumar R and Begum VH. Antimicrobial studies of some selected medicinal plants. Anc Sci Life, 2002; XXI(4): 230-239.