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Evaluation of Three Medicinal Plants of Bangladesh for Antimicrobial Properties

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Authors' contributions

This work was carried out in collaboration among all authors. Authors TS and MSR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MAHO and MAH managed the analyses of the study. Authors MAHO and MAH managed the literature searches. Authors TS and MSR revised the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The methanolic crude extracts of *Wedelia chinensis* Osbeck. Merr. whole plant, *Mimosa diplotricha* Sauvalle. stem bark and *Bauhinia purpurea* Roxb. leaf as well as their organic and aqueous soluble partitionates were evaluated for antimicrobial potential.
Study Design: Evaluation of antimicrobial activity by disc diffusion method.
Place and Duration of Study: Phytochemical Research Laboratory, Department of Pharmacy, School of Health Science, State University of Bangladesh, from April to September, 2016.
Methodology: Accurate amount of test sample was weighed and dissolved in measured volume of solvent which was then applied to sterile discs. The discs were then carefully dried for the evaporation of the residual solvent. The Institute of Nutrition and Food Science (INFS) of University of Dhaka provided the bacterial and fungal strains used for the experiment. The strains were collected as pure cultures. In this investigation, ciprofloxacin (30 µg/disc) disc was used as the standard.

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Results: The highest 16.0 mm zone of inhibition was exhibited against *Vibrio parahemolyticus* by the carbon tetrachloride soluble fraction of methanolic crude extract of *W. chinensis*. The hexane soluble fraction showed 12.0 mm zone of inhibition against *Staphylococcus aureus*. The carbon tetrachloride soluble fraction of *M. diplotricha* exhibited the highest 14.0 mm zone of inhibition against *Pseudomonas aeruginosa*. This fraction also revealed 11.0 mm zone of inhibition against. *Bacillus megaterium*. 5.0 to 15.0 mm zone of inhibition was demonstrated by test samples of *B. malabarica*. The carbon tetrachloride soluble fraction of *B. malabarica* extract showed the highest (15.0 mm) zone of inhibition against *Salmonella typhi.*

Conclusion: From our investigation, it can be suggested that, the extractives can further be studied extensively to find out their efficacy.

Keywords: Wedelia chinensis Osbeck. Merr.; Mimosa diplotricha Sauvalle.; Bauhinia purpurea Roxb.; disc diffusion method; zone of inhibition; ciprofloxacin.

1. INTRODUCTION

According to the estimates of WHO, more than 80% of people in developing countries depend on traditional medicine for their primary health needs [1,2]. Use of herbal medicines is quite common among rural population due to high cost or unavailability of western medicines [2]. 78% of the new drugs approved by the FDA within the time frame between 1983 and 1994, are mainly derived from original natural products or semi-synthetic natural drugs [3,4]. Methodical assessment of plants used in traditional medicine for different diseases is necessary to meet the high requirement for drugs from plant sources. Therefore, evaluation of medicinal plants with significant biological activity is a challenge to be achieved [4,5].

Wedelia chinensis Osbeck. Merr. (Synonyms: *Solidago chinensis* Osbeck., *Verbesina calendulacea* L.) is a yellow-flowered perennial herb of sunflower family Asteraceae. In Bangladesh, the plant is recognized as Kesraj, Bangra, Bhimraj, Bhimra or Mahavringaraj and is available in Chittagong, Dhaka, Mymensingh, Patuakhali, Tangail and Nijum Deep. Commonly *W. chinensis* is known as Chinese Wedelia. Attenuation of androgen receptor activity and orthotopic growth of prostate cancer are documented activities of the plant extract [4,6]. The essential oil of *W. chinensis* can prevent cancer by reducing oxidative stress [4,7].

Synonyms of *Mimosa diplotricha* Sauvalle. are *Mimosa invisa* C. Mart., *Morongia pilosa* Standl. etc. The plant is a shrubby or sprawling annual vine and well recognized as giant sensitive plant. Belonging to the Fabaceae family, the plant is native to Brazil and is available in the Pacific since it has been introduced in all those island groups. A few cytotoxic flavones have been isolated from the plant [8].

Bengali names of *Bauhinia purpurea* Roxb. belonging to Caesalpiniaceae family, are Phutki, Kanchan, Karmai (Synonyms: *Bauhinia acida* Korth., *Casparea castrata* Hassk. Hassk. etc.). The plant is an erect low brushy tree. In Bangladesh, the plant is abundant in forests of Sylhet. Seven flavonols, including 6, 8-di-C-methyl kaempferol 3-methyl ether, kaempferol, afzelin, quercetin, isoquercitrin, quercitrin, and hyperoside have been isolated and characterized from the leaf extract [9]. Significant antioxidant activity has been reported from the bark extract [10]. From the roots of this species, Racemosol and demethylracemosol, together with their possible biogenetic precursors, preracemosol A and preracemosol B, were isolated [11].

It is our continuous effort to investigate the potential and available medicinal plants of Bangladesh [12,13]. As part of our endeavor, this time we have taken an attempt to assemble data obtained from the analyses of the crude methanol extracts of *W. chinensis* whole plant*, M. diplotricha* stem bark and *B. purpurea* leaves, growing in Bangladesh, as well as their organic and aqueous soluble partitionates for antimicrobial activity.

2. MATERIALS AND METHODS

2.1 Collection of Plant Materials and Extraction

The whole plant of *W. chinensis,* stem bark *of M. diplotricha* and leaves of *B. malabarica* were collected in March 2012 from Dhaka and voucher specimens for these collections have been deposited in Salar Khan Herbarium, Department of Botany, University of Dhaka.

Table 1. Kupchan partitioning of *W. chinensis, M. diplotricha* and *B. malabarica*

Crude extract/ Fractions	*W. chinensis* (g)	*M. diplotricha* (g)	*B. malabarica* (g)
ME	5.0	5.0	5.0
HXSF	1.0	1.3	1.0
CTCSF	1.5	0.8	1.0
CSF	1.0	0.5	0.5
AQSF	0.5	1.5	1.5

ME= Methanolic crude extract; HXSF= Hexane soluble fraction; CTCSF= Carbon tetrachloride soluble fraction; CSF= Chloroform soluble fraction; AQSF= Aqueous soluble fraction

The collected plant materials were cleaned, sun dried and pulverized. The powdered materials (500 g each) of the collected plants were separately soaked in 2.0 liters of methanol at room temperature for 7 days. The extracts were then filtered through fresh cotton bed and finally with Whatman filter paper number 1 and concentrated with a rotary evaporator at reduced temperature and pressure. An aliquot (5 g) of each of the concentrated methanol extract was fractionated by the modified Kupchan partition protocol [14] and the resultant partitionates were evaporated to dryness with rotary evaporator to yield hexane (HXSF), carbon tetrachloride (CTCSF), chloroform (CSF) and aqueous (AQSF) soluble materials (Table 1 above). The residues were then stored in a refrigerator until further use.

2.2 Antimicrobial Screening

Antimicrobial activity of the crude methanol extract and its different fractionates was determined against gram positive and gram negative bacteria and fungi by the disc diffusion method [15].

2.3 Statistical Analysis

For all bioassays, three replicates of each sample were used for statistical analysis and the values are reported as mean ± SD.

3. RESULTS AND DISCUSSION

The crude methanol extracts of *W. chinensis* whole plant*, M. diplotricha* stem bark and *B. purpurea* leaves, growing in Bangladesh, as well as their organic and aqueous soluble partitionates [4] were involved in the screenings for efficacy to postpone the microbial growth by disc diffusion method and the findings of the study are showed in Tables 2, 3 and 4.

Table 2. Antimicrobial activity of *W. chinensis, M. diplotricha and B. malabarica* extractives against gram positive bacteria

	Diameter of zone of inhibition (mm)				
Test samples	***Bacillus cereus***	***B. megaterium***	***B. subtilis***	***Staphylococcus aureus***	***Sarcina lutea***
W. chinensis					
ME	-	8.0±0.58	-	-	7.0±0.34
HXSF	7.0±0.43	-	10.0±0.32	12.0±0.76	8.0±0.95
CTCSF	-	-	9.0±0.72	-	-
CSF	-	7.0±0.95	-	8.0±0.66	-
AQSF	-	-	-	-	-
M. diplotricha					
ME	-	8.0±0.66	-	-	-
HXSF	6.0±0.52	-	-	-	-
CTCSF	-	11.0±0.55	-	7.0±0.26	6.0±0.44
CSF	8.0±0.43	-	-	-	7.0±0.81
AQSF	-	-	-	-	-
B. malabarica					
ME	-	-	7.0±0.33	-	5.0±0.14
HXSF	-	5.0±0.63	-	-	-
CTCSF	10.0±0.82	-	-	7.0±0.22	7.0±0.26
CSF	-	7.0±0.54	-	-	-
AQSF	-	-	-	-	-
CF (30 µg/disc)	45.0±2.01	42.0±1.17	42.0±0.73	42.0±0.56	42.0±0.13

ME= Methanolic crude extract; HXSF= Hexane soluble fraction; CTCSF= Carbon tetrachloride soluble fraction; CSF= Chloroform soluble fraction; AQSF= Aqueous soluble fraction; CF= Ciprofloxacin

Table 3. Antimicrobial activity of *W. chinensis, M. diplotricha and B. malabarica* extractives against gram negative bacteria

	Diameter of zone of inhibition (mm)							
Test samples	***Escherichia coli***	***Pseudomonas aeruginosa***	***Salmonella typhi***	***S. paratyphi***	***Shigella boydii***	***S. dysenteriae***	***Vibrio mimicus***	***V. parahemolyticus***
W. chinensis								
ME	6.0±0.77	8.0±0.32	6.0±0.74	-	-	7.0±0.61	-	6.0±0. 81
HXSF	6.0±0.31	7.0±0.91	6.0±0.75	7.0±0.46	-	7.0±0.62	6.0±0.54	10.0±0.93
CTCSF	-	6.0±0.32	-	-	-	8.0±0.32	7.0±0.32	16.0±0.55
CSF	-	9.0±0.32	-	-	-	-	-	-
AQSF	-	-	-	-	-	-	-	-
M. diplotricha								
ME	7.0±0.32	-	-	-	8.0±0.32	7.0±0.32	-	-
HXSF	-	-	7.0±0.19	-	-	-	-	10.0±0.34
CTCSF	5.0±0.53	14.0±0.44	-	-	8.0±0.32	-	7.0±0.28	-
CSF	-	-	8.0±0.32	-	-	-	-	-
AQSF	-	-	-	-	-	-	-	-
B. malabarica								
ME	-		-	-	8.0±1.15	-	-	-
HXSF	-	-	-	-	-	-	-	-
CTCSF	9.0±0.61	-	15.0±0.95	-	-	10.0±0.36	10.0±0.54	8.0±0.44
CSF	-	7.0±0.55	-	-		10.0±0.74	-	-
AQSF	-	-	-	-	-	-	-	-
CF (30 µg/disc)	42.0±0.43	42.0±1.11	45.0±0.73	47.0±2.33	34. 0±0.58	42.0±0.22	35.0±0.44	40.0±0.53

ME = Methanol crude extract; HXSF = Hexane soluble fraction; CTCSF = Carbon tetrachloride soluble fraction; CSF = Chloroform soluble fraction; AQSF = Aqueous soluble fraction; CF= Ciprofloxacin

Table 4. Antimicrobial activity of *W. chinensis, M. diplotricha and B. malabarica* extractives against fungi

	Diameter of zone of inhibition (mm)		
Test samples	***Candida albicans***	***Aspergillus niger***	***Sacharomyces cerevacae***
W. chinensis			
ME	7.0±0.51	-	6.0±0.22
HXSF	8.0±0.22	-	10.0±0.36
CTCSF	8.0±0.65	-	7.0±0.88
CSF	-	-	-
AQSF	-	-	-
M. diplotricha			
ME	-	-	-
HXSF	6.0±0.48	-	8.0±0.63
CTCSF	-	6.0±0.22	-
CSF	7.0±0.57	-	5.0±0.41
AQSF	-	-	-
B. malabarica			
ME	-	-	-
HXSF	-	-	-
CTCSF	8.0±0.65	8.0±0.32	11.0±0.22
CSF	-	-	-
AQSF	-	-	-
CF (30 µg/disc)	38.0±0.49	37.0±0.64	38.0±0.30

ME= Methanolic crude extract; HXSF= Hexane soluble fraction; CTCSF= Carbon tetrachloride soluble fraction; CSF= Chloroform soluble fraction; AQSF= Aqueous soluble fraction; CF= Ciprofloxacin

W. chinensis test samples showed 6.0 to 16.0 mm zone of inhibition against the test organisms. *Vibrio parahemolyticus* was the organism against which the carbon tetrachloride soluble fraction showed the highest 16.0 mm zone of inhibition. The hexane soluble fraction showed 12.0 mm zone of inhibition against *Staphylococcus aureus.* This fraction also revealed 10.0 mm zone of inhibition against *Bacillus subtilis, Vibrio parahemolyticus* and *Sacharomyces cerevacae*.

In case of gram positive organisms, the highest 11.0 mm zone of inhibition was demonstrated against *Bacillus megaterium* by the carbon tetrachloride soluble fraction of *M. diplotricha*. 5.0 to 14.0 mm zone of inhibition was exhibited by *M. diplotricha* extractives against gram negative organisms. The carbon tetrachloride soluble fraction revealed the highest 14.0 mm zone of inhibition against *Pseudomonas aeruginosa*.

5.0 to 15.0 mm zone of inhibition was observed for the test samples of *B. purpurea* against the test organisms. The carbon tetrachloride soluble fraction of *B. purpurea* extract revealed the highest 15.0 mm zone of inhibition against *Salmonella typhi.* Against *Sacharomyces cerevacae*, the same fraction revealed 11.0 mm zone of inhibition.

4. DISCUSSION

The potential of whole plant of *W. chinensis,* stem bark *of M. diplotricha* and leaves of *B. malabarica* has been explored for antimicrobial activities in our investigation. The test samples revealed different extents of antimicrobial efficacies that can be correlated with their traditional uses or scientifically proven biological potencies of other plant parts.

Traditionally, the fruits, leaves and stem of *W. chinensis* are used in fever and infection [16]. The leaves are used in the treatment of cold [16,17], wounds and viral hepatitis [18,19]. All these traditional uses support our findings in terms of efficacy against microorganisms.

Mimosa plants have a history of use for the treatment of various ailments. Another species of the same genus *M. pudica* has been reported to have phytoconstituents responsible for antimicrobial activity [20]. Therefore, it could be estimated that antimicrobial potential in *M. diplotricha* extractives may also be due to the presence of similar phytoconstituents.

B. purpurea has traditional use in the treatment of dropsy, pain, rheumatism, convulsion, delirium, septicaemia, etc [21]. Findings in our investigation is quite promising for further systematic analysis to find the active constituents.

5. CONCLUSION

Plants are gifts of nature as sources of medicines but modern civilization has narrowed down the

number of medicinally important plants worldwide. It has been extensively observed and accepted that medicinal value of plants lies in the valuable phytoconstituents. Although studies on the evaluation of the crude plant materials are being conducted, many of the bioactive components present in the plants responsible for these activities are still unknown. The objective of the study was to evaluate the antimicrobial potentials of a few medicinal plants of Bangladesh. Our investigation may draw the conclusion that traditional plants may be considered as new sources of stable, biologically active components that can establish a scientific foundation for the use of these plants in modern medicine. Local ethnomedical preparations should be scientifically evaluated and this knowledge can be extended for future investigation into the field of pharmacology, phytochemistry, ethnobotany and other biological actions for drug discovery. It is evidently apparent from our study that all the extractives exhibited mild to moderate activity against the test organisms. Therefore, bioassay-guided fractionation and other analytical procedures must be involved to isolate and characterize the active phytocomponents accountable for this activity. These plants should also be screened for other bioactivities to broaden the possibilities of finding important natural medicines [22].

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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