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Antidiarrhoeal Activities of Some Medicinal Plants

Garba S*, Salihu L and Shoge M

Department of Chemistry, Nigerian Defence Academy, Kaduna, Nigeria

Abstract

The phytochemical screening, extraction and antimicrobial analysis of the crude extracts from the seeds and pods of *Acacia nilotica* Linn, the roots of *Uvaria afzelii* Sc and *Terminalia avicennioides* Guill & Perr were carried out using standard methods. The results of the phytochemical screening showed that the plants contained saponins, flavonoids, phenols, tannins, terpenoids and triterpenoids. The results of the antibacterial screening showed that the ethyl acetate extract of *Acacia nilotica* Linn exhibited the highest activities against the test microbes with zones of inhibition diameter ranging from 27-32 mm. It was closely followed by the ethyl acetate extract of *Terminalia aviccenoides* with zones of inhibition diameter ranging from 25-30 mm and finally, the ethyl acetate extract of *Uvaria afzelii* with zones of inhibition ranging from 24-29 mm. The results of Minimum Inhibitory Concentration (MIC) showed that the extracts of the plants gave MIC values at a concentration of 800, 700, 600 µg/cm^3 against *Escherichia coli, Vibro cholerea, Shigella dysentriae* and *Salmonella enteritidis* respectively. The Minimum Bactericidal Concentration (MBC) values occur at the same concentration against the same microbes. The results of this study showed that the ethylacetate extract of the seeds and pods of *Acacia nilotica* was the most active against diarrhoea causing organisms and may be a potential source of a broad spectrum antibiotic for the treatment of diarrhoea.

Keywords: Antidiarrheal; Medicinal plants; Phytochemical screening

Introduction

Over 75-80% of the world's population in developed and developing countries depends on. Herbal medicines derived from medicinal plants for their health care [1]. Herbs have medicinal property due to presence of different active principles like alkaloids, volatile essential oils, glycosides, resins, oleoresins, steroids, tannins, terpenes and phenols found them [2].

It is against this background that the plants such as *Uvaria afzelii* Sc, *Acacia nilotica* Linn., *Terminalia avicennioides* Guill & Perr and *Fagara zanthoxyloides* Lam which were extensively used as herbal preparation in some parts of Nigeria were investigated. The plants were selected base on their medicinal importance among traditional medicine practitioners in Nigeria. The diarrhoea causing organism commonly found in the affected sites of the patients such as *Staphylococcus aureus, Escherichia coli, Campylobacter* species*, Clostridium difficile, Vibrio species, Salmonella enteritidis, Salmonella typhi and Shigella dysentriae* were used for this study. These plants were used for various ailments throughout Nigeria. For example, *Uvaria afzelii* is used in the treatments of liver problems, pulmonary troubles, naso-pharyngeal infections, food poisoning and venereal diseases [3]. *Acacia nilotica* Linn, is used in the treatments of intestinal pains, diarrhea, nerve stimulant, cold, congestion, coughs, dysentery, fever, hemorrhages, leucorrhea, ophthalmia and sclerosis [4]. And *Terminalia avicennioides* Guill & Perr is used in the treatment of diarrhoea, dysentery, dropsy, swellings, oedema, gout, leprosy, mucosae, vermifuges, skin irritations and as pain killers [5].

Materials and Methods

Sample collection

The plants parts were collected in Kaduna, Zaria and Nasarawa state. It was identified by Dr Ajibade, at the Herbarium of Biological Sciences, Faculty of Science, Nigeria Defence Academy, Kaduna. The seeds and pods of *Acacia nilotica* were collected in Nasarawa state and it has a voucher number of 403. The roots of *Uvaria afzelii* and *Terminalia avicennoides* were collected in Zaria and they have voucher numbers of 405 and 406 respectively. The plant materials were air-dried, pulverized by the use of a wooden mortar and pestle and stored in bags.

Extraction

A portion (100 g) each of the ground plant parts was separately percolated in 300 cm^3 each of methanol, ethyl acetate, chloroform and petroleum ether for two weeks. The extracts were separately filtered and evaporated on rotary evaporator at 40°C. The marc was repercolated with the recovered solvents for an additional one week. The extracts were drained, filtered and combined with the previous residue and evaporated on rotary evaporator. Each extract was cooled, weighed and stored in the refrigerator until needed.

Phytochemical Screening

The presence of bioactive compounds in the chloroform, ethyl-acetate, methanol and petroleum ether extracts was determined by phytochemical test using standard method [6].

Antidiarrhoeal Screening

The antidiarrhoeal activities of the extracts from the plants; *Uvaria afzelii*, *Acacia nilotica* and *Terminalia avicennioides* was determined using standard methods [7]. The pathogenic enteric microorganisms were obtained from the Department of Medical Microbiology, A.B.U Teaching Hospital, Zaria.

Results and Discussion

Results

The results of phytochemical screening of crude extracts of the three plants were presented in Table 1. Table 2 showed the results of

***Corresponding author:** Saidi Garba, Department of Chemistry, Nigerian Defence Academy, Kaduna, Nigeria, Tel: +2347037108443; E-mail: abubakarsaidu63@gmail.com

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the antimicrobial test while Tables 3 showed the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) respectively.

Discussion

The results of the phytochemical screening of the chloroform, ethylacetate, methanol and petroleum ether extracts of *Uvaria afzelii* Sc, *Acacia nilotica* Linn., *Terminalia avicennioides* Guill & Perr and *Fagara zanthoxyloides* Lam showed that they contain Saponins, flavonoids, phenols, tannins, terpenoids and triterpenoids.. These phytocompounds were synthesized by plants to safeguard themselves against antimicrobial infections [7]. They are known to be effective against diarrhoea caused by *Tripanasome* and *Plasmodium* and possess the ability to initiate human physiological activities such as the stimulation of phargocytic cells and mediation of tumor activities [8]. In addition, the extracts of *Acacia nilotica* also contain Alkaloids and Steroids. This therefore showed that the extracts of this plant could be effective against diarrhea because these phytocompounds have been reported to have antimicrobial properties due to their ability to form complex with nucleophilic amino acids of the microorganism. These therefore suggested that the extracts of the plants targeted may possess antimicrobial activities against diarrhoea causing microbes.

The results of the antimicrobial screening of the extracts (Table 2) showed that *Acacia nilotica* exhibited the highest activity and possess appreciable antibacterial properties by inhibiting the growth of the test organisms at concentrations of 7×10^2 - 8×10^2 µg/cm^3. It showed the highest zone of inhibition of 32 mm for the ethylacetate extract against *Streptococcus feacalis*. The MIC showed no colour change on the organisms *Salmonella typhi* and *Campylobacter sp.* (Tables 3). However, most of the plants extract exhibited moderate activities against the test organisms. From Table 2, *Uvaria afzelii* exhibited zones of inhibition diameter of 26, 25, 27, 29, 26 and 24 mm against *Escherichia coli, Vibro*

Plant	Plant parts	Al.	Sa.	CG	Cd. G	F	Aq	St.	Ph	Tn	Tp	Ttp
A. nilotica (Chloroform)	S and P	+	+	_	_	+	_	+	+	+	+	+
A. nilotica (Ethylacetate)	S and P	+	+	_	_	+	_	+	+	+	+	+
A. nilotica (Methanol)	S and P	+	+	_	_	+	_	+	+	+	+	+
A. nilotica (Pet-ether)	S and P	+	+	_	_	+	_	+	+	+	+	+
Terminalia avicennoides (Chloroform)	Root	+	+	_	+	+	+	+	+	+	+	+
Terminalia avicennoides (Ethylacetate)	Root	+	+	_	+	+	+	+	+	+	+	+
Terminalia avicennoides (Methanol)	Root	+	+	_	+	+	+	+	+	+	+	+
Terminalia avicennoides (Pet-ether)	Root	+	+	_	+	+	+	+	+	+	+	+
Uvaria afzelii (Chloroform)	Root	+	+	_	+	+	+	_	+	+	+	+
Uvaria afzelii (Ethylacetate)	Root	+	+	_	+	+	+	_	+	+	+	+
Uvaria afzelii (Methanol)	Root	_	+	_	+	+	+	_	+	+	+	+
Uvaria afzelii (Pet-ether)	Root	+	+	_	_	+	+	_	+	+	+	+

Table 1: Results of phytochemical screening of the crude extracts. KEY: **+:** Presence; -: Absence; Al: Alkaloids; Sa: Saponins; CG: Cyanogenic Glycosides; Cd. G: Cardiac glycosides; F: Flavonoids; Aq: Anthraquinones; St: Steroids; Ph: Phenols; Tn: Tannins; Tp: Terpenoids; Ttp: Triterpenoids; S and P: Seeds and pods.

Plants extracts	Extracting solvents	C(µg/l(10^2)	Ec	Vc	Sf	Sd	St	Se	Cs	Ck
Acacia nilotica	Chloroform	4	NI	NI	8	9	NI	12	NI	NI
		5	10	11	17	15	NI	8	NI	14
		6	15	17	22	19	NI	13	NI	18
		7	20	19	23	22	NI	15	NI	21
		8	25	20	27	24	NI	22	NI	24
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	35	NI
	Ethylacetate	4	NI	8	13	9	NI	17	NI	8
		5	10	13	17	12	NI	18	NI	11
		6	15	15	22	15	NI	20	NI	13
		7	25	20	25	27	NI	28	NI	26
		8	27	27	32	30	NI	30	NI	29
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Methanol	4	NI	NI	5	11	NI	11	NI	12
		5	NI	NI	12	13	NI	15	NI	17
		6	NI	7	15	17	NI	18	NI	18
		7	NI	11	20	22	NI	19	NI	19
		8	22	21	24	21	NI	20	NI	21
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Pet-ether	4	NI	NI	NI	NI	NI	5	NI	7
		5	NI	NI	NI	5	NI	9	NI	11
		6	NI	NI	7	7	NI	6	NI	13
		7	NI	11	13	15	NI	5	NI	19
		8	19	18	18	17	NI	18	NI	18
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35

Terminalia avicennoides	Chloroform	4	NI	NI	NI	NI	NI	NI	NI	NI
		5	9	NI	11	NI	7	5	NI	6
		6	15	NI	13	NI	8	9	13	9
		7	20	NI	21	NI	16	21	17	19
		8	23	NI	22	NI	20	24	20	22
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Ethylacetate	4	NI	NI	NI	NI	4	6	NI	7
		5	5	NI	5	NI	6	9	13	12
		6	7	NI	6	NI	9	11	17	17
		7	9	NI	10	NI	11	19	22	24
		8	26	NI	27	NI	25	30	25	27
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Methanol	4	5	NI	NI	NI	4	NI	5	NI
		5	9	NI	11	NI	5	NI	9	NI
		6	11	NI	13	NI	8	15	11	15
		7	17	NI	19	NI	15	18	17	18
		8	21	NI	20	NI	20	22	19	20
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Pet-ether	4	NI	NI	NI	NI	NI	NI	NI	NI
		5	NI	NI	NI	NI	NI	NI	NI	NI
		6	NI	NI	5	NI	5	6	NI	NI
		7	13	NI	9	NI	12	11	10	13
		8	19	NI	18	NI	18	19	18	18
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
Uvaria afzelii	Chloroform	4	7	5	5	NI	6	6	NI	7
		5	12	8	7	NI	10	8	NI	10
		6	17	12	10	NI	15	15	NI	15
		7	20	17	15	NI	20	20	NI	18
		8	22	23	20	NI	24	23	NI	21
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Ethylacetate	4	NI	10	7	NI	8	8	NI	5
		5	10	12	10	NI	13	9	NI	7
		6	15	15	13	NI	18	12	NI	10
		7	22	20	19	NI	25	25	NI	12
		8	26	25	27	NI	29	26	NI	24
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Methanol	4	NI	6	NI	NI	NI	4	NI	NI
		5	NI	8	NI	NI	10	7	NI	11
		6	5	12	NI	NI	13	9	NI	13
		7	13	15	11	NI	15	14	NI	17
		8	21	20	18	NI	21	20	NI	20
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35
	Pet-ether	4	4	NI	5	NI	4	NI	NI	4
		5	6	5	6	NI	8	NI	NI	9
		6	8	8	9	NI	10	NI	NI	13
		7	10	12	11	NI	12	12	NI	15
		8	18	19	18	NI	18	18	NI	18
		C1	37	NI	41	42	47	NI	39	NI
		C2	NI	NI	NI	NI	NI	NI	NI	35

Table 2: Results of Antimicrobial sensitivity test of the crude extracts. Zone of inhibition diameter (mm). KEY: NI -No inhibition; C1- Control 1 (Ciprofloxacin=50 µg/ml); C2 - Control 2 (Fluconazole=50 µg/ml); Ec: *Escherichia coli*; Vc: *Vibro cholera*; Sf: *Streptococcus feacalis*; Sd: *Shigella dysentriae*; St: *Salmonella typhi*; Se: *Salmonella enteritidis*; Cs: *Campylobacter sp.*; Ck: *Candida krusei.*

Plants extracts	Solvents	C (µg/l(10^2)	Ec	Vc	Sf	Sd	St	Se	Cs	Ck
A. nilotica	Chloroform	8	-	-	-	-		-		-
		7	-	-	-	-		-		-
		6	*	*	-	*		*		*
		5	+	+	*	+		+		+
		4	++	++	+	++		++		++
	Ethylacetate	8	-	-	-	-		-		--
		7	-	-	-	-		-		-
		6	-	-	-	-		-		*
		5	*	*	*	*		*		+
		4	+	+	+	+		+		
	Methanol	8	-	-	-	-		-		-
		7	-	-	-	-		-		-
		6	*	*	*	*		*		*
		5	+	+	+	+		+		+
		4	++	++	++	++		++		++
	Pet-ether	8	-	-	-	-		-		-
		7	*	*	*	*		*		*
		6	+	+	+	+		+		+
		5	++	++	++	++		++		++
		4	+++	+++	+++	+++		+++		+++
Terminalia avicennoides	Chloroform	8	-		-		-	-	-	-
		7	-		-		-	-	-	-
		6	*		*		*	*	*	*
		5	+		+		+	+	+	+
		4	++		++		+	++	+	++

Table 3: Results of the Minimum Inhibition Concentration (MIC) of the extracts against the test microorganisms. Key: -: No colour change; *: MIC; +: Colour change (light pink); ++: Moderate pink, +++: Deep pink.

cholerae, Streptococcus feacalis, Salmonella typhi, Salmonella enteritidis and *Candida krusei* respectively (Table 2). The results of the MIC showed no colour change for *Shigella dysentriae* and *Campylobacter sp*. The lowest concentration where there is no colour change (MIC value), ranges from 6×10^2 - 7×10^2 µg/cm^3 for the extracts. Finally, *Fagara zanthoxyloides* shows the highest zone of inhibition of 26 mm for the ethylacetate extract against *Streptococcus feacalis*. The MIC showed no colour change on the organisms *Salmonella typhi, Campylobacter sp* and *Vibro cholera*. However, the extracts of *Uvaria afzelii*, *Terminalia avicennioides* and *Fagara zanthoxyloides* recorded lower antimicrobial activities compared to the ethylacetate extract of the seeds and pods of *Acacia nilotica*. These differences in the activities of the crude extracts could be due to the fact that they contain different types of phytocompounds [9].

Conclusion

The result of the phytochemical screening carried out on *Uvaria afzelii*, *Acacia nilotica*, *Terminalia avicennioides* and *Fagara zanthoxyloides* revealed that the plants contained Saponins, flavonoids, phenols, tannins, terpenoids and triterpenoids. The crude extract from the four plants are found to be very active against *Escherichia coli, Streptococcus feacalis, Salmonella enteritidis* and *Candida krusei*. These therefore showed that the phytocompounds from these plants could be used as broad spectrum antibiotic against diseases caused by the test microbes.

These results also showed that the ethylacetate extract of *Acacia nilotica* Linn was the most active extract and it suggested that the extracts of this plant could be a good source of new antimicrobial compounds as shown by the preliminary results. It was therefore selected for further work, which include isolation and characterization of the phytocompounds responsible for the activity of the plant extract.

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