(2001). J. Myan. Acad. Tech. I. 75 - 88

Antibacterial Activity of Selected Myanmar Medicinal Plants

Nwe Yee Win[1], Mar Mar Nyein[2], Nyunt Wynn[1], Win Myint[3], Saw Hla Myint[4] and Myint Khine[5]

1. Yangon Technological University. 2. Bacteriology Research Division DMR. 3.Research and Development, Department of Traditional Medicine. 4. Yangon University. 5. Myanma Scientific and Technological Department.

(Received 5 October 2000)

Abstract

Thirteen plants which are traditionally used for the treatment of dysentery and diarrhoea in Myanmar were selected and tested for antibacterial activity by using agar disc diffusion technique. Polar and non-polar solvents were employed for extraction of plants. The minimum inhibitory concentration (MIC) of the extracts with the most significant predominant activity were evaluated by plate dilution method. The plants *Eugenia jambolana, Quisqualis indica, Leucaena glauca and Euphorbia splendens* var. 1 were found to show significant antibacterial activity. It was also observed that extracts using non-polar solvents did not show any antibacterial activity and extracts using polar solvents showed antibacterial activity on tested bacteria, indicating that the active chemical compound responsible for the antibacterial action must be a polar soluble compound.

Keywords : Myanmar Medicinal plants; antibacterial activity; disc diffusion; MIC.

1. Introduction

Diverse medicinal plants are commonly used in many countries for the treatment of different illness conditions, discomforts, ailments and infectious diseases. Thus, different properties attributed to the plants are: antihypertensive, tonic, antipyretic, anti-diabetic, anti-cancer, diuretic, astringent, wound healing, anti-inflammatory, anti-microbial, antifertility and antiseptic etc. (Kirtikar & Basu, 1975; Tin Myo Ngway, 1972; Wee Yeow Chin & Hsuan Keng, 1990: Ashin Nagathein, 1971, 1972, 1973, 1976; Galvez *et. al.*, 1972). Unique among the medicinal plants, are those which contain pharmacological active

1. Corresponding author

constituents having antibacterial and antifungal properties. In Myanmar, in the treatment of dysentery and diarrhoea which occasionally break out in the rural areas, most of the rural people mainly rely on traditional medicinal plants rather than modern medicines. This social acceptance of herbal medicine among the majority of the people points to the fact that certain plants do have reliable curative powers, therefore noteworthy to conduct systematic and thorough investigation.

In this study thirteen indigenous plants claimed to be effective against abdominal disorders were extracted and their extracts were tested against various strains of microorganisms. The main microorganisms employed are *Shigella* and *Vibrio* species. *In-vitro* method was adopted to evaluate the affective antibacterial activity of the extracts.

2. Materials and Methods

Chemicals

Most of the chemicals employed in this investigation were from British Drug House Chemical Ltd. Poole, England, Difco Laboratories, Detroit, USA, and Becton Dickson and Co., Cockeyville, USA. All the chemicals were used as obtained unless otherwise stated. Petroleum spirit having a boiling range of 42-62 °C is a product of Myanmar Petroleum Enterprise and Ethanol 95% is also a local product.

Plant samples

The plant samples were collected from various localities of Yangon Division, during 1998, August to December.

Table 1 lists the common name, botanical name, family name, the part used, local method of administration, and their therapeutic use.

Preparation of crude extracts

Prior to extraction, the plant samples were all air- dried. Each specific sample (i.e., flower, leaves, roots, rinds) were ground and packaged. From each package, a representative sample (20 to 100g) was taken and subjected to solvent extraction. The solvents used were 95% ethanol, 50% ethanol, double distilled water, and petroleum spirit having a boiling range (42-62°C). Soxhlet apparatus was used for the extractions with petroleum sprit (42-62°C) and 95% ethanol. Normally the extraction time was 6 hrs.

Table 1. Plant materials : Local name, Scientific name, form of preparation and their uses

No.	Common Name	Botanical Name	Family Name	Part of the Plant Used	Preparation	Traditional uses
1.	Shazaung tinga neah	*Euphorbia splendens* var.1	Euphorbiaceae	leaf	chew, boiled	dysentery, diarrhoea, colic
2.	Shazaung tinga neah	*Euphorbia splendens* var.2	Euphorbiacease	leaf	chew, boiled	dysentery, diarrhoea, colic
3.	Tayoke sakar	*Plumeria rubra* Linn.	Apocynaceae	flower	salad	dysentery, earache
4.	Meekwin gamone	*Rhoeo discolor* Hance	Commelinaceae	leaf	boild, heated, salad, crushed	dysentery, haemoptysis, burn, cough, otorrhea
5.	Eikemwe thee	***Emb**elia robusta clarke*	Myrsinaceae	fruit	boiled,powdered	anthelmintic
6.	Nwa myet yin	***Cyp**erus species*	Cyperaceae	root	boiled,powdered, grind, embrocated	dysentery, inflammation, vomiting
7.	Oke shit	***Aegle** marmelos* Correa	Rutaceae	small fruit	fried, boiled	scabies, suppurating sores, abscess
8.	Yae htigayone	***Nep**tunia olerace* Lour.	Mimosaceae	whole plant	fried	dysentery, diarrhoea, hydruria
9.	Bawsakine	***Leu**caena glauca* Benth.	Mimosaceae	leaf	crushed, boild	diarrhoea, diuretic
10.	Mingood	*Garcinia mangostana* Linn.	Guttiferae	rind	boild,powdered	dysentery, ulcers, pain in the body
11.	Htawe mhine	*Quisqualis indica* Linn	Combretacease	leaf	salad, boiled	dysentery, chronic suppurating sores, piles
12.	Thapyay	*Eugenia jambolana* Lam	Myrtaceae	leaf	crushed	dysentery, diarrhoea, detoxication for scorpion's venom
13.	Ywetkya pinpauk	*Bryophyllum calycinum* Salisb.	Crassulaceae	leaf	crushed, heated	diarrhoea, wound, furuncle, suppurating sores

Two other extracts were prepared by using 50% ethanol and twice distilled water. The method of extraction was by simple refluxing of the samples in the specific solvents on a water bath. The extracts were evaporated to dryness at normal pressure on a water bath so that the temperature does not exceed 100°C and the dried extracts were stored in a desiccator. These dried extracts were employed for antibacterial activity testing.

Organisms

The antibacterial activity of the plant-extracts were tested using the strains as supplied by the Department of the Medical Research (DMR). The different strains used are listed in Table 2.

Table 2 Organism and their respective code numbers

No.	Organism	Code No
1.	*Escherichia coli* ATCC	ATCC 25922/DMR
2.	*Escherichia coli* LT	DMR-ID-6
3.	*Escherichia coli* EAEC	DMR-ID-7
4.	*Escherichia coli* EPEC	DMR-ID-32
5.	*Escherichia coli* ST	DMR-ID-5
6.	*Plesiomonas shigelloides*	DMR-ID-23
7.	*Proteus morganii*	DMR-ID-1
8.	*Shigella flexneri*	DMR-ID-46
9.	*Shigella dysenteriae*	DMR-ID-58
10.	*Salmonella typhi*	DMR-ID-3
11.	*Pseudomonas pyocyanea*	DMR-ID-74
12.	*Vibrio cholerae* 01	DMR-A 532
13.	*Salmonella typhi*	DMR-SEP-69
14.	*Shigella flexneri*	DMR-NGOH-11-2
15.	*Shigella Sonnei*	DMR-ID-56
16.	*Shigella boydii*	DMR-ID-22
17.	*Shigella flexneri*	DMR-ID-57
18.	*Shigella dysenteriae*	DMR-ID-25
19.	*Shigella boyii*	DMR-NOGH-36-4
20.	*Shigella flexneri*	DMR-MLD 26-5
21.	*Shigella dysenteriae*	DMR-NOGH-43-4

No.	Organism	Code No
22.	*Shigella flexneri*	DMR-MLD 19-1
23.	*Shigella flexneri*	DMR-NOGH-3-4
24.	*Shigella flexneri*	DMR-MLD 11-4
25.	*Shigella dysenteriae*	DMR-MLD 23a 4
26.	*Shigella sonnei*	DMR-MLD 8-7
27.	*Shigella dysenteriae*	DMR-30-1
28.	*Shigella boydii*	DMR-NGOH 41-5
29.	*Shigella flexneri*	DMR-MLD 25-4
30.	*Shigella dysenteriae*	DMR-MLD 15-4
31.	*Shigella dysenteriae*	DMR-MLD 32-5
32.	*Vibrio cholerae* 01	DMR-CD 2
33.	*Vibrio cholerae* 01	DMR-CD 7
34.	*Vibrio cholerae* 01	DMR-CD 8
35.	*Vibrio cholerae* 01	DMR-CD 14
36.	*Vibrio cholerae* 01	DMR-CD 24
37.	*Vibrio cholerae* 01	DMR-CD 29
38.	*Vibrio cholerae* 01	DMR-CD 34
39.	*Vibrio cholerae* 01	DMR-CD 38
40.	*Vibrio cholerae* 01	DMR-CD 53
41.	*Vibrio cholerae* 01	DMR-A 539-1
42.	*Vibrio cholerae* 0139	DMR-CD 10
43.	*Vibrio cholerae* 0139	DMR-CD 12
44.	*Vibrio cholerae* 0139	DMR-CD 13
45.	*Vibrio cholerae* 0139	DMR-CD 16
46.	*Vibrio cholerae* 0139	DMR-CD 20
47.	*Vibrio cholerae* 0139	DMR-CD 25
48.	*Vibrio cholerae* 0139	DMR-CD 35
49.	*Vibrio cholerae* 0139	DMR-CD 39
50.	*Vibrio cholerae* 0139	DMR-CD 42
51.	*Vibrio cholerae* 0139	DMR-CD 46
52.	*Vibrio cholerae* 0139	DMR-CD 49
53.	*Vibrio cholerae* 0139	DMR-CD 50
54.	*Vibrio cholerae* 0139	DMR-A 525-1
55.	*Staphylococcus aureus*	DMR-ID 15

Determination of antibacterial activity of the crude extracts

The antibacterial activity of the extracts were determined by the agar disc diffusion method (Cruickshank *et. al.*, 1975; Finegold & Martin , 1982; Mar Mar Nyein *et. al.*, 1991).

Screening was made by the use of impregnated paper discs. (8mm) discs, a product of Advantec, Japan, were sterilized by autoclaving and followed by dry heat at 60°C for 1hr. It was then impregnated with concentrated extracts and allowed to dry at 42°C in a air flow incubator. A few colonies of the organisms to be tested were introduced into the trypticase soy broth and incubated at 37°C for 3 hr to obtain the bacterial suspension of moderate cloudiness. The bacterial suspension was streaked evenly onto the surface of the Trypticase soy agar plates with sterile cotton swab. After the inoculum had dried (5 min), the dried discs were placed on the agar with flamed forceps and gently pressed down to ensure proper contact. A disc impregnated with solvent only was placed alongside the test discs for control and comparing purpose.

The plates were incubated immediately after inoculation and after 19 hrs of incubation at 37°C, the zone diameters including 8mm discs were measured.

Determination of minimum inhibitory concentration (MIC) of the extracts

The minimum inhibitory concentration (MIC) of the extracts were determined by plate dilution method (Finegold *et.al.*1978; Cruickshanks *et .al.*, 1975).

The active plant extracts were dissolved with their respective solvents (e.g. ethanolic extracts with ethanol) and diluted with Trypticase soy agar to obtain the following concentrations: 10; 5; 2.5; 0.63; 0.3 and 0.15 mg/ml.

The above solutions of varying concentration were poured each into a sterile petridish. Trypticase soy agar containing only the solvent was also prepared with a sterile petridish for control purposes.

Bacterial suspension was obtained by inoculation of few colonies of the organisms to Trypticase soy broth and incubated at 37°C for 3 hr. The bacterial suspension was streaked on to the surface of the prepared agar plates. Then the plates were incubated at 37°C for 19 hrs. After 19 hrs of incubation, the lowest concentration showing no growth of the organisms was taken to be the minimum inhibitory concentration (MIC) expressed in mg/ml. The experiments were repeated three times at exactly the same parameters, and mean results were taken.

3. Results and Discussion

The yield of plant extracts are shown in Table 3. Percentage values are represented on the basis dried materials.

Table 3 Yield Percentage (W/W) of crude extracts

No.	Plant	P.spirit%	95% ethanol%	50% ethanol%	Distilled water %
1.	*Euphorbia splendens* var.1	-	-	12.590	-
2.	*Euphorbia splendens* var.2	-	-	9.330	-
3.	*Plumeria rubra* Linn	-	-	13.500	-
4.	*Rhoeo discolor* Hance	2.070	11.190	6.480	6.580
5.	*Embelia robusta clarke*	13.260	9.160	7.110	4.130
6.	*Cyperus species*	4.930	5.620	4.440	5.290
7.	*Aegle marmelos* Correa	0.360	6.430	7.160	8.070
8.	*Neptunia olerace* Lour	2.620	13.430	10.130	8.680
9.	*Garcinia mangostana* Linn	2.090	9.450	8.800	9.530
10.	*Leucaena glauca* Benth	2.810	10.950	10.030	3.880
11.	*Quisqualis indica* Linn	1.680	3.920	9.790	17.410
12.	*Eugenia jambolana* Lam	1.410	7.850	8.900	12.870

The antibacterial activity of the extracts are shown in Table 4, 5 and 6. The measurable zone (i.e. diameter in mm) is a measure of the degree of antibacterial activity.

In Table 5 and 6 , of the thirteen plants, four plants (*Eugenia jambolana, Quisqualis indica, Laucaena glauca and Euphorbia splendens* var. 1) were found to show significant zone of inhibition exceeding other plants of Table 4, against a board spectrum of bacteria. The antibacterial activity of four plants (shown in terms of mean zone diameter) tested on 23 species of bacteria are to be seen in Table 6. The mean zone diameter of these plants were found to range from 11 to 26 mm. The remaining eight plants namely, *Euphorbia splendens* var.2, *Plumeria rubra, Rhoeo discolor, Embelia robusta, Cyperus species, Neptunia olerace, Garcinia mangostana, and Bryophyllum calycinum* showed only slight activity against avery narrow spectrum of bacteria as can be seen in Table 4.

One of the plants *Aegle marmelos* did not indicate any significant antibacterial activity as anticipated. It was also observed that the petroleum spirit extracts, which will yield non-polar or lipophilic substances based on the "Like dissolves like" rule, did not show any antibacterial activity on the tested bacteria strains, where as 95% ethanol extracts showed antibacterial

Table 4. Antibacterial activity of extracts (Mean zone diameter in mm)

No.	Plants	Extracts	Organisms*																												
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1.	*Euphorbia splendens* var 2	50% EtOH	-	-	-	-	-	-	-	15	-	-	-	16	-	-	-	12	-	12	21	10	12	-	-	-	-	-	-	-
2.	*Plumeria rubra* Linn.	50%EtOH	-	-	-	-	-	-	-	16	-	-	-	16	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Rhoeo discolor* Hance	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	11	-	-	-	10	-	-	-	13	NT	NT	11	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Embelia Robusta Clarke*	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	11	-	-	-	13-	-	-	-	10	-	-	13	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	12	-	-	-	12	-	-	-	13	NT	NT	16	-	-	-	-	-	-	-	-	-
		D/W	-	16	-	-	-	-	-	15	-	-	-	16	-	-	-	13	-	-	20	-	-	-	-	-	-	-	-	-
5.	*Cyperus species*	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	14		-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	15	-	-	-	15	-	-	-	13	NT	NT	16	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	*Aegle marmelos* Correa	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	10	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NT	-	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	*Neptunia olerace* Lour.	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	12	-	-	-	15	-	-	-	-	-	-	17	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	14	-	-	-	14	-	-	-	13	NT	NT	13	-	-	12	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.	*Garcinia mangostana* Lin	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	14	-	-	-	15	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	12	-	-	11	13	-	-	-	-	-	12	14	-	-	-	-	-	-	-	-	-
9.	*Bryophyllum calycinum* Salisb.	fresh juice	-	-	-	-	-	-	-	19	-	-	-	16	-	-	-	-	-	15	22	-	-	-	-	-	-	-	-	-

Table 4. (Contd.)

No.	Plants	Extracts	Organisms*																									
			29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1.	*Euphorbia splendens* var.2	50% EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	12	-	-	-	-	12
2.	*Plumeria rubra* Linn.	50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Rhoeo discolor* Hance	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Embelia robusta clarke*	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	10	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		D/W	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	*Cyperus species*	P-spint	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
6.	*Aegle marmelos* Correa	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	*Neptunia olerace* Lour.	P-spint	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	12	-	-	-	-	-
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	13	13	-	-	-	14
8.	*Garcinia mangostana* Lin	P-spirit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		95%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		50%EtOH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
		D/W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	*Bryophyllum calycinum* Salisb.	fresh juice	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5. Antibacterial activity of extracts (Mean zone diameter in mm)

No.	Plants	Extracts	Organisms*																										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1.	*Euphorbia splendens* var.2	50% EtOH	-	-	-	-	-	-	-	19	-	-	-	19	-	-	-	16	-	13	19	13	13	13	11	13	-	-	13	13
2.	*Leucaena glauca* Benth.	5%EtOH	-	-	-	-	-	-	-	16	-	-	-	20	-	-	-	10	-	13	13	-	-	-	-	-	13	-	10	-
		50%EtOH	-	-	-	-	-	-	-	19	-	-	-	22	-	-	-	14	-	14	21	15	14	14	11	12	18	-	16	14
		D/W	-	-	10	-	-	23	-	21	-	-	15	22	-	-	-	15	11	15	22	15-	15	15	14	14	15	-	15	14
3.	*Quisqualis indica* Linn.	95%EtOH	-	-	-	-	-	-	-	16	-	-	-	16	-	-	-	-	-	-	17	14	13	11-	12	12	12	-	12	12
		50%EtOH	-	-	-	-	-	-	-	21	-	-	-	21-	-	-	-	16	-	-	22	15	16	16	15	15	15	-	16	15
		D/W	-	-	-	-	-	-	-	20	-	-	-	20	-	-	-	14	-	-	20	14	15	14	12	12	12	-	13-	14
4.	*Eugenia jambolana* Lam.	95%EtOH	-	-	-	-	-	-	-	16	-	-	17	16	-	-	-	15	-	13	20	13	13	13	12	13	-	-	12	13
		50%EtOH	-	-	-	-	-	-	-	22	-	-	17	26	-	-	-	18	-	14	23-	15	15	15	14	16	15	-	14	15
		D/W	-	-	-	-	-	-	-	21	-	20	14	24	-	-	-	15	-	15	23	15	14	16	16	14	13	-	14	14

Table 5. (Contd.)

No.	Plants	Extracts	Organisms*																									
			29	30	32	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1.	*Euphorbia splendens* var.2	50% EtOH	14	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	-	16	12	-	-	-	11
2.	*Leucaena glauca* Benth.	95%EtOH	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	13	11	-	-	-	-
		50%EtOH	13	16	15	-	-	-	-	13	-	-	-	-	-	-	-	-	15	-	-	12	16	15	-	-	-	12
		D/W	16	16	12	-	-	-	-	15	-	-	-	-	-	-	-	-	15	-	-	12	14	14	-	-	-	14
3.	*Quisqualis indica* Linn.	95%EtOH	11	13	-	-	-	-	-	10	-	-	-	-	-	-	-	-	14	-	-	-	13	10	-	-	-	10
		50%EtOH	16	19	12	-	-	-	-	16	-	-	-	-	-	-	-	-	17	-	-	13	16	13	-	-	-	13
		D/W	14	16	10	-	-	-	-	12	-	-	-	-	-	-	-	-	14	-	-	13	14	12	-	-	-	12
4.	*Eugenia jambolana* Lam.	95%EtOH	14	13	12	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	13	12	-	-	-	12
		50%EtOH	15	15	15	-	-	-	-	14	-	-	-	-	-	-	-	-	16	-	-	13	18	14	-	-	-	13
		D/W	15	15	15	-	-	-	-	14	-	-	-	-	-	-	-	-	16	-	-	14	16	16	-	-	-	15

Table 6. Antibacterial activity of extracts (Mean zone diameter in mm)

			Organisms*																					
No.	Plants	Extracts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.	*Euphorbia splendens* var.2	50% EtOH	19	13	13	13	11	13	-	13	13	14	14	-	19	19	-	-	-	17	-	16	12	11	17
2.	*Leucaena glauca* Benth.	95%EtOH	13	-	-	-	-	-	13	10	-	-	-	13	16	20	-	-	-	13	-	13	11	-	-
		50%EtOH	21	15	14	14	11	12	18	16	14	13	16	15	19	22	-	13	-	15	12	16	15	12	26
		D/W	22	15	15	15	14	14	15	15	14	16	16	12	21	22	-	15	-	15	12	14	14	14	24
3.	*Quisqualis idica* Linn.	95%EtOH	17	11	13	11	12	12	12	12	12	11	13	-	16	16	-	10	-	14	-	13	10	10	12
		50%EtOH	22	15	16	16	15	15	15	16	15	16	19	12	21	21	-	16	-	17	13	16	13	13	24
		D/W	20	14	115	14	10	12	12	13	14	14	16	10	20	20	-	12	-	14	13	14	12	12	20
4.	*Eugenia jambolana* Lam.	95%EtOH	20	15	13	13	12	13	-	12	13	14	13	12	16	16	-	-	-	14	-	13	12	12	15
		50 %EtOH	23	15	15	15	14	16	15	14	15	15	15	15	22	26	-	14	-	16	13	18	14	13	24
		D/W	23	15	14	16	16	14	13	14	14	15	15	15	21	24	-	14	-	16	14	16	16	15	24

***Organisms**

1.	*Shigella boydill*	NOGH 36-4	9. Shigella boydill	NOGH 41-5	17. *Vibrio cholerae 01*	CD 29
2.	*Shigella flexneri*	MLD 26-5	10. Shigella flexneri	MLD 25-4	18. *Vibrio cholerae 0139*	CD 16
3.	*Shigella dysenteriae*	NOGH 43-4	11. Shigella dysenteriae	MLD 15-4	19. *Vibrio cholerae 0139*	CD 35
4.	*Shigella flexneri*	MLD 19-1	12. Shigella dysenteriae	NOGH 32-5	20. *Vibrio cholerae 013*	CD 39
5.	*Shigella flexneri*	NOGH 3-4	13. Shigella flexneri	ID-46	21. *Vibrio cholerae 0139*	CD 42
6.	*Shigella flexneri*	MLD 11-4	14. Vibrio cholerae 01	A 532	22. *Vibrio cholerae 0139*	A 525 - 1
7.	*Shigella dysenteriae*	MLD 23a-4	15. Vibrio cholerae 01	CD 14	23. *Staphylococcus aureus*	ID - 15
8.	*Shigella dysenteriae*	MLD 30-1	16. Vibrio cholerae 01	CD 24		

Table 7. Minimum inhibitory concentration of extracts (mg/ml)

No.	Plants	Extracts	Organisms*																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1.	*Euphorbia splendens* var.1	50% EtOH	0.63	5.00	0.63	10.00	10.00	10 00	2 50	0 63	1.25	10 00	0 63	2.50	1 25	1 25	>5	1 25	>5	1.25	>5	1.25	2.50	1.25
2.	*Leucaena glauca* Benth.	95%EtOH	5.00	10.00	10 00	10 00	10.00	10 00	10.00	5.00	10 00	10 00	5.00	10.00	2.50	2.50	>10	>10	>10	5.00	>10	5 00	10 00	10 00
		50%EtOH	0.63	2.50	1.25	2.50	2.50	2.50	5.00	2.50	5.00	2.50	2.50	5.00	2.50	2 50	>10	10	>10	5.00	10 00	2 50	2 50	2 50
		D/W	0.63	1.25	0.63	1.25	1.25	1.25	5 00	1.25	1 25	1 25	1 25	2.50	1 25	1 25	>10	1.25	>10	2.50	5 00	1.25	2.50	2.50
3.	*Quisqualis idica* Linn.	95%EtOH	1.25	2 50	1.25	5.00	5.00	5 00	5.00	1.25	2.50	5.00	2.50	5.00	1.25	1.25	10	5.00	>10	2 50	10 00	2.50	5.00	2.50
		50%EtOH	0.63	0.63	0.63	1.25	1.25	1.25	2.50	0 63	1.25	1.25	0.63	1.25	0 63	0.63	10	2.50	10	2 50	5 00	2.50	2.50	0.63
		D/W	0.63	1.25	1.25	1.25	1.25	1.25	2.50	1.25	1 25	1.25	0 63	2.50	1.25	1.25	>10	>10	>10	2.50	5.00	2.50	2.50	1.25
4.	*Eugenia jambolana* Lam.	95%EtOH	1.25	1.25	1.25	2.50	2 50	2.50	2 50	1.25	1.25	2.50	1.25	2.50	1.25	1.25	>10	10	>10	1.25	5.00	2.50	2.50	1.25
		50 %EtOH	0.63	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	2.50	1.25	1 .5	10	10	10	2 50	5.00	2.50	2.50	2.50
		D/W	0.63	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1 25	1 25	1.25	1.25	1 25	1 25	10	10	10	2.50	5.00	2.50	5.00	1.25

***Organisms**

1.	*Shigella boydii*	NOGH 36-4	9.	*Shigella boydii*	NOGH 41-5	17.	*Vibrio cholerae* 01	CD 29
2.	*Shigella flexneri*	MLD 26-5	10.	*Shigella flexneri*	MLD 25-4	18.	*Vibrio cholerae* 0139	CD 16
3.	*Shigella dysenteriae*	NOGH 43-4	11.	*Shigella dysenteriae*	MLD 15-4	19.	*Vibrio cholerae* 0139	CD 35
4.	*Shigella flexneri*	MLD 19-1	12	*Shigella dysenteriae*	NOGH 32-5	20.	*Vibrio cholerae* 0139	CD 39
5.	*Shigella flexneri*	NOGH 3-4	13.	*Shigella flexneri*	ID-46	21.	*Vibrio cholerae* 0139	CD 42
6	*Shigella flexneri*	MLD 11-4	14.	*Vibrio cholerae* 01	A 532	22.	*Vibrio cholerae* 0139	A 525-1
7.	*Shigella dysenteriae*	MLD 23a-4	15	*Vibrio cholerae* 01	CD 14			
8.	*Shigella dysenteriae*	MLD 30-1	16.	*Vibrio cholerae* 01	CD 24			

activity on a variety of bacteria strains. Therefore in this screening test, plants found to possess bactericidal activity can be attributed to the presence of polar substances. This finding is supported by the fact that subsequent test conducted with water and 50% ethanol extracts reveal a comparatively more pronounced activity.

The minimum inhibitory concentration (MIC) corresponding to the four plants which showed pronounced antibacterial activity are presented in Table 7.

As can be seen in Table 7, it was found that *Shigella* species were inhibited at lower concentrations than *Vibrio* species by the four antibacterially active plant extracts.

From this investigation, it can be deduced that four *plants (Eugenia jambolana, Quisqualis indica, Leucaena glauca,* and *Euphorbia splendens* var. 1) which showed significant activity against a wide spectrum of bacteria will also be effective in the treatment of dysentery and diarrhoea, where as other eight plants could have limited curing properties. It can also be concluded that our findings showed no significant discrepancies against the claims of traditional medicine, except for one plant , *Aegle marmelos* which showed no significant activity against the tested strains of microorganisms.

References

Ashin Nagathein (1971, 1972, 1973, 1976) : *Pon Pya Say Ah Bea Dan,*vol. 1-4 *(Myanmar version)* Mingalar Press, Yangon.

Cruickshank, R., Duguid, J.P., Marmior, B.P and Swain, R.H.A. (1975): *Medical Microbiology.* pp 196-203. Churchill Livingstone Ltd., London.

Finegold, S.M., Martin, W.J (1982): *Diagnostic Microbiology,* pp- 542-545. The C.V. Mosby Co., London.

Finegold, S.M., Martin, W.J. and Scott, E.G. (1978). *Diagnostic Microbiology.* pp- 398-391. The C.V. Mosby Co., London.

Galvez, J. *et.al* (1992) : Antidiarrhoeic activity of Euphorbia hirta extract and isolation of an active flavonoid constituent. *Planta Med.***59**, 333-335.

Kirtiker, K.R. and Basu, B.D. (1975): *Indian Medicinal plants.* **1-4**. International Book distributors and Sellers Ltd., Dehra Dun.

Mar Mar Nyein, Chit Maung. Mya Bwin and Tha. S.J. (1991): *In-vitro* testing of various indigenous plant extracts on human pathogenic bacteria. *Myanmar Hlth. Sci. Res. J.*, **3**, 89-99.

Tin Myo Ngway. (1972) : *Medicinal Plants of Burma.* **1**. Rangoon University Press, Higher Education, Ministry of Education, Burma.

Wee Yeow Chin and Hsuan Keng (1990): *An Illustrated Dictionary of Chinese Medicinal Herbs.* Time Edition Pte Ltd., Singapore.

Acknowledgement

One of the authors[1] wish to express her profound gratitude to Ministry of Science and Technology, to the Yangon Technological University for allowing to carry out this research programme, to Dr. Than Swe, former Director General, to Dr. Paing Soe, Director General, Department of Medical Research (Lower Myanmar) (DMR), Yangon, for their kind provision of the research facilities of the DMR, and also to Dr. Kyaw Myint Tun, Director General, Dapartment of traditional Medicine, Yangon, for allowing to carry out this research in his department.