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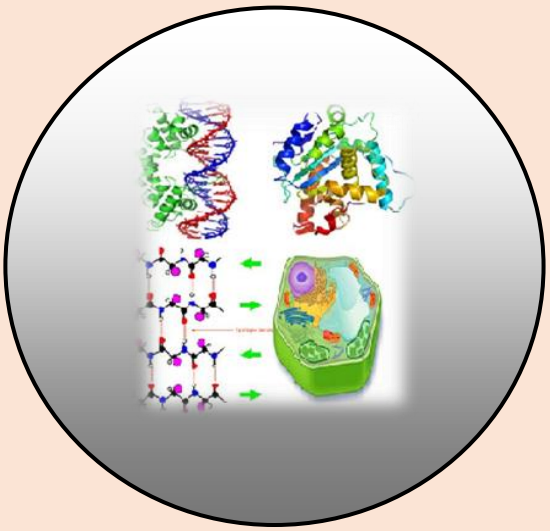

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Studies on Antibacterial and Antioxidant Activities of *Moringa oleifera* Lam.

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ABSTRACT

Antibacterial and antioxidant activities of Moringaoleifera were evaluated by using agar-well diffusion method and DPPH free radical scavenging assay respectively. Antibacterial activity of different plant part extracts in acetone, methanol and water solvents was tested against four human pathogenic bacteria namely Escherichia coli, Salmonella typhi, Bacillus cereus and Staphylococcus aureus using different concentration i.e. 25, 50, 75 and 100%. Further, antioxidant activity of different plant part extracts of M. oleiferain acetone, methanol, and water plant extract was also studied at 20, 40, 60, 80 and 100% µg/mL concentrations. Results showed that all studied extracts exhibited significant antibacterial and antioxidant activities. Methanol flower extract showed maximum zone of inhibition and again methanol flower extract exhibited higher antioxidant potential with lowest IC_{50} values than water extract and acetone extract, thereby proving themedicinal value of the selected plant and can be used for further investigation for knowing their proper therapeutic knowledge.
Keywords: Moringaoleifera, plant extracts, antibacterial activity agar-well diffusion, free radical scavenging assay(DPPH)

INTRODUCTION

India has rich heritage of flora that is widespread all over the country. Out of more than 7,500 plant species, 4,635 species are used commercially on a large scale. Huge number of potential drugs isbeing obtained from the medicinal plants. Drugs obtained from these plants are easily available, safe and have no side effects (Kannan*et al.,* 2009). The Himalayan region has rich biodiversity which is used for a number of purposes i.e. medicinal, wild edible, fuel, fodder, timber making, agricultural tools, religious, spices etc. (Pant *et al*., 2009). Himachal Pradesh is the part of North Western Himalaya which constitutes a wide variety of medicinal plants. It has about 643 medicinal plant species (Singh *et al*., 2009).

The leading cause of premature death in the world is prevalence of the infectious diseases. These infectious diseases kill more than 50,000 people every day. In present times, multiple drug resistance to human pathogenic microorganism has developed all over the world due to the miscellaneous use of commercial antimicrobial drugs (Devis, J. 1994 and Robin *et.al.,* 1998). Due to the increasing rate of antibiotic resistance in bacteria, there is a need to develop substitute antimicrobials for the treatment of infectious diseases from the medicinal plants (Prakash*etal*., 2016). Medicinal plants contain a wide range of substances that can be used to treat chronic as well as infectious diseases.

Antioxidants obtained from the medicinal plants reduce the risk of diseases and oxidative stress. Oxidative stress illustrates the presence of free radicals and reactive oxygen species (ROS), which appeared under normal physiological conditions but turns into destructive forms when not being removed by endogenous

system (Prakash*etal*., 2017) The major sources ofprimary catalysts are reactive oxygen species that initiate oxidation *in vitro*and *in vivo* which cause various diseases (Halliwell, 1994; Rackova *et al*., 2007) such as Parkinson's disease, Alzheimer's disease, cancer 2004), neural disorder (Sas*et al*., 2007) etc.

Animal cells exhibit elaborate defence mechanism for radical detoxification. This defence mechanism comprises scavenging of free radicals by number of antioxidant enzymes. Examples of antioxidant enzymes are superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX). Non-enzymatic molecules likethioredoxin, thiols and disulphide bonding also play significant role in antioxidant defence system. Some of compounds obtained from food such as α-tocopherol, β-carotene, vitamins C and vitamin E are known to possess antioxidant potential.Antioxidant based drugs for the treatment of various complex diseases have reported during the last three decades. This has developed a great deal of research interest in natural antioxidants (Devasagayam*et al*., 2004). Natural antioxidants enhance the antioxidant capability of plasma and decrease the risk of certain diseases such as heart diseases and cancer etc. (Prior and Cao, 2000). The various natural antioxidant compounds are derived from medicinal plants, which include anthocyanin, coumarin, flavonoid, isoflavonoid, flavone, lignin etc. These antioxidant compounds are effective free radical scavenger and commonly known as secondary metabolites. They are present in all parts of the plant such as flower, leaf, fruit, bark and root (Methew and Abraham, 2006). Investigated medicinal plant *Moringaoleifera* is most widely cultivated species of Moringaceae family. The ethno-botanical knowledge about this plant has gained from the local people of district Bilaspur. *M*. *oleifera*is native to sub-Himalayanregion of India, Pakistan, Bangladesh and Afghanistan. This plant iscommonly used to treat stomachache, swelling, asthma, and cough in Ayurvedic and Unani medicines. Indian inhabitants use fresh leaves for the preparation of cow and buffalo ghee from butterfat. Its leaves are rich source of Vitamin A and C, protein, calcium and phosphorus. Therefore, in some regions of India its leaves are used as food recuperation of children and adults suffering from malnutrition.

MATERIALS AND METHODS

Collection of plant material

GehriPanjyal village at an altitude of 375m in Bilaspur district of Himachal Pradesh was selected for collection of study material.

Processing of plant material

Aerial parts were first washed under tap water and then treated with 2% Mercuric chloride. Leaves, flower and bark of *M*. *oleifera* were separated from stem and then allowed to shade dried for 15-20 days. After drying plant materials were crushed to form a fine powder with the help of pestle mortar. Prepared fine powders were stored at room temperature in air tight containers.

Preparation of acetone, methanol and water extracts

Extracts (acetone, methanol and water) of different parts of plant have been prepared to check antimicrobial activity. 5 g dried plant material was taken in separate Erlenmeyer flasks to which 50ml of required solvents i.e., methanol, acetone and water were added. Theflasks were covered with aluminium foil and allowed to stand for 3-5 days for extraction. These extracts were filtered through Whatman filter paper no. 1 and evaporated at 40°C using rotary evaporator. The extracts were collected and weighed. Finally, stock solution of conc. 50 mg/mL was prepared.

Procurement of bacteria

Bacterial strains used for antibacterial studies were *Escherichiacoli*, *Salmonellatyphi*, *Bacilluscereus*, *Staphylococcusaureus* which were procured from Department of Microbiology and Biotechnology, Himachal Pradesh University, Summer Hill, Shimla, India.

Revival of pathogen

The collected pathogens were revived in nutrient broth and stored in nutrient agar slants at 4°C.

Screening of acetone, methanol and water extracts of *M*. *oleifera* for antibacterial activity

Different extracts (methanol, acetone and water) of this plant were screened using Agar-well diffusion method. Nutrient agar medium (Beef extract 1 g, Yeast extract 2 g, Sodium chloride 1 g, Peptone 5 g, Agar 20 g, and Distilled water 1000 mL) was used throughout the investigation. The medium was autoclaved at 121.6 ºC for half an hour and poured into Petri plates. Bacteria were grown in nutrient broth for 24 hours. A 100 µL of bacterial suspension was spread on each nutrient agar plate. Agar-wells of 8 mm diameter were prepared with the help of sterilized stainlesssteelcork borer in each Petri plate. The wells in each plate were loaded with 25, 50, 75 and 100% concentration of prepared plant extracts.

The Petri plate kept as a control contained pure solvent only. The plates were incubated at 37±2 ºC for 24 hours in the incubation chamber. The zone of growth inhibition was calculated by measuring the diameter of the inhibition zone around the well (in mm) including the well diameter. The readings were taken in perpendicular direction in all the three replicates and the average values were tabulated. Percentage inhibition of bacterial species was calculated after subtracting control from the values of inhibition zone diameter using positive control as standard (Prakash*et al*., 2016).

Percentage of growth inhibition (%) = (Control−Test /Control) x100

Control = average diameter of bacterial colony in control.

Test = average diameter of bacterial colony in treatment sets (Rana*et al*., 2016).

Evaluation of antioxidant activity of acetone, methanol and water extract of *M. oleifera* and DPPH radical scavenging activity assay

The free radical scavenging activity of plant extracts was measured using 2,2-diphenyl-1-picryl-hydrazyl (DPPH) as described by Blois (1958). Briefly, to 1 mL of different concentrations (20, 40, 60, 80 and 100 µg/mL) of plant or test extract, 1 mL of DPPH (0.1 mM in methanol) was added. Corresponding blank sample was prepared and ascorbic acid was used as reference standard. Mixture of 1 mL methanol and 1 mL DPPH solution was used as control. All the tests were carried out in triplicate and the decrease in absorbance was measured at 517 nm after 30 minutes in dark using UV-VIS spectrophotometer. The percentage (%) of inhibition was calculated using the following formula:

DPPH scavenging effect (%) = $(A_{control}-A_{sample}/A_{control}) \times 100$

Where, $A_{control}$ is the absorbance of control; $A_{sample}$is the absorbance of sample

Graphs were plotted against percent inhibition v/s conc. of plant extracts and standard

ascorbic acid in order to find out the values of slope and y-intercepts. IC_{50} value (the amount of antioxidant required to decrease the initial DPPH concentration by 50 %) for each extract and ascorbic acid was evaluated using the following equation given below:

IC_{50} = 50 – $Y-Intercept/$ Slope

RESULTS

Antibacterial activity screening: Table 1-3 and **Fig. 1-3**is showing the results for antibacterial activity of *M. oleifera*. Results came out from Table-2 methanol flower extract of *M. oleifera*is showing highest antibacterial activity among all parts of plant extracts. According to the Table 1, water leaf extract of the *M. oleifera* exhibited maximum activity with 18.3 mm, 18.6 mm, 22.6 mm, 24.6 mm zone of inhibition at 25, 50, 75 and 100% concentration respectively against *B. cereus.* It is evident from the Table 3 that maximum activity is showing against *S. typhi* by acetone bark extract with zone of inhibition of 14.3 mm at 25%, 17.3 mm at 50%, 20.6 mm at 75% and 22.3mm at 100% concentration and minimum inhibition against *B. cereus*with 8 mm, 9.3 mm, 10.3 mm and 11 mm at 25%, 50%, 75% and 100% concentrations respectively.

Table 1. Zones of inhibition produced by acetone, methanol, water leaf extractat different concentrations

Extract	Concentration	Diameter of inhibition zone in mm (± S.E.)			
		E. coli	***S. typhi***	***B. cereus***	***S. aureus***
Acetone Extract	**Control**	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	11.3±0.27	12.3±0.54	11.6±0.27	11.3±0.27
	50	11.6±0.27	13±0.94	12±0.47	12±0.47
	75	12±0.47	13.6±0.54	12.3±0.27	13±0.47
	100	12.3±0.54	14±0.47	18.3±1.96	14±0.47
MethanolExtract	**Control**	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	11.3±0.27	12.3±0.54	14±0.47	12.6±0.27
	50	14.3±0.54	12.6±0.27	14.3±0.54	13.6±0.54
	75	14.6±0.27	13.3±0.27	14.6±0.27	14.6±0.27
	100	18.6±1.51	13.6±0.27	15±0.81	15.3±1.08
WaterExtract	**Control**	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	10±0.47	18.6±0.27	18.3±0.54	8.6±0.27
	50	10.3±0.47	20.3±0.27	18.6±0.54	10±0.47
	75	10.6±0.27	20.6±0.54	22.6±0.27	10.6±0.27
	100	11.3±0.27	21.3±0.27	24.6±0.27	11±0.47

Each data point represents mean of three replicates ± S.E. (Standard error).

Antioxidant activity screening

Table 4-7 and Fig. 4-7 are showing the results for antioxidant activity of acetone, methanol and water extracts of selected medicinal plant. Ascorbic acid taken as positive control exhibited IC_{50} value of 26.76 µg/mL (Table 4). According to Table 5, methanol leaf extract of *M*. *oleifera* is showing highest antioxidant activity with 118.25 µg/ml IC_{50} value than leaf water extract with 245.05 µg/ml IC_{50} value and leaf acetone extract with 254.31 µg/mL IC_{50} value. In case of Table 6, methanol extract of flower is showing higher antioxidant activity 56.55 µg/mL IC_{50} value than water extract 121.39 µg/mL IC_{50} value and acetone extract 178.17 µg/mL IC_{50} value. In case of bark, acetone extract is showing least antioxidant activity (302.16 µg/mL IC_{50} value) as compared to water extract (282.85 µg/mL IC_{50} value) and methanol extract (167.14µg/mL IC_{50} Value) (Table 7).

Table 2.Zone of inhibition produced by acetone, methanol and water flower extract

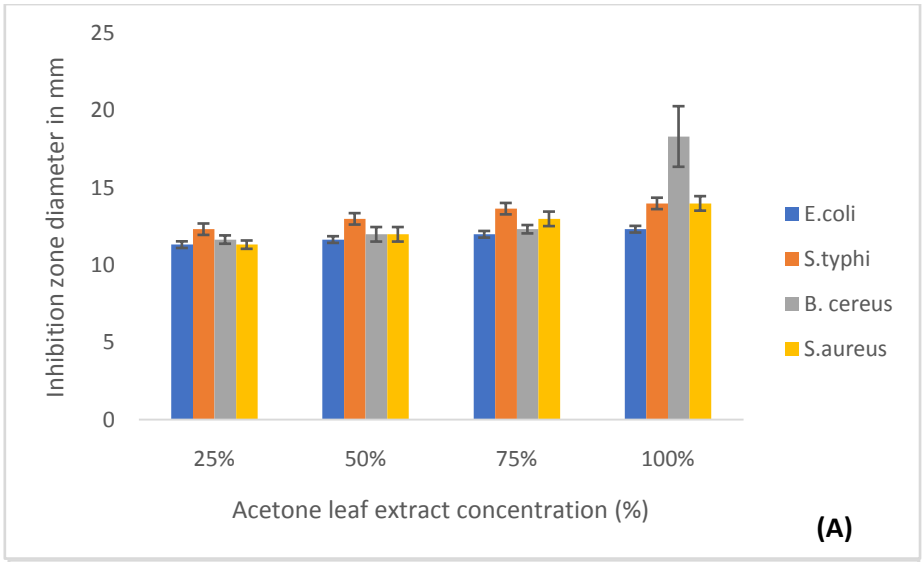
Extract	Concentration	Diameter of inhibition zone in mm (± S.E.)			
Acetone Extract		*E. coli*	*S. typhi*	*B. cereus*	*S. aureus*
	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	10.3±0.27	19.3±0.54	12.3±0.54	10.6±0.27
	50	14±0.81	19.6±0.27	13±0.81	11±0.47
	75	14.3±0.98	20.3±0.27	13.6±0.27	11.3±0.27
	100	14.6±0.27	21±0.47	14.6±0.27	12.6±0.27
MethanolExtract	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	13±0.47	13±0.47	11±0.47	11±0.27
	50	13.6±0.27	13.3±0.72	14±0.47	13.6±1.08
	75	14.3±0.27	14.6±0.27	14.6±0.27	14±0.47
	100	15.3±1.18	25±0.47	22.3±1.78	14.3±0.54
Water Extract	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	7.3±0.27	8.3±0.27	0	7±0.47
	50	7.6±0.54	9.4±0.27	0	8.3±0.27
	75	8±0.47	15.3±0.27	0	9±0.94
	100	13.3±0.27	20.6±0.72	0	10±0.94

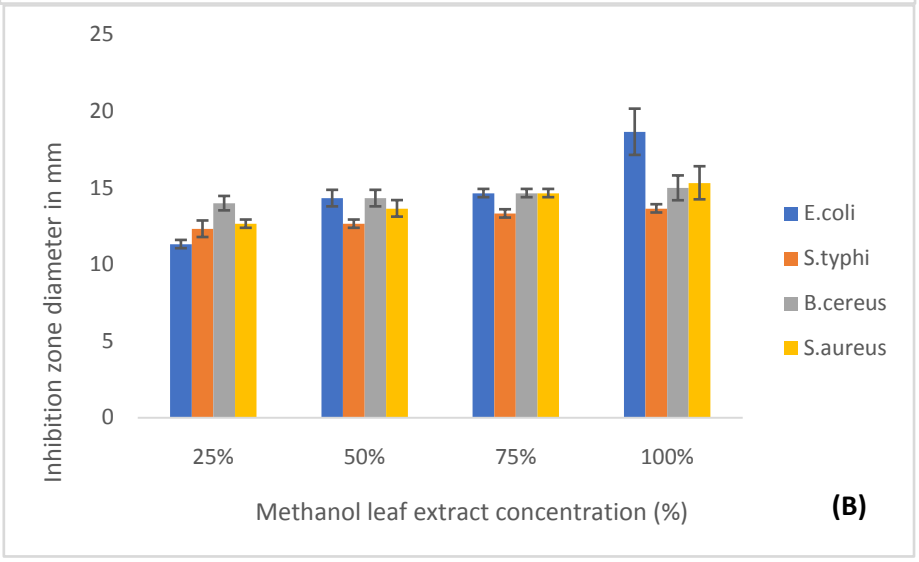
Each data point represents mean of three replicates ± S.E. (Standard error).

Table 3.Zones of inhibition produced by acetone bark extractat different concentrations.

Extract	Concentration	Diameter of inhibition zone in mm (± S.E.)			
		E. coli	*S. typhi*	*B. cereus*	*S. aureus*
Acetone extract	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	9.3±0.27	14.3±0.54	9.3±0.27	8.6±0.27
	50	9.6±0.27	17.3±0.54	9.6±0.27	10±0.47
	75	11±0.47	20.6±0.54	13±0.47	10.6±0.54
	100	15±0.47	22.3±0.72	13.6±0.27	11.6±0.27
Methanol extract	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	11.3±0.72	16.3±0.98	11.3±0.27	9.3±0.54
	50	12±0.47	16.6±0.54	12±0.47	10.3±0.27
	75	13.3±0.27	18.6±0.27	12.6±0.27	11±0.94
	100	15.8±0.27	20±0.81	14.3±0.98	15.6±0.27
Water extract	Control	00.00±00.00	00.00±00.00	00.00±00.00	00.00±00.00
	25	7.6±0.27	8±0.47	8.6±0.27	8±0.47
	50	8.6±0.27	8.3±0.27	9.6±0.27	9.3±0.27
	75	10±0.47	8.6±0.27	10±0.47	10.3±0.27
	100	11.3±0.54	9.6±0.72	11±0.47	11±0.47

Each data point represents mean of three replicates ± S.E. (Standard error).





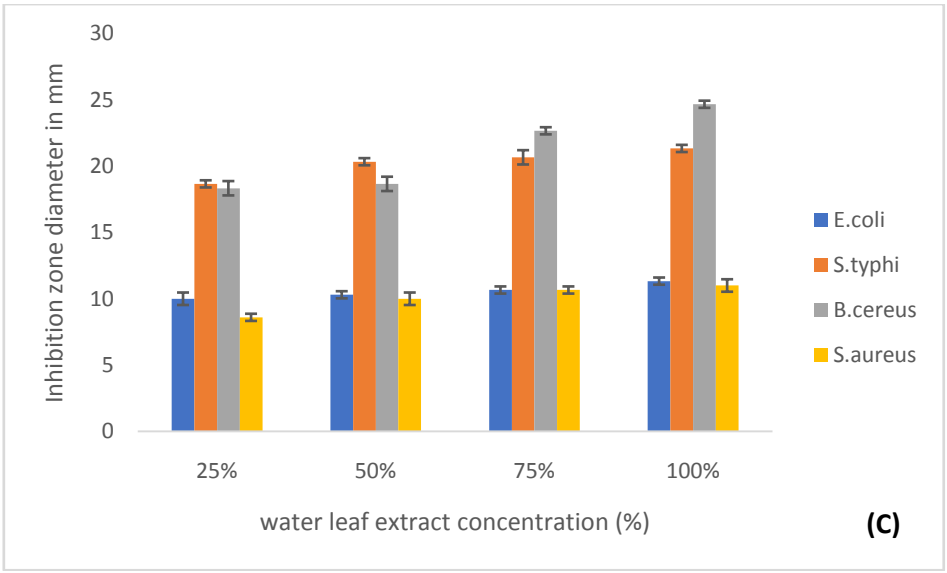


Figure 1. Antibacterial activity of *M. oleifera*acetone(A), methanol(B) and water(C) leaf extracts.

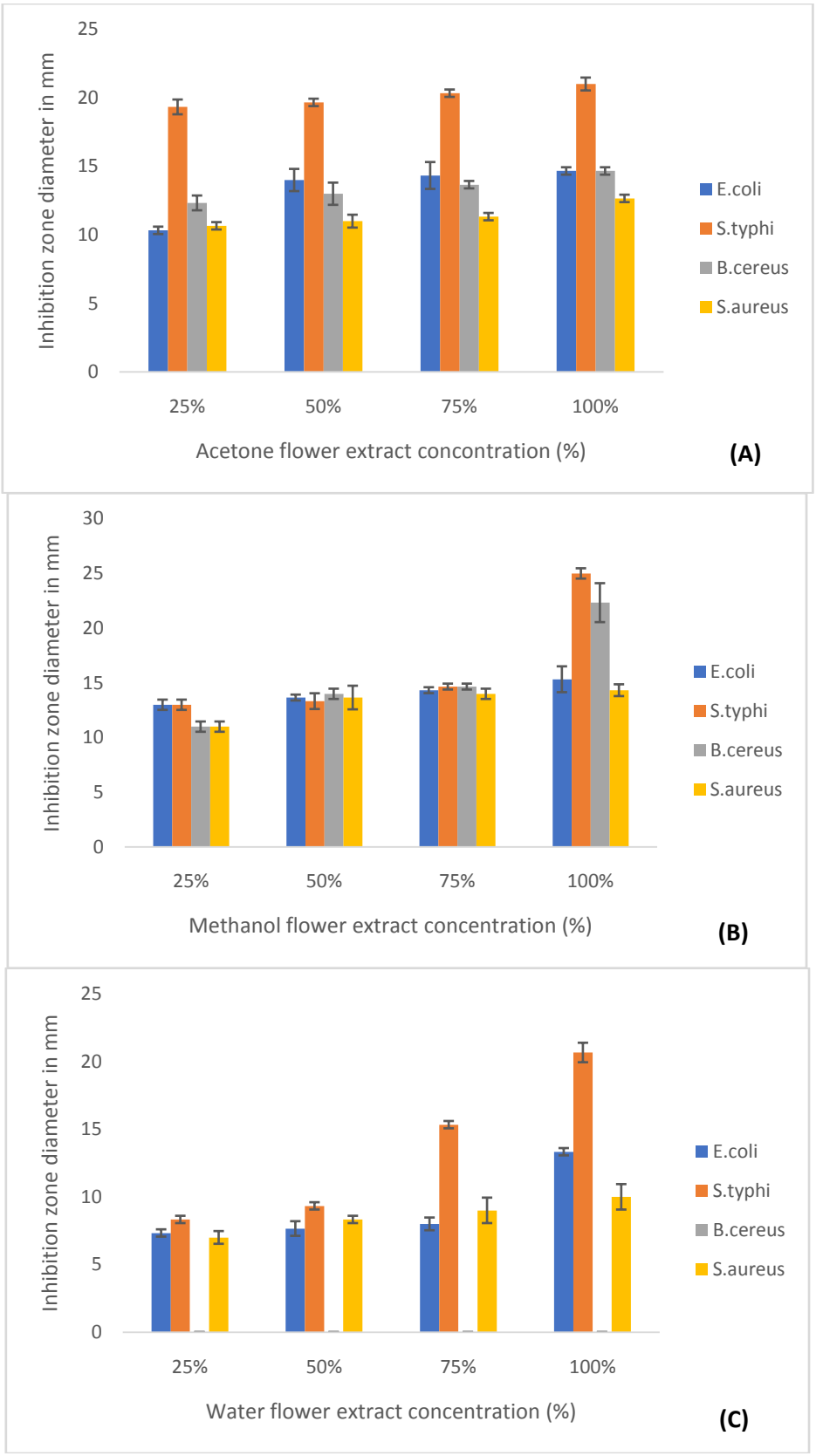


Figure 2. Antibacterial activity of *M. oleifera*acetone (A), methanol (B) and water (C) flower extracts.

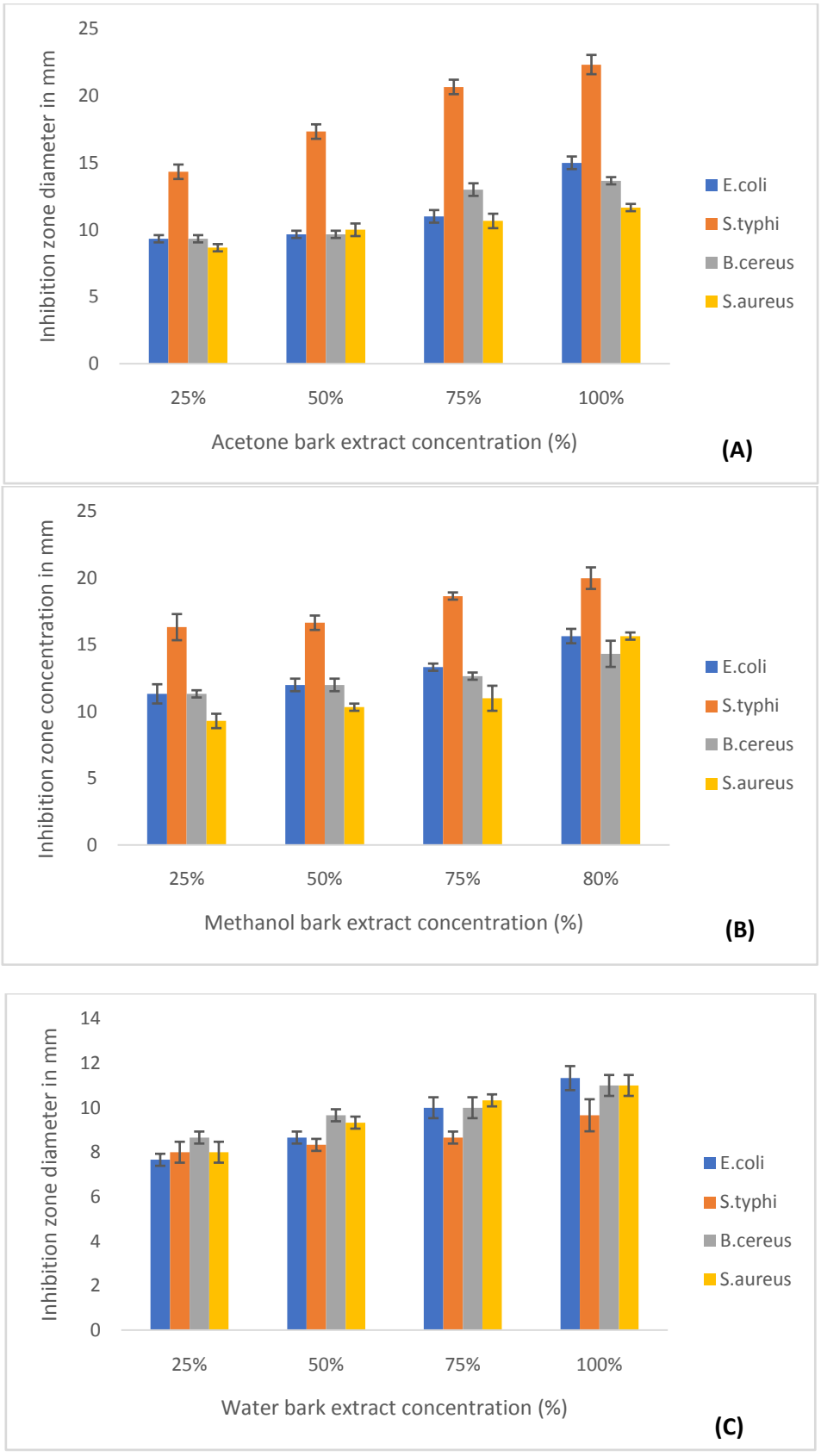


Figure 3. Antibacterial activity of *M.oleifera* acetone (A), methanol (B) and water (C) bark extracts

Table 4. Free radical scavenging activity (%) of the control i.e. ascorbic acid at different concentrations.

Ascorbic acid (control)	Concentration (µg/ml)	Methanol extract	IC_{50} valve (ug/ml)
	20	47.49±0.27	26.76
	40	56.02±0.54	
	60	66.88±0.80	
	80	75.31±0.56	
	100	88.53±0.41	

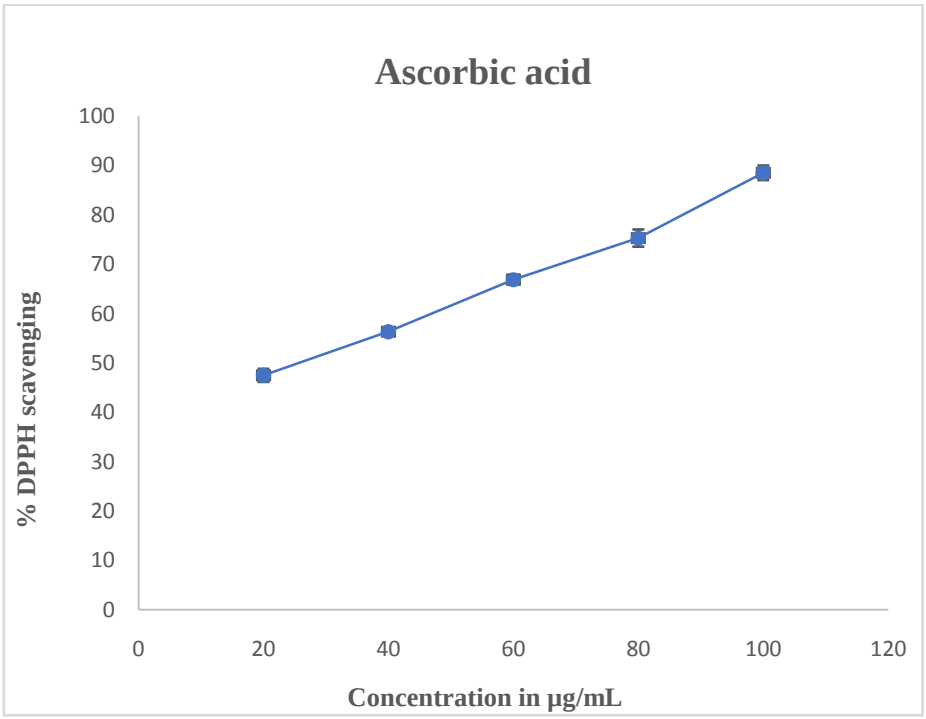


Figure 4. Free radical scavenging activity of ascorbic acid as a control.

Table 5. Free radical scavenging activity (%) of leaf extract of *M. oleifera* at different concentrations in acetone, methanol and water solvents.

Plant part	Conc. (µg/mL)	Acetone Extracts	IC50Value (µg/mL)	Methanol Extract	IC50 Value (µg/mL)	Water Extract	IC50Value (µg/mL)
Leaf	20	25.27±1.54	254.31	5.05±0.04	118.25	23.17±3.31	245.05
	40	27.34±1.19		23.31±0.42		25±3.45	
	60	29.51±0.93		26.83±0.65		26.28±2.92	
	80	31.16±0.46		30.02±0.80		29.89±2.85	
	100	34.62±1.47		43.38±0.99		33.61±2.91	

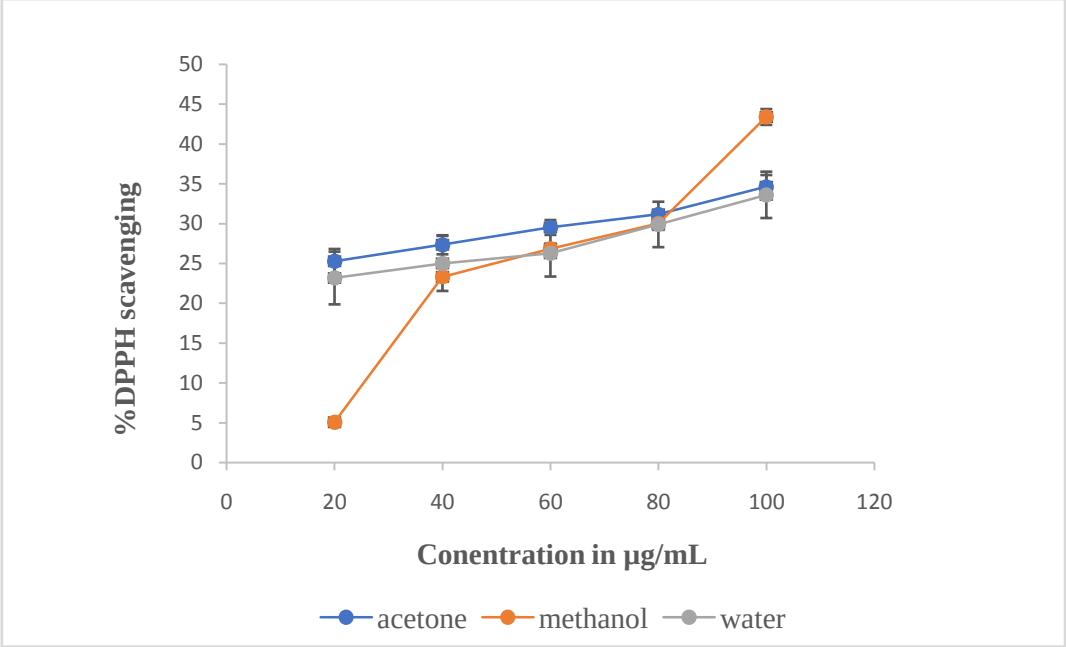


Figure 5. Free radical scavenging activity of the acetone, methanol and water leaf extracts

Table 6. Free radical scavenging activity (%) of flower extract of *M. oleifera*at different concentrations in acetone, methanol and water solvents

Plant part	Conc. (µg/mL)	Acetone Extracts	IC50 Value (µg/mL)	Methanol Extract	IC50 Value (µg/mL)	Water Extract	IC50 Value (µg/mL)
Flower	20	25.22±0.81	178.17	19.78±1.91	56.55	20.10±1.32	121.39
	40	29.22±0.55		40.50±3.41		23.1±0.84	
	60	32.50±0.38		60.17±0.45		25.87±1.03	
	80	34.57±0.55		79.02±1.87		37.49±1.74	
	100	37.88±0.76		88.05±1.21		44.98±1.47	

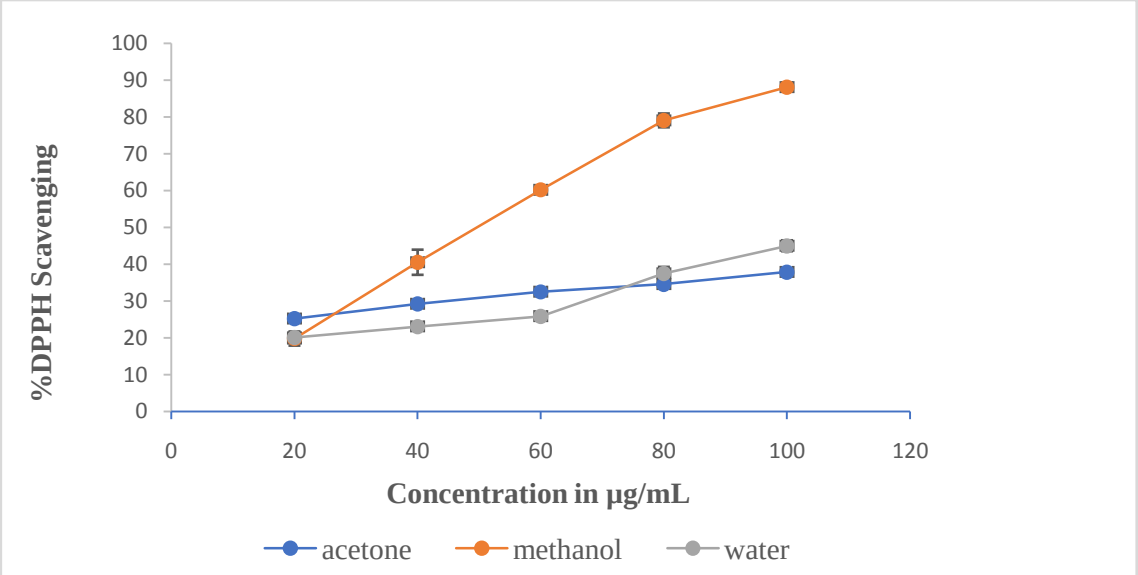


Figure 6. Free radical scavenging activity of the acetone, methanol and water flower extracts

Table 7. Free radical scavenging activity (%) of bark extract of *M. oleifera*atdifferent concentrations in acetone, methanol and water solvents

Plant part	Conc. (µg/mL)	Acetone Extracts	IC50 Value (µg/mL)	Methanol Extract	IC50 Value (µg/mL)	Water Extract	IC50 Value (µg/mL)
Bark	20	21.29±1.26	302.16	30.45±0.28	167.14	5.55±0.32	282.85
	40	22.86±1.00		35.39±1.70		9.22±0.56	
	60	24.42±0.31		37.97±0.40		11.98±0.79	
	80	25.91±0.68		39.57±0.52		13.56±0.41	
	100	30.10±0.12		40.67±0.89		20.43±0.57	

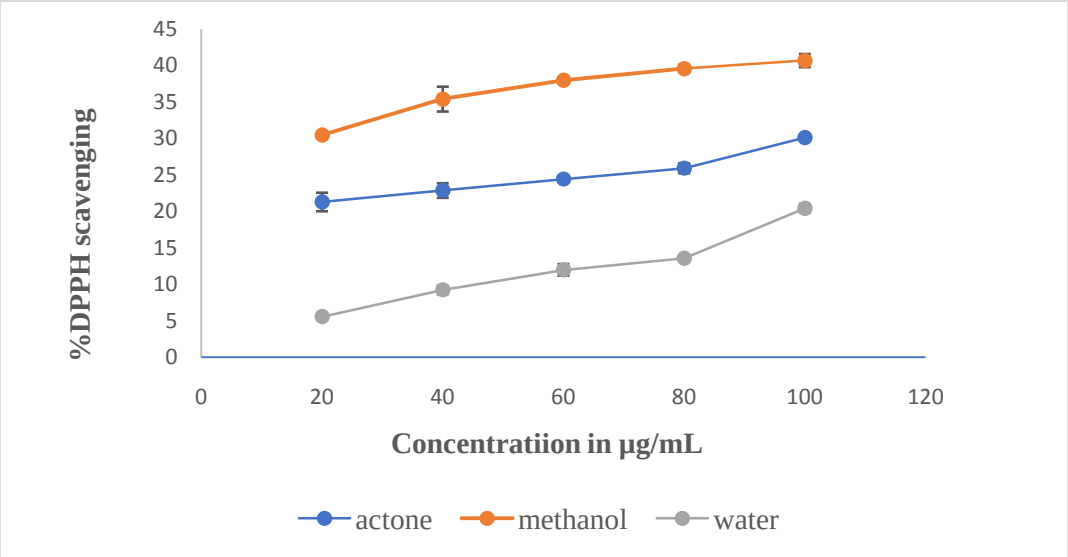


Figure 7. Free radical scavenging activity of the acetone, methanol and water bark extracts

DISCUSSION

Present investigation showed antibacterial activity and it was observed that methanol flower extract showed the highest antibacterial activities against all the tested bacteria that means 15.3 mm against *E. coli*, 25 mm against *S. typhi*, 22.3 mm against *B. cereus* and 14.3 mm against *S. aureus* at 100% concentration in comparison with acetone and water flower extract. In the case of water leaf extract higher activity showed against *B. cereus* and *S. typhi* at 25%, 50%, 75% and 100% concentration with zone of inhibition value i.e. 18.6 mm, 18.6 mm, 22.6 mm, 24.6 mm and 18.6 mm, 20.3 mm, 20.6 mm, 21.3 mm respectively than methanol and acetone extracts. In comparison with acetone leaf extract, methanol leaf extract showed higher antibacterial activity against *E. coli* at 25%, 50%, 75% and 100% concentration with zone of inhibition values 11.3 mm, 14.3 mm, 14.6 mm and 18.6 mm respectively followed by *S. aureus* and *S. typhi* except the inhibition value against *B. cereus* where acetone extract showed higher activity than methanol leaf extract. In case of bark, the methanol bark extract showed high antibacterial activity against *E. coli*, *S. aureus* and *B.cereus* i.e. 15.8 mm, 15.6 mm and 14.3 mm respectively at 100% concentration than acetone and water bark extract except for*S. typhi* where the acetone extract showed high inhibition than the methanol and water extracts respectively.

Antibacterial activity of *M. oleifera* and *M. stenopetala* against three bacterial species *Salmonellatyphi*, *Vibriocholerae* and *Escherichiacoli*was investigated by Walter *etal*. (2011). The strongest inhibition was determined at dilution of 20, 5, 40% for *M.oleifera* and *M. stenopetala* methanol extract on *E.coli,S. typhi*, *V. cholerae* respectively. The n- hexane extract of both species had higher inhibition towards *S.typhii* than *V. cholerae* and *E.coli*. Raj *et al.* (2011) investigated the antimicrobial activity of *Moringaoleifera* (Lam.) root extract. The roots extracted with petroleum ether, ethyl acetate, chloroform, ethanol and aqueous extract were tested for antimicrobial activities against number of bacteria and fungi.

The result showed that ethyl acetate extract had high antibacterial activity against *Pseudomonasaeruginosa*. Chloroform extract did not show antibacterial activity against *Escherichia coli* and *Proteusmirabilis*. Kumar *etal*. (2012) studied the antibacterial and antioxidant activity of *M.oleifera* leaf extract against number of bacteria and reported that methanol extract showed maximum zone of inhibition against *S. aureus* however aqueous extract showed activity against *B. subtilis*. Antibacterial activity of *M. ovalifolia* and *M.oleifera* methanol, N hexane and water seeds and bark extract against pathogens was analysed by Shailemo*et al.*(2016). *Escherichiacoli*, *Enterococcus*faecalis, and *Bacilluscereus* bacteria were chosen for the study. The *M. oleifera* showed higher inhibitory effects than *M. ovolifolia.* The n-hexane extracts of both seeds bark of *M. ovolifolia* and *M. oleifera* had almost the same inhibition activities against *B. cereus, E. coli* and *E. faecalis*. Paray *et al.* (2018) studied the antimicrobial activity of crude aqueous extracts of *M. oleifera*, *Azadirachtaindica,Tinosporacordifolia*and *Curcuma longa* against six pathogen bacteria using Agar-well diffusion-method. The extract of *M. oleifera* exhibited zone of inhibition (mm) of 7.50±1.04, 12.75±0.85, 10.25±0.62, 8.75±0.47 and 8.50±1.25 against *Escherichia coli, Proteus* spp*., Enterococcus faecium, Enterococcus faecalis, Staphylococcus aureus*and *Streptococcus agalactiae*respectively. It is evident from the results of present investigation that ascorbic acid shows 26.76 µg/ml IC_{50} valve which is taken as a control. The free radical scavenging activity (%) of the methanol leaf extract (118.25µg/mL) shows higher IC_{50} than water and acetone extract. Alsothe free radical scavenging activity (%) of acetone, methanol and water flower extract, the methanol flower extract (56.55 µg/mL) shows higher IC_{50} than acetone and water flower extract. The free radical scavenging activity (%) of the bark extract in acetone and methanol and water solvents at different concentrations with 302.16 µg/mL IC_{50} value of acetone extract, 167.14 µg/mL IC_{50} value of methanol extract and 282.85 µg/mL IC_{50} value of water extract. Santos *et al*. (2012) investigated the antioxidant activity of *M. oleifera* ethanol (E1) and saline (E2) extracts from flowers (a), inflorescence rachis (b), seeds (c), leaf rachis (e) and fundamental tissue of stem (f). The radical scavenging activity capacity of extract analysed using dot blots on thin layer chromatography stained with a 0.4 mM 1,1- diphenyl-2-picrylhydrazyl radical (DPPH) solution; spectrophotometric assay recorded at 515 nm. Antioxidant compounds were detected in all E1 and E2 from a, b and d. The best radical scavenging capacity was obtained with ethanol extract of leaf tissue. The antioxidant present in saline extract reacted very slowly with DPPH. The antioxidant activity of leaves and flowers of *Moringaoleifera* plant and the comparison of its activity with other selected vegetables was studied by Padake*et al.*(2013). Antioxidant activity was examined by analysing the total phenolic content, flavonoid content, reducing power and radical scavenging activity using the 2,2-diphenyl-1-picrylhydrazyl free radical method. The results showed that the reducing power of *Moringa* was more as compared to the other selected vegetables and the percentage of free radicals remaining was lower than that of vegetables. Fitriana *et al*. (2016) investigated the antioxidant activity of *Moringaoleifera.* Leaves of *M. oleifera* were extracted with methanol, ethyl acetate, dichloromethane, and n-hexane. The antioxidant activity was evaluated by 1,1-diphenyl-2-picrylhydrazyl free radical scavenging activity assay and an improved assay 2,2'-azino-bis-[3-ethylbenzothiazoline sulphonate] (ABTS) radical cationdecolorization assay *in vitro*. The methanol extract reported the strongest free radical scavenging activity with IC_{50} value of 49.30µg/mL in DPPH assay and 11.73 µg/mL in ABTS assay. It can be concluded from the present investigations that *Moringaoleifera* has a considerable antibacterial and antioxidant potential which can be attributed to the presence of different phytochemicals in its leaves, bark and flowers. The results of the study are in agreement with the reports of work of earlier workers. Although present study is of primitive nature yet it has established a base for further investigations which can be carried out for isolation and identification of different phytochemicals present in this medicinal plant.

CONCLUSION

It can be concluded from the above experimental observations that the plant *Moringaoleifera*is showing significant antibacterial and antioxidant activity at different concentrations used. From the leaf extract analysis, water leaf extract is found to be more effective followed methanol and acetone leaf extracts. From flower extract analysis, methanol flower extract exhibited higher antibacterial activity followed by acetone and water flower extract. From bark extract analysis, acetone extractpossessed potent antibacterial activity than methanol and water extract. It is observed from the studied plant parts that methanol extract exhibited potent antioxidant activity followed by water and acetone extract. This study suggests that *Moringaoleifera* might be helpful in preventing the progress of various diseases.

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