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## Comparative phytochemical screening and microbiocidal activity of different parts of *Mimosa pudica* L.

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### Abstract

The present study was aimed with the potential antimicrobial activity in terms of antibacterial and antifungal activities of *Mimosa pudica* L. (MP) whole parts collected from two different cultural conditions, viz., West Bengal (WB) and Tamil Nadu (TN). The plant parts like roots, stems, leaves and flowers are collected separately and further directly extracted with ethanol, aqueous and hydroalcoholic mixture (2:1). The resulting extracts were subjected with qualitative phytochemical screening, estimation of yield content followed by their antibacterial activity. Antibacterial activity was performed against two Gram-positive bacteria, namely; *Bacillus subtilis* ATCC 6633, *Staphylococcus aureus* ATCC 29726, and two Gram-negative bacteria, *Pseudomonas aeruginosa* ATCC 25619, and *Escherichia coli* ATCC 8739. Phytochemical analysis of extracts revealed the presence of various group of compounds, namely; alkaloids, flavonoids, saponins, sterols, flavonoids, tannins and glycosides. MIC's ranged from 19.2 to 34.6 µg/ml and MBC of 19.8 and 33.7 µg/ml except *P. aeruginosa* which as less sensitive and its MBC reached to 36.7 µg/ml of MP collected from respective places. The antibacterial study demonstrated that methanol root extract was able to inhibit the maximum growth ( $p < 0.05$ ) of both *S. aureus* and *E. coli* for both samples (WB and TN) when compared with amoxicillin. The both activities were significantly different for both the samples. Antibacterial activity was more with roots followed by leaves, flowers and stem for sample collected from WB, whereas the same activity was significantly higher with leaves extract followed by flower, roots and stem extracts of MP collected from TN. The present study concluded that MP has potential antimicrobial activity but the activity depends on the geographical location and with the other environmental conditions.

### 1. Introduction

Herbalism involves the use of plants for medicinal purposes. India is a land of agriculture and the hub of medicinal plants. The quest for traditional natural herbs with medicinal properties continues to receive attention as scientists are in need of natural sources, especially ethnobotanical significance for a complete range of biological activities of the plants which ranges from simple fever to chronic diseases such as viral, cancer, etc. Therefore, all the causes and remedies are present in nature. Such a very common and serious one of the diseases causes by microorganisms. They are freely available in nature and can easily reach food during harvesting, processing, and packaging of the plant products and also food products (Hatab *et al.*, 2016). As a result, they cause food spoilage with many health related issues along with has been a significant safety concern to public health (Kirk *et al.*, 2017). There are many synthetic or chemical drugs available in market which are effective for certain time period but due to drug resistance or due to many unwanted side effects, people are rely on natural based products, i.e., herbal sources which are less toxic or having minimal side effects.

Of late, *Mimosa pudica* L. (MP) belongs to the family Fabaceae, is a creeping annual or perennial herb. The plant is widely available throughout the temperate zones especially in the road sides of India. The plant is well known as sensitive plant, shame plant, sleeping grass, touch me not, and many other names with having fascinating behavior (Kumar *et al.*, 2009). Traditionally, whole MP plants are used as medicines. The plant leaves, flowers, stems, roots, and fruits are used in the treatment of leprosy, dysentery, vaginal and uterine complaints, inflammations, burning sensation, asthma, leucoderma, fatigue and blood pressure. It is very useful in diarrhea, amoebic dysentery, bleeding piles and urinary infections (Chauhan *et al.*, 2009). It has potent pharmacological activities like antidiabetic, antitoxin, antihepatotoxin, antioxidant and wound healing activities (Meenatchisundaram *et al.*, 2009). Apart from that, many research articles reported its antioxidant, antimicrobial, anti-venom, anti-convulsant, antiulcer, Antihyperglycemic activities (Gandhiraja *et al.*, 2009; Ngo Bum *et al.*, 2004; Chowdhury, 2008; Meenatchisundaram *et al.*, 2009; Aarthi and Murugan, 2011; Elango *et al.*, 2012). These activities are mainly due to the presence of various plant secondary metabolites such as the presence of bioactive constituents like terpenoids, flavonoids, glycosides, alkaloids, quinines, phenols, tannins, saponins and coumarin (Gandhiraja *et al.*, 2009). It was reported that herbs included all the plant parts like leaves, roots, stem, flowers, fruits and seeds which shows various therapeutic activities. Therefore, in the present study, whole parts of MP were selected and compared for one specific activity. Furthermore, cultural condition also affects the constituents present in the plant. Many

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research literatures are evident of that condition and because of that the therapeutic activities are also affects for the particular plant species (Stanton-Geddes *et al.*, 2012; Mohiuddin, 2019). Focusing the same idea, the present study was carried out by selected the said plant from two different cultural conditions, *viz.*, West Bengal (WB) and Tamil Nadu (TN). The composition of biologically active compounds of medicinal plants varies widely depending on the plant species, soil type and on their association with microbes (Zhu *et al.*, 2009; Zhao *et al.*, 2011; Morsy, 2014). Therefore, antimicrobial activity of the given plant collected from two different cultural conditions was selected. As the herbs include various parts of the plant, therefore, it was worth while to select whole plant parts for the effective evaluation of antimicrobial activity.

## 2. Materials and Methods

### 2.1 Collection of plant material

The whole MP plants leaves were collected from two different cultural zones (Srirampur, West Bengal and Hosur, Tamil Nadu) of India. The graphical positions of these two areas were highlighted, *i.e.*, Srirampur, West Bengal (Longitude 88° 20' 18.6324' E and latitude 23° 24' 12.0204' N) and Hosur, TN (77° 49' 45.6168' E longitude and 12° 44' 6.4536' N latitude) (Figure 1). The plant was identified and authenticated by a plant taxonomist, Dr. P. E Rajshekharan, IIHR, Bengaluru and preserved with the voucher specimens (KCP-PCOG/MP-1/322/2021-22 and KCP-PCOG/MP-2/

322/2021-22) separately in the Department of Pharmacognosy, Krupanidhi College of Pharmacy, Bengaluru, in the herbarium.

### 2.2 Preparation of plant crude extracts

The MP plants were washed with distilled water and air dried at room temperature for 2 weeks. Then, all the parts were separated and coarsely powdered. Labelled them separately and stored in to the plastic sealed cover to resist moisture or microbial contamination till further used for the experimental purpose.

The ethanol, aqueous and hydroalcoholic mixture (2:1) were used as solvent for the extract preparation. Each 200 g of powdered drugs were used for the extraction using Soxhlet method at temperature 40° C for 4 h. The extracts were filtered separately through whatman filter paper No 42. Further, concentrated to a thick viscous crude from using rotary evaporator (Heidoph 4001 efficient), warmed on water bath at 70°C for the aqueous extract and temperature of 50°C for methanol, and hydroalcoholic mixture (2:1) to obtain semi-solid crude extracts.

### 2.3 Phytochemical screening

Phytochemical screening for the MP plant extracts were performed separately to determine the presence of bioactive components such as alkaloids, glycosides, tannins, saponins, terpenoids, flavonoids, and sterols using the method described in the literature (Donkor *et al.*, 2016; Jagetia and Lalmangaihi 2018).

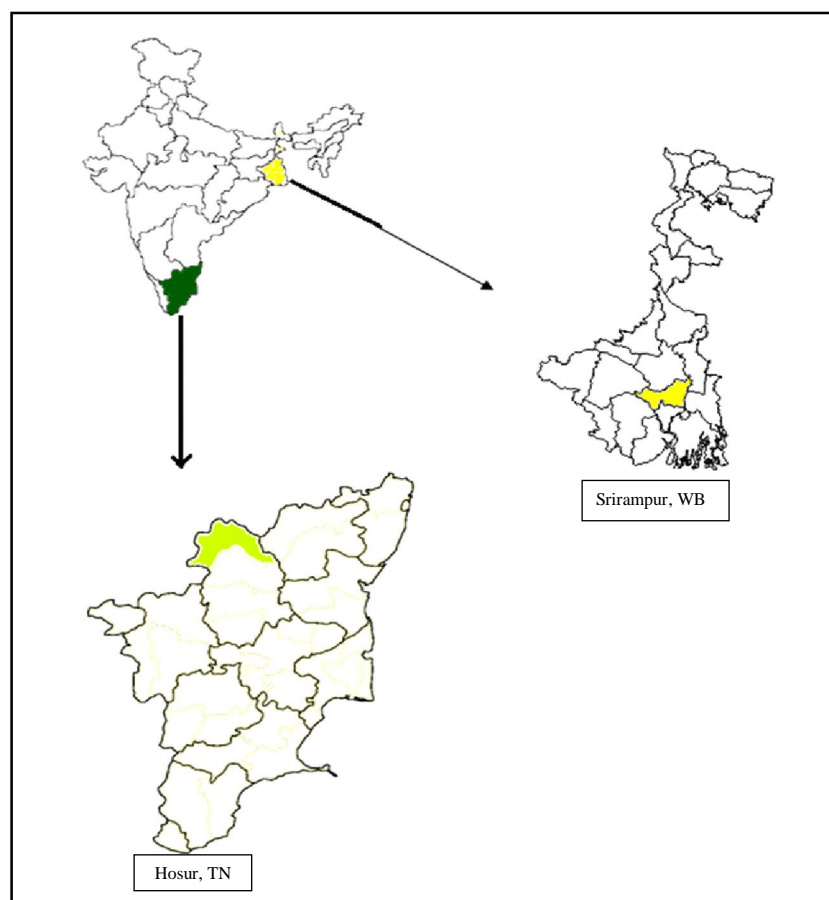


Figure 1: Two different states for MP plant collection.

## 2.4 Test organism

Four bacterial species were considered, two Gram-positive bacteria such as *Bacillus subtilis* ATCC 6633, *Staphylococcus aureus* ATCC 29726, and two Gram-negative bacteria, *Pseudomonas aeruginosa* ATCC 25619, and *Escherichia coli*. Clinical isolates of these microorganisms were obtained from the Department of the Microbiology, Maharani College, Bengaluru and they were maintained on nutrient broth at 2°C.

## 2.5 In vitro antimicrobial activity

The modified agar well diffusion method was applied with 6 mm sterile borer and the study was conducted as per the method described in the literature (Holder and Boyce, 1994). About 20 ml of molten Mueller Hinton agar was poured into a sterile Petri plate (Himedia, Mumbai, India). The plates were allowed to solidify, after 18 hours (OD adjusted to 0.6), 100 µl of above said type strains were transferred onto plate and made culture lawn by using sterile L-rod spreader. After 10 mins, a sterile cork borer was used to make wells on the agar plate with diameter 6 mm. The plant extracts were dissolved in sterile saline and loaded into wells with various concentrations (25, 50, and 75 µg/well). Amoxicillin (20 µg/ml) was used as positive control. The plates were incubated at 37°C for one day in a 40W florescent light source (~ 400 nm). The diameter of the zone of inhibition around the well was measured using antibiotic zone scale (Himedia, Mumbai, India) to find the antibacterial activity.

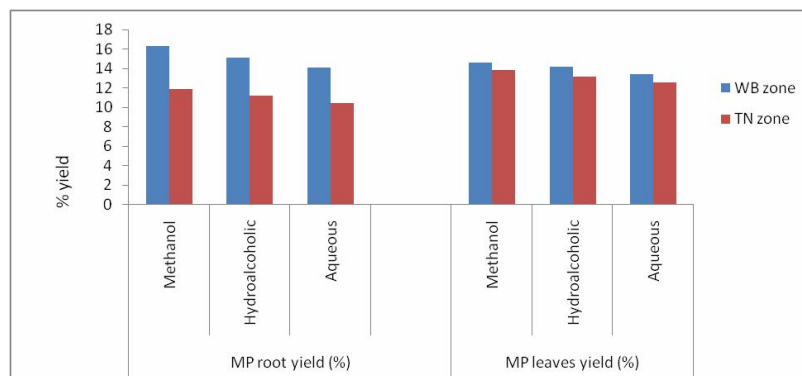
## 2.6 Preparation of plates

The diluted all the extracts were added separately to the melted and cooled medium in a ratio of 1 part extract sample agent to 9 parts medium (2.5 ml of plant extract mixed with 17.5 ml of Mueller Hinton agar media for each petri plate). Amoxicillin was used as control for the study.

**Table 1: Yield (w/w) of the MP plant in various extracts**

Solvents	MP extract (WB sample) (w/w)				MP extract (TN sample) (w/w)			
	Roots	Leaves	Flower	Stem	Roots	Leaves	Flower	Stem
Methanol	32.6	29.1	26.4	22.3	23.8	27.6	25.2	21.7
Aqueous	28.2	26.8	22.6	19.4	20.8	25.0	23.2	18.7
Hydroalcohol	30.2	28.3	24.7	20.8	22.3	26.2	24.1	20.1

In Figure 2, only higher percentage of yield from both the soil zones are depicted for the MP plant extracts whereas other parts such as flowers, stem are not shown due to less content of yields.



**Figure 2: % yield of the MP samples collected from two different zones.**

## 2.7 Inoculum preparation for minimum inhibitory concentration (MIC) and minimum bactericidal concentrations (MBC)

Inocula for selected test organisms were collected from an overnight agar culture. Inoculum was prepared for both the MIC and MBC experimentation by taking at least three well isolated colonies of the same agar plate culture. The surface of the bacterial colony was touched with a sterile loop and the loop was transferred into a tube containing 5 ml of normal saline and then vortexed. The broth culture was incubated at 37°C and monitored for 4 h until it achieved the turbidity of 0.5 McFarland standard ( $1.5 \times 10^8$  cfu/ml). The lowest concentration revealed no visible bacterial growth after sub-culturing was taken as MBC.

## 2.8 Statistical analysis

Means and SEM (standard error of the mean) were calculated for the zones of inhibition for the two sets of experiments. These means were statistically compared using the one-way ANOVA to determine the significant different at  $p < 0.05$ . The MIC and MBC were analyzed by one-way analysis of variance of ANOVA.

## 3. Results

### 3.1 Yield and phytochemical screening

The yields of the results from the conducted experiment were tabulated in Table 1. It was observed that highest yield in methanol extract followed by hydroalcoholic and aqueous extracts of the MP plants collected from the two different zones but the yield were varied with the parts. The methanol root extracts showed higher than other parts of MP plant collected from WB zone whereas, the same was showed higher with methanol leaves extract followed by flower, roots and stem extracts of MP plant collected from TN zone (Figure 2).

Phytochemical screening for all the extracts was carried out separately and result obtained that maximum amount of phytochemical groups are present in the MP plants collected from WB zone than TN zone but the interesting observation recorded that methanol extract followed by hydroalcoholic extract and aqueous extract gave the

prominence presence of the bioactive groups such as alkaloids, flavonoids, saponins, sterols, flavonoids, tannins and glycosides which was followed the similar results for the MP samples collected from both the zones. In Table 2, root extracts of WB sample and leaves extracts of TN samples were depicted.

**Table 2: Phytochemical screening of MP extracts collected from WB and TN zones.**

Phytochemicals	WB sample			TN sample		
	Methanol extract (Root)	Hydroalcoholic extract (Root)	Aqueous extract (Root)	Methanol extract (Leaves)	Hydroalcoholic extract (Leaves)	Aqueous extract (Leaves)
Glycoside	++	+	+	++	+	+
Alkaloids	+++	++	+	++	++	+
Tannins	++	+	--	+	+	--
Flavonoids	++	+	+	++	+	+
Sterols	++	+	+	++	+	+
Phenolics	++	+	+	++	+	+
Saponins	--	--	--	++	+	--
Terpenoids	--	--	--	--	--	--
Resins	--	—	--	--	--	--
Proteins	++	++	+	++	+	+
Lipids	--	--	—	--	--	--

(+++)= Prominent; (++) = Medium ; (+) = very less present; (--)= Absent

**Table 3: Antibacterial activity of MP extracts of two different zones**

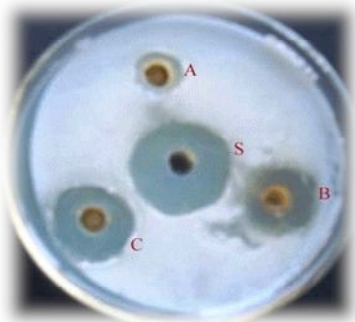
Organisms	Conc (µg/ml)	Zone of inhibition (mm)					
		MP of WB (Meth. root)	MP of WB (Hydro-alcoholic root)	MP of WB (Aqu. root)	MP of TN (Meth. leaves)	MP of TN (Hydro-alcoholic leaves)	MP of TN (Aqu. leaves)
SA	25	12.4 ± 0.01**	12.3 ± 0.13**	10.2 ± 0.30**	11.40 ± 0.14**	10.8 ± 0.11**	9.0 ± 0.31*
	50	14.8 ± 0.20***	13.8 ± 0.12**	10.4 ± 0.21**	12.32 ± 0.20***	12.2 ± 0.13**	9.2 ± 0.31*
	75	17.4 ± 0.01***	15.2 ± 0.31***	11.6 ± 0.20**	14.4 ± 0.11***	14.2 ± 0.31***	10.2 ± 0.31**
BS	25	13.2 ± 0.22**	11.0 ± 0.26**	9.78 ± 0.14*	10.8 ± 0.30*	9.6 ± 0.61*	9.0 ± 0.31*
	50	13.7 ± 0.41***	11.4 ± 0.20**	10.21 ± 0.22**	11.6 ± 04**	10.2 ± 0.21**	9.8 ± 0.31*
	75	14.2 ± 0.10***	12.3 ± 0.24***	11.4 ± 0.03*	12.0 ± 31**	11.1 ± 0.01**	10.2 ± 0.31**
EC	25	9.82 ± 0.43*	9.01 ± 0.30*	8.03 ± 0.01*	11.02 ± 0.22**	9.0 ± 0.30*	8.3 ± 0.11*
	50	10.6 ± 0.13**	9.33 ± 0.41*	8.21 ± 0.24*	11.62 ± 0.11**	9.2 ± 0.31*	9.0 ± 0.21*
	75	12.7 ± 0.30**	10.8 ± 0.20**	9.8 ± 0.20**	12.4 ± 0.04***	10.2 ± 0.31**	9.2 ± 0.32**
PA	25	8.9 ± 0.36*	7.4 ± 0.26*	7.0 ± 0.33*	8.6 ± 0.51*	7.3 ± 0.34*	7.2 ± 0.12*
	50	9.1 ± 0.61*	7.9 ± 0.26*	7.2 ± 0.54*	9.10 ± 0.24*	8.0 ± 0.01*	8.0 ± 0.41*
	75	10.23 ± 0.14**	8.10 ± 0.01*	8.01 ± 0.20*	9.5 ± 0.01*	8.2 ± 0.32**	8.3 ± 0.34**
S	20	26.8 ± 0.01	26.2 ± 0.03	26.4 ± 0.11	25.8 ± 0.22	25.1 ± 0.32	25.2 ± 0.02

The results represent mean ± standard error of mean (n = 3). SA = *Staphylococcus aureus*, BS = *Bacillus subtilis*, EC = *Escherichia coli*, PA = *Pseudomonas aeruginosa*. S = Amoxicillin. Data were analyzed by one-way ANOVA, followed by Dunnett comparison test against standard Ampicillin. Values were considered significant at \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ .

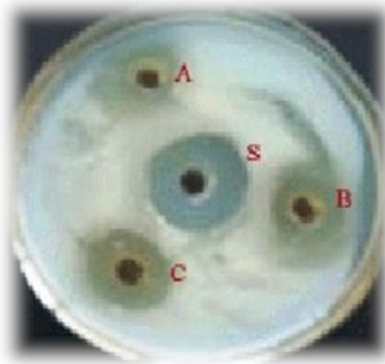
Leaves, flowers and stems extracts of MP sample (WB zone) showed the presence of alkaloids, flavonoids, sterols, tannins and phenolics medium to less amount whereas, the same also present in less to very less amount in roots, flowers and stems of MP sample collected from TN zone (Results not tabulated).

### 3.2 Antibacterial study

All the three different extracts from two different zones revealed potential antibacterial activity to all the tested micro-organisms. Among them, methanol extract showed higher activity than other two solvent extracts and the same trend followed for both the MP plants collected from the separate zones. In WB sample, methanol root extract showed higher activity in terms of zone of inhibition (in mm) ( $17.4 \pm 0.01$ ), followed by hydroalcoholic ( $15.2 \pm 0.31$ ) and aqueous extracts ( $11.6 \pm 0.20$ ) against *S. aureus*, respectively. Similarly, methanol extract showed maximum inhibition zone with diameter of  $12.7 \pm 0.30$  mm in *E. coli* and  $10.23 \pm 0.14$  mm in *P. aeruginosa*. The same trend followed for the MP sample collected from TN zone, but the leaves part showed higher activity than root and others. More specifically, methanol extract represented higher antibacterial activity against all bacterial strains (Table 3, Figures 3 and 4). Other extracts were also carried out for antibacterial activity, but the results were not presented in Table 3.



**Figure 3: Methanol root extract against SA (WB sample)**  
S = Standard.



**Figure 4: Methanol leaves extract against SA (TN sample)**  
S = Standard.

A = 25 µg/ml; B= 50 µg/ml; C = 75 µg/ml A = 25 µg/ml; B= 50 µg/ml; C = 75 µg/ml

The results represent mean  $\pm$  standard error of mean (n=3). SA= *Staphylococcus aureus*, BS = *Bacillus subtilis*, EC = *Escherichia coli*, PA = *Pseudomonas aeruginosa*. S = Amoxicillin. Data were analyzed by one-way ANOVA, followed by Dunnett comparison test against standard ampicillin. Values were considered significant at \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$

### 3.3 MIC and MBC

The MIC and MBC were determined against all the causative microorganisms for all the different extracts separately for both the states (WB and TN). Results showed very interesting data where methanol extract showed lower MIC value against *S. aureus* (19.2 µg/ml) whereas the same was higher with *Pseudomonas aeruginosa* (30.6 µg/ml) for WB sample. The same trend followed with the TN sample where methanol MP extract showed lower MIC for *S. aureus* (20.1 µg/ml) and higher for *Pseudomonas aeruginosa* (34.2 µg/ml). Interestingly, MBC values for each case were higher than MIC (Tables 4 and 5, Figure 5).

**Table 4: MIC and MBC for the MP extracts for MP sample (WB)**

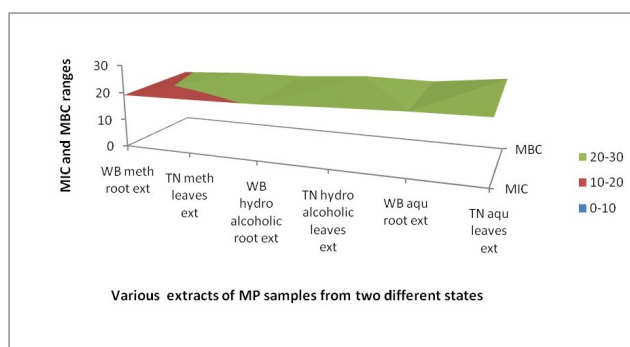
Root extracts	<i>Staphylococcus aureus</i>		<i>Bacillus subtilis</i>		<i>Pseudomonas aeruginosa</i>		<i>Escherichia coli</i>	
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC
Methanol extract	$19.2 \pm 0.23$	$19.8 \pm 0.21$	$19.3 \pm 0.14$	$20.8 \pm 0.24$	$30.6 \pm 0.24$	$31.7 \pm 0.21$	$27.6 \pm 0.21$	$28.2 \pm 0.20$
Hydroalcohol extract	$20.1 \pm 0.20$	$21.6 \pm 0.13$	$20.6 \pm 0.13$	$21.2 \pm 0.20$	$32.8 \pm 0.03$	$34.6 \pm 0.03$	$28.2 \pm 0.33$	$29.1 \pm 0.13$
Aqueous extract	$22.1 \pm 0.03$	$23.2 \pm 0.43$	$21.8 \pm 0.20$	$23.4 \pm 0.21$	$34.6 \pm 0.22$	$34.9 \pm 0.25$	$29.0 \pm 0.13$	$29.9 \pm 0.43$

Values are mean of triplicate readings (mean  $\pm$  SEM).

**Table 5: MIC and MBC for the MP extracts for MP sample (TN)**

Leaves extracts	<i>Staphylococcus aureus</i>		<i>Bacillus subtilis</i>		<i>Pseudomonas aeruginosa</i>		<i>Escherichia coli</i>	
	MIC	MBC	MIC	MBC	MIC	MBC	MIC	MBC
Methanol extract	$19.6 \pm 0.11$	$21.2 \pm 0.43$	$20.1 \pm 0.21$	$22.6 \pm 0.14$	$31.6 \pm 0.03$	$34.6 \pm 0.33$	$28.2 \pm 0.43$	$30.4 \pm 0.11$
Hydroalcohol extract	$21.2 \pm 0.15$	$23.4 \pm 0.33$	$21.6 \pm 0.13$	$23.2 \pm 0.03$	$32.4 \pm 0.20$	$36.7 \pm 0.13$	$28.6 \pm 0.21$	$32.6 \pm 0.21$
Aqueous extract	$22.6 \pm 0.03$	$26.0 \pm 0.20$	$23.1 \pm 0.16$	$26.4 \pm 0.20$	$34.2 \pm 0.21$	$36.3 \pm 0.26$	$30.2 \pm 0.20$	$33.7 \pm 0.20$

Values are mean of triplicate readings (mean  $\pm$  SEM).



**Figure 5: Comparison between different state MP samples of various extracts.**

#### 4. Discussion

The collected MP whole plants from two different states were extracted with three different solvents (methanol, hydroalcohol and aqueous) and separately collected the extracts. The yield of the crude extracts was estimated (w/w) and revealed higher yield with methanol sample. This was because of the bioactive compounds were maximum dissolved in the methanol sample than other two solvents which resulted higher yield. It was evident that when several solvents were used for the plant extraction, methanol among the solvent provided higher yield than others and also showed that content of total alkaloids, flavonoids were higher than other solvents (Dieu-Hieu *et al.*, 2019; Houda Lezoul *et al.*, 2020). The same trend followed in this research investigation. Thereafter, all the different extracts were investigated for the presence of phytochemicals and revealed the more prominently presence of phytochemicals in methanol extracts from both the state samples. It indicated that the methanol extract contained more bioactive constituents in the dissolved form. In WB sample, the methanolic root extract showed higher yield and also the presence of many active constituents when phytochemical screening was performed, whereas TN sample showed higher yield in methanolic leaves extracts followed by other extracts. This may be due to the soil nature and soil fertility. It was observed that acidic soil pH (5-6) enhance the availability of most micronutrients to plants and also favouring the plant growth (Loncaric *et al.*, 2008). In neutral to alkaline soils, although the availability of most macronutrients is increased, but the availability phosphorus and micronutrient availability is generally reduced and their lower levels can adversely affect plant growth (Jiang *et al.*, 2017). The same condition may occur in the present investigation. The MP sample from WB state especially the root showed more accumulation of soil nutrient as a result the availability of phytoconstituents showed higher in root part than other parts. In other hand, the soil nature of TN is neutral to alkaline with pH (7-8) and, hence accumulation of nutrients in root was less but cumulative accumulation occurred in the leaves part. Therefore, methanol leaves extract showed higher yield and prominent phytochemicals in the same. All the extracts particularly roots, and leaves of MP showed presence of alkaloids, glycosides, flavonoids, tannins, sterols in methanol extract which was similar with the earlier reports (Gandhiraja *et al.*, 2009; Ranjan *et al.*, 2013).

In the present day, bacteria are the most and very hazardous microorganism and Indian traditional medicinal plants are widely used to treat the microbial diseases due to their rich source of

antimicrobial activity, less side effects and also economic (Hemalatha *et al.*, 2013). Thereafter, in the present study, amoxicillin was used as standard against selected bacterial strains due to its broad spectrum nature which effective against for both Gram-positive and Gram-negative bacteria. In the present study, antimicrobial efficacy showed by the whole parts of MP plant because of its essential bioactive compounds. It was reported that the group of phytochemicals such as alkaloids, flavonoids, saponins, phenols, tannins, triterpenoids are commonly associated with combating microbial resistance and shows antimicrobial activity (Neog *et al.*, 2013; Thakur *et al.*, 2018; Thakur *et al.*, 2020). The differences in zone of inhibition may be come from the differences in antibacterial activity in that geographical area of plant collection, bacterial strains used, and the parts of the plant used for extraction (Berhanu, 2014). The same trend showed in the present study where root methanol extract showed higher zone of inhibition (WB sample) than the same plant root collected from TN source. Thereafter, leaves methanol extract of MP collected from TN State showed higher zone of inhibition than leaves methanol extract of WB sample. Hence, it indicated that cultural condition had significant role in any pharmacological activities.

Further, minimum inhibitory concentration (MIC) is the highest dilution or least concentration of the extracts that inhibit growth of organisms. MIC is important because it helps in confirming resistance of micro-organism to an antimicrobial agent and it monitors the activity of new antimicrobial agents. Thereafter, the MBC was determined by sub culturing the test dilution (used in MIC) on to a fresh solid medium and incubated further for 24 h. The concentration of plant extract at which completely killed the bacteria is MBC. Interestingly, it was observed that MBC values were higher than that of MIC values and also the Figure 5 demonstrated that confirmation. This indicated that the MP extracts are bacteriostatics at lower concentrations and bactericidal at higher concentrations. The same results were also reported by the earlier researchers (Omar *et al.*, 2010; Sen and Batra, 2012). Henceforth, the results of MIC and MBC of the MP plant extracts suggested that MP can be used to resist and prevent food borne bacteria and food poisoning diseases. *S. aureus* considered as the one of the most common sources of food borne disease while *B. subtilis*, *E. coli*, and *P. aeruginosa* produce toxins and other metabolites that induce GI diseases. MP extracts from both the states suppressing microbial growth of all tested bacterial strains which appear to be potentially effective against four bacterial strains (Mostafa *et al.*, 2018).

#### 5. Conclusion

Many herbal plant extracts scientifically proved to be potentially effective against wide ranges of bacterial species and natural alternative preventives to control food borne diseases and avoiding healthy hazards. In this study, methanol extract showed maximum antimicrobial activity, followed by hydroalcoholic and aqueous extracts, but the intensity of the effectiveness varied with the concentration while compared with the standard antibiotic salt-amoxicillin. Interestingly, cultural condition greatly has impact on potential therapeutic efficacy which revealed in this investigation. This research gives a scientific validation to the fact that bioactive components in the plant MP are extracted substantially in methanol solvent and exhibited highly promising antibacterial inhibitory activity.

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