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Full Length Research Paper

A study of phytochemical and antimicrobial screening of some medicinal plants in Nigeria

D. Kubmarawa[1]*, G. A. Ajoku[2], N. M. Enwerem[3] and D. A. Okorie[4]

[1]Department of Chemistry, Federal University of Technology, P. M. B. 2076, Yola, Adamawa State, Nigeria.
[2]Department of Pharmaceutical Microbiology, National Institute for Pharmaceutical Research and Development Abuja, Nigeria.
[3]Department of Medicinal Plant Research and Traditional Medicine, National Institute for Pharmaceutical Research and Development, Abuja, Nigeria.
[4]Department of Chemistry, University of Ibadan, Ibadan, Nigeria.

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Ethanolic extracts of 50 plant species were screened for their antimicrobial activity against *Bacillus subtilis*, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Candida albicans*. The results indicated that of the 50 plant extracts, 28 plant extracts inhibited the growth of one or more test pathogens. Four plant extracts showed a broad spectrum of antimicrobial activity. Phytochemical investigation revealed the presence of tannins, saponins, alkaloids, glycosides, flavonoids and essential oils.

Key words: Medicinal plant, antimicrobial activity, phytochemical, ethnomedicinal.

INTRODUCTION

Medicinal plants represent a rich source form which antimicrobial agents may be obtained. Plants are used medicinally in different countries and are a source of many potent and powerful drugs (Srivastava et al., 1996). The interest in the scientific investigation of these 50 medicinal plants from Nigeria is based on the claims of their effective use for the treatment of many diseases. Therefore, research into the effects of these local medicinal plants is expected to enhance the use of these plants against diseases caused by the test pathogens. However, most of these plants used in folk medicine have not been screened for their antimicrobial activity.

The active principles of many drugs found in plants are secondary metabolites (Ghani, 1990; Dobelis, 1993). Therefore, basic phytochemical investigation of these extracts for their major phytoconstituents is also vital. In the present study, the ethanolic extracts from 50 medicinal plants were screened for phytochemical constituents and antimicrobial activity against *Staphylococus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Candida albicans* and *Escherichia coli.*

*Corresponding author. E-mail: dkubmarawa@yahoo.com

MATERIALS AND METHODS

Plant material

Plants used for this study were collected in July 2001 at Riji in Adamawa State of Nigeria. All the plants were identified at Forestry Research Institute, Ibadan where their voucher specimens are deposited (Table 1).

Preparation of plant extracts

The plant materials were dried at room temperature and then powdered using a grinder. A sample (200 g) of each powdered plant material was soaked in ethanol (200 ml) for 24 h. At the end of the extraction, each extract was filtered using Whatman filter paper. The filtrate was concentrated in vacuum at 30^{o}C and stored at 4^{o}C until further use.

Phytochemical screening

Phytochemical screening for major constituents was undertaken using standard qualitative methods as described by Odebiyi and Sofowora (1990) and Fadeyi et al. (1989). The plant extracts were

Table 1. Phytochemical analysis of 50 medicinal plants.

S/N	Plant specie, voucher specimen number and family	Part used	Traditional use	Phytocompounds					
				S	G	T	F	A	V
1.	*Acacia albida* Del F.H.I. 36998 MIMOSOIDEAE	SB	Skin infections	-	-	-	-	-	+
2.	*Acadia nitolica* (Gull & Par) Kuntze F.H.I. 51743 MIMOSOIDEAE	SB	Sore throat	-	-	+	-	-	+
3.	*Acacia sebriana* DC F.H.I. 55744 MIMOSOIDEAE	RT	Swellings	+	-	+	-	-	-
4.	*Acacia Senegal* (Linn) Wild F.H.I. 93790 MIMOSOIDEAE	SP	Cough	+	+	+	-	+	+
5.	*Acacia tortilis* (Forssk) Hayne F.H.I. 23330 MIMOSOIDEAE	SB	Cough	+	+	+	+	+	+
6.	*Adansonia digitata* Linn F.H.I. 89479 BAMBACACEAE	AP	Diarrhoea	-	-	-	-	-	-
7.	*Afromosia laxiflora* Ex. BAK F.H.I. 50890 PAPILIONOIDEAE	SB	Tuberculosis	+	+	-	-	-	-
8.	*Afzelia africana* sm F.H.I. 40391 CAESALPINIOIDEAE	RT	Dysentry	-	-	-	-	-	-
9.	*Amblygonocarpus andogenesis* (Welv ex. div) F.H.I. 43238 MIMOSOIDEAE	SB	Breast cancer	+	+	-	-	-	-
10.	*Anogeissus leiocarpus* DC F.H.I. 16303 COMBRETACEAE	SB	Diarrhoea and dysentery	-	-	-	+	+	-
11.	*Anona senegalensis* Pers F.H.I. 66372 COMBRETACEAE	RT	Tooth ache	+	-	-	-	-	-
12	*Aristolochia albida* Ducha F.H.I. 96082 ARISTOLOCHIACEAE	RT	Malaria	-	-	-	+	-	-
13	*Balanites aegyptiaca* Ducha F.H.I. 94010 BALAITACEAE	RT	Swellings	+	-	+	-	-	+
14	*Boswellia dalzielii* Hutch F.H.I. 42474 BURSERACEAE	LF	Laxative	+	+	-	+	-	+
15	*Butyrospermum paradoxum* (Gaertn.f.) F.H.I. 83524 SAPOTACEAE	SB	Diarrhoeae	+	+	-	-	+	-

Table 1. Contd.

16.	*Callotropis procera* R. Br. F.H.I. 83524 ASCLEPIADACEAE	LF	Anti-scorpion bite	+	-	+	-	+	+
17.	*Cardiospermum grandiflorum* Swantz F.H.I. 57861 SAPINDACEAE	FR	Abortion	-	-	-	-	-	+
18.	*Ceiba pentandra* (L.) F.H.I. 54404 BOMBACACEAE	AP	Chest pain	+	-	+	-	+	+
19.	*Combtretum mole* R.Br. ex. G. DON F.H.I. 57804 COMBRETACEAE	SB	Diarrhoea	+	-	+	-	-	+
20.	*Commiphora kerstingii* Engl F.H.I. 24484 BURSERACEAE	SB	Laxative	+	-	+	-	-	+
21.	*Cyperus esculentus* L. F.H.I. 94028 CYPERACEAE	TB	Eye infection	-	-	-	-	-	+
22.	*Danillia olivera* (Rolf) Hutch & DALZ F.H.I. 46301 CAESALPINIOIDEAE	AP	Tuberculosis	+	-	-	-	+	+
23.	*Detarium macrocarpum* Guill & part F.H.I. 95105 CAESALPINIOIDEAE	SB	Wound infection	-	-	-	-	-	+
24.	*Dichostachys cinera* (Linn.) F.H.I. 28867 MIMOSOIDEAE	AP	Chest pain	+	-	+	-	-	+
25.	*Drospyros mespiliformis* Ex A.DC F.H.I. 99329 EBENACEAE	SB	Back pain	-	-	+	+	-	-
26.	*Ficus abotifolia* (miq) miq F.H.I. 35928 MORACEAE	SB	Whitlow	-	-	+	-	+	+
27.	*Ficus platyphylla* Del F.H.I. 37878 MORACEAE	SB	Tuberculosis	+	-	-	+	+	+
28.	*Ficus polita* Vahl F.H.I. 12197 MORACEAE	SB	Swellings	+	-	-	+	-	-
29.	*Ficus sycomorus* Linn F.H.I. 106574 MORACEAE	SB	Cough	-	+	+	+	-	+
30.	*Ficus thoningii* Blume F.H.I. 62204 MORACEAE	SB	Sore throat	+	-	-	-	-	+

Table 1. Contd.

31.	*Grewia venusta* FRES F.H.I. 56066 TILIACEAE	SB	Diarrhoeae	+	+	+	+	+	+
32.	*Haematotaphis barteri* Hook F.H.I. 106576 ANACARDIACEAE	AP	Cancer	-	-	+	+	-	+
33.	*Heeria insignis*(Del) Kuntze F.H.I. 106581 ANARCARDIACEAE	FR	Antivenom	+	-	-	-	-	-
34.	*Isorberlinia doka* Craib & Stapf F.H.I. 101396 CAESALPINIOIDEAE	SB	Cough	+	-	-	+	+	+
35.	*Isoberlinia tomentosa* (Harms) Craib & Stapf F.H.I. 106578 CAESALPINIOIDEAE	SB	Laxative	-	-	-	-	-	-
36.	*Jatropha curcas* L. F.H.I. 99933 EUPHORBIACEAE	RT	Gonorrhoeae	-	-	-	-	-	-
37.	*Khaya senegalensis* (Desr.) A. Juss F.H.I. 59961 MILLACEAE	SB	Skin infection	+	+	-	+	-	+
38.	*Nauclea diderichii* (Dewild & Th. Dur) Merril F.H.I. 57253 RUBIACEAE	SB	Malaria	-	-	-	-	-	-
39.	*Nauclea latifolia* (Dewild & Th. Dur) merrill RUBIACEAE	SB	Stomach ache	+	-	-	-	-	-
40	*Parkia clapertonia* Keay F.H.I. 18238 MIMOSOIDEAE	SB	Stomach ache	-	-	-	+	-	-
41.	*Piliostigma reticulatum* (DC.) Hochst F.H.I. 62529 CAESALPINIOIDEAE	RT	Jaundice	+	-	+	+	-	-
42.	*Sterculia setigera* Del F.H.I. 88356 STERCULACEAE	SB	Diarrhoea	+	-	-	+	+	+
43.	*Strychnos spinosa* Lam F.H.I. 35401 LOGANIACEAE	SB	Swellings	+	-	-	-	-	-
44.	*Syzigium guineense* DC F.H.I. 47959 MYRTACEAE	AP	Tuberculosis	-	-	+	+	-	+
45.	*Tamarindus indica* Linn F.H.I. 10658 CAESALPINIOIDEAE	SB	Sore throat	+	+	-	+	-	-

Table 1. Contd.

46.	*Terminalia avicenoides* GULL & PARR F.H.I. 10462 COMBRETACEAE	RT	Swellings	+	+	+	-	+	+
47.	*Vernonia amygdalina* Del F.H.I. 31597 COMPOSITAE	LF	Stomach ache	-	-	-	-	-	-
48.	*Vitex doniana* SWEET F.H.I. 106580 VERBENACEAE	SB	Eye infection	+	-	+	-	-	+
49.	*Ximenia Americana* Linn. F.H.I. 66336 OCACACEAE	LF	Tuberculosis	-	-	+	-	-	+
50.	*Zizyphus mauritiana* Lam F.H.I. 94010 RHAMNACEAE	SB	Wound infection	+	+	-	+	-	-

S =Saponins, G = glycosides, T = tannins, F = flavonoids, A = alkaloids, V= volatile oil, RT = roots, AP = aerial parts, LF = leaf, SB = stem bark, FR = fruits and TB = tubers.

screened for the presence of glycosides, alkaloids, tannins, flavonoids, saponins and essential oils.

Test organisms

The strains used for the investigation were: *B. subtilis*, (NCTC 8236) *E. coli*, (ATCC 9637) *S. aureus* (ATCC 13709) *P. aeruginosa* (ATCC 27853) *C. albicans* (ATCC 10231)

Antimicrobial activity

The Agar dilution method was used to determine the antimicrobial activity. The nutrient agar used to dilute the sample solution to required concentration was inoculated by surface streaking using a wire loop with test organisms. The plates were kept overnight in the incubator at 37^{o}C and observed for growth inhibition. Plates that had growth of the test organism inhibited at 2.0 mg/ml were further diluted in order to determine the minimum inhibitory concentrations (MIC).

Minimum inhibitory concentration (MIC)

The minimum inhibitory concentration (MIC) was observed after incubation at 37^{o}C for 24 h. a 1:20 dilution was prepared in normal saline from the overnight culture of each test organism containing approximately 5 x 10^{7} to 9 x 10^{7} cfu/ml of nutrient broth before inoculation. The lowest concentration of the sample required to inhibit the growth of the test organism was recorded for each organism as the minimum inhibitory concentration (MIC). The extracts were dissolved in dimethyl sulfoxide (DMSO).

RESULTS AND DISCUSSION

Preliminary phytochemical investigation revealed the presence of saponins, glycosides, tannins, alkaloids, volatile oils and flavonoids, as indicated in Table 1. The results showed that *Grewia venusta* and *Acacia tortilis* demonstrated the presence of all phytocompounds tested. The presence of some of these compounds has been demonstrated previously by other researchers. For example, the presence of alkaloids in the stem bark of *Sterculia setigera*, and the absence of tannins in the stem bark of *S. setigera* has been demonstrated (El-kheir and Salim, 1980; Tona et al., 1998). Similarly the absence of alkaloids in the stem bark of *Nauclea latifolia* has also being demonstrated (El-kheir and Salim, 1980; Tona et al., 1998). However some of the results obtained are not in agreement with the previous findings. For example alkaloids were found to be absent in the stem bark of *Anogeisus leiocarpus* which is contrary to the findings of Baowa et al. (1978) and Atal et al. (1978). This might be due to climatic and environmental factors.

The crude extracts of 50 medicinal plants were screened for their antimicrobial activity. Among the 50 plants tested 28 plants showed antimicrobial activity (Table 2). The minimum inhibitory concentration of 0.065 mg/ml was observed with crude extract of *Anona seneglensis* against *B. subtilis*. *S. aureus* was inhibited by nine plant extracts. The bacteria were most inhibited by the extract of *A. tortilis*, *Afromosia laxiflora* and *Terminalia avicen-noides* at MIC values of 0.25 mg/ml. Similarly, *E. coli* were inhibited by nine plant extracts. *A. tortilis* and *A. leiocarpus* inhibited the growth of all of the microorganisms. These plant extracts have the broadest spectrum of inhibition. Similarly, *A. laxilflora* inhibited the growth of all the bacteria tested, except the fungus *C. albicans*.

The antimicrobial activity of some of these plants has been studied previously. The ethanol extracts of the stem bark of *Acacia albida* (Legrand et al., 1988) was found to

Table 2. Antimicrobial activities of the 50 medicinal plants.

S/No.	Plant species	MIC (mg/ml)				
		Ca	Sa	Ps	Bs	Ec
1.	*Acacia albida*	-	0.50	1.0	2.0	-
2.	*Acacia nilotica*	-	-	-	-	-
3.	*Acacia sebriana*	-	-	-	-	-
4.	*Acacia Senegal*	-	2.0	2.0	2.0	-
5.	*Acacia tortilis*	0.50	0.25	2.0	2.0	2.0
6.	*Adansonia digitata*	-	-	-	-	-
7.	*Afromosia laxiflora*	-	0.25	2.0	0.25	2.0
8.	*Afzelia africana*	-	-	-	-	-
9.	*Amblygonocarpus andogenesis*	-	-	-	2.0	-
10.	*Anogeissus leiocarpus*	0.50	0.50	2.0	1.0	1.0
11.	*Anona senegalensis*	0.25	-	-	0.0635	1.0
12.	*Aristolochia albida*	-	1.0	-	0.50	-
13.	*Balanites aegyptiaca*	-	-	-	-	-
14.	*Boswellia dalzielii*	-	-	-	-	0.50
15.	*Butyrospermum paradoxum*	0.125	1.0	-	0.50	2.0
16	*Callotropis procera*	-	-	-	-	-
17.	*Cardiospermum grandiflorum*	-	-	-	-	-
18.	*Ceiba pentandra*	-	-	-	0.50	-
19.	*Combretum mole*	-	1.0	2.0	0.50	-
20.	*Commiphora kerstingii*	2.0	-	-	1.0	1.0
21.	*Cyperus esculentus*	-	-	-	-	-
22.	*Danillia olivera*	-	-	-	-	-
23.	*Detarium macrocarpum*	-	-	-	-	-
24.	*Dichostachys cinera*	-	-	-	-	-
25.	*Drospyros mespiliformis*	-	-	-	-	-
26.	*Ficus abotifolia*	-	-	-	0.50	-
27.	*Ficus platyphylla*	-	-	-	1.0	-
28.	*Ficus polita*	-	-	-	-	-
29.	*Ficus sycomorus*	-	-	-	-	-
30.	*Ficus thoningii*	1.0	-	-	1.0	1.0
31.	*Grewia venusta*	-	-	-	0.50	1.0
32.	*Haemtotaphis barteri*	-	-	-	-	-
33.	*Heeria insignis*	-	-	-	1.0	-
34.	*Isoberlinia doka*	-	-	-	0.50	-
35.	*Isoberlinia tomentosa*	-	-	2.0	-	-
36.	*Jatropha curcas*	1.0	-	-	0.50	-
37.	*Khaya senegalensis*	-	-	-	-	-
38.	*Nauclea diderichii*	-	-	-	-	-
39.	*Nauclea latifolia*	1.0	-	-	0.50	1.0
40.	*Parkia clapertonia*	-	-	-	-	-
41.	*Piliostigma reticulatum*	-	-	-	-	-
42.	*Sterculia setigera*	-	-	2.0	1.0	-
43.	*Strychnos spinosa*	-	-	-	-	-
44.	*Sysigium quineense*	-	-	-	-	-
45	*Tamarindus indica*	-	-	-	1.0	-
46.	*Terminalia avicenoides*	-	0.25	2.0	1.0	2.0
47.	*Vernonia amygdalina*	-	-	-	-	-
48.	*Vitex doniana*	2.0	-	-	2.0	2.0
49.	*Ximenia Americana*	-	0.50	2.0	2.0	-
50.	*Zizyphus mauritiana*	-	1.0	-	0.50	-

- = No activity, M.I.C. = minimum inhibitory concentration, Ca = *Candida albicans* (ATCC 10231), Sa = *Staphlococcus aureus* (ATCC 13709), Ps = *Pseudomonas aeruginosa* (ATCC 27853), Ec = *Escherichia coli* (ATCC 9637), and Bs = *Bacillus subtilis* (NCTC 8236).

inhibit the growth of *S. aureus* and *B. subtilis*. The present finding on the extracts of *A. albida* is in agreement with the previous workers. Also, the ethanol extracts the root of *Balanites aegyptiaca* (Liu and Nakanishi, 1982) and the aerial parts of *Danillia olivera* (Awachic and Ugwu, 1997) was found to inhibit the growth of *B. subtilis*, while in the present study, both the extracts indicated no activity. These differences might also be attributed to the changes in environmental conditions.

The results obtained indicated the existence of antimicrobial compounds in the crude ethanolic extracts of these plants and some showed a good correlation between the reported use of these plants in traditional medicine against infectious diseases. For example the inhibition of *E. coli* by the extract of *A. leiocarpus*, *Botrychium paradoxum*, *Commiphora kerstingii*, *Ficus thoningii* and *G. venusta* has justified their use for the treatment of diarrhea and dysentery in the traditional medicine.

Conclusions

This study is a preliminary evaluation of antimicrobila activity of the plants. It indicates that several plants have the potential to generate novel metabolites. The crude extracts demonstrating anticandidal activity could result in the discovery of novel anticandidal agents. Similarly the plants demonstrating broad spectra of activity may help to discover new chemical classes of antibiotics that could serve as selective agents for the maintenance of health.

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