

Full Length Research Paper

Ethnobotanical survey and preliminary evaluation of medicinal plants with antidiarrhoea properties in Sokoto state, Nigeria

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Ethnobotanical survey of medicinal plants use in Sokoto state of Nigeria for the treatment of diarrhoeal disorders was conducted. The plants documented were identified botanically and ranked based on informant frequency of citation. Ten top rank plants were then selected and screened for acute toxicity, phytochemical constituents and antidiarrhoea properties. A fixed single dose (3000 mg/kg b.wt.) of aqueous extract of each plant was administered orally to five female Sprague dawley rats in sequence to test for acute toxic effect. Another fixed dose of 200 mg/kg (b.wt.) of each extract was administered orally to treat diarrhoea induced with castor oil (1.0 ml) in each group of rats (n = 6). The results showed that, nineteen plants were cited by the Herbalist as being used for the treatment of diarrhoea in Sokoto state. The aqueous extracts of the ten selected plants were relatively safe after short term oral administration and tannins was the only phytochemical compound detected in all the extracts. Even though the ten selected plants exhibited varying degrees of antidiarrhoea activities, *Lannea acida* followed by *Euphorbia hirta* and *Acacia nilotica* respectively produced the most effective diarrhoea inhibition. This study has identified nineteen medicinal plants used in Sokoto for the treatment of diarrhoea. Tannins was the only phytochemical compound detected in all the screened plants and *Lannea acida* showed the highest antidiarrhoea potential.

Keywords: Diarrhoea, medicinal plants, wistar rats, oral administration.

INTRODUCTION

Diarrhoeal diseases cause almost four and half million deaths in a year globally. These deaths occur mainly among children less than five years of age (Dano and Borge, 1999). Diarrhoea prevalence among children in north eastern Nigeria was estimated to be as high as 22% (Das et al., 1999). Presently the control of diarrhoea is achieved by the use of synthetic drugs like diphenoxylate, atropine maleate, kaolin, pectin, and fluid/electrolyte replacement. This drug therapy is often associated with a lot of problems such as availability, high cost and toxic effects of the drugs (Dano and Borge, 1999). As a result of all these problems, many people

have embarked on the use of indigenous plants as remedy against diarrhoeal diseases (Havagiray et al., 2008). Also the potentials for new drugs development or discovery depend on screening, evaluation and documentation of herbal plants used in the treatment of diseases including diarrhoea (Ajagbonna et al., 2000).

Sokoto state has a wide environmental and ecological diversity like the rest of Nigeria. A range of medicinal plants with antidiarrhoea properties have been used by the traditional healers. The efficacy and safety of many of these medicinal plants have been reported (Etuk et al., 2006; Bala and Adamu, 2008). The present study is aimed at documenting, evaluating and grading the pharmacological potentials of the medicinal plants use in Sokoto state for the treatment of diarrhoea. The study protocol was approved by the Institutional Ethical Committee.

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MATERIALS AND METHOD

Ethnobotanical survey

The data was collected through oral interview of randomly selected Herbalists in Sokoto state. Structured questions were asked and their responses documented in a pre-piloted data collection form. The data forms were later analyzed; plants materials cited were collected with the assistance of the Herbalists, authenticated by a Taxonomist in the Department of Botany, Usmanu Danfodiyo University, Sokoto (UDUS) and voucher specimens for the plants prepared, labeled and deposited at the Herbarium of the Pharmacology Department, UDUS. The plant data extracted were collated and tabulated to give the vernacular names (Hausa), common names, botanical and family names.

Experimental animals

Male and female wistar rats, age six to twelve weeks, weighing 172 - 183 g were obtained from the colony bred at National Veterinary Research Institute, Vom, Plateau state, Nigeria. The animals were allowed to acclimatize for 14 days in the experimental laboratory of Pharmacology Department, UDUS. They were fed with standard rat pellets (Pfizer Feeds, Jos, Nigeria) and provided with water *ad libitum*.

Extract preparation

Two hundred grams of each powdered plant material was extracted with distilled water using Soxhlet Extractor. The filtrates were dried in Oven at 50°C and stored at -17°C pending administration.

Phytochemical screening

The freshly prepared extract of each plant was tested for the presence of glycosides, alkaloids, flavonoids, saponins, tannins, anthraquinones using the method of Odebiyi and Sofowora (1979).

Acute toxicity testing

The plants were assessed for acute toxic effect using Up and Down procedures (OECD, 2001). Five female wistar rats were randomly selected and housed individually. A test dose of 3000 mg/kg was administered orally in a single dose one after the other by gavage using a gastric tube. After the dosing of each animal; food was withheld for further three hours before feeding the animals. In the first day of dosing, the first animal was dosed and observed immediately for any sign of acute toxicity for about an hour. On the survival of the first animal after 48 h, other four animals were subsequently and sequentially dosed at 48 h intervals.

Antidiarrhoeal test

The castor oil model of diarrhoea induction was chosen for this test (Offiah and Chikwendu 1999). Seventy two wistar rats of both sexes were randomly selected, examined thoroughly to ensure that they were healthy and divided into 12 groups (n = 6). The animals were housed singly in cages lined with white blotting paper. They were deprived of food but given free access to water 18 h before drugs administration. The rats in groups 1 - 10 were pretreated orally with 200 mg/kg of aqueous extracts of *Acacia nilotica*, *Terminalia macroptera*, *Myrtagne africana*, *Lannea acida*, *Ampelocissus grantii*, *Psidium quajava*, *Acacia polyacantha*,

Anogiessus leiocarpus, *Euphobia hirta* and *Boswellia dalzieli* respectively. While those in groups 11 and 12 received normal saline (negative control) and 5 mg/kg of diphenoxylate (Searl, Germany)(positive control) respectively through the same oral route. After one hour, all the rats were subsequently treated with 1.0 ml of castor oil orally. The animals were then kept and observed over a period of 6 h for the frequency of passing watery (wet) or unformed stool. Absence of such dropping was recorded as positive, indicating protection.

Statistical analysis

The experimental results were expressed as mean plus or minus standard deviation (mean \pm SD). Student paired t-test was used for the evaluation of data. Level of significance was set at 5% which is $P < 0.05$.

RESULTS

Ethnobotanical survey

A total of 36 herbal sellers were interviewed and 19 herbs were cited as being used for the treatment of diarrhoea in Sokoto state. The names of the plants, parts used, their families and frequency of citation by the Herbalist are shown in Table 1. The respondents were both men and women (ratio 11:1), with more than 94% being indigenous Hausa and Fulani people.

Phytochemical analysis

The result of the phytochemical screening showed that all the plants extracts contain tannins, Only *L. acida*, *B. dalzieli*, *P. quajava* and *E. hirta* contain alkaloid while flavonoid was found in *T. macroptera* and *E. hirta* (Table 2).

Acute toxicity testing

All the rats survived following the oral administration of 3000 mg/kg (b.wt.) of the aqueous extracts of *B. dalzieli*, *P. quajava*, *A. nilotica*, *T. macroptera*, *M. Africana*, *L. acida*, *A. grantii*, *A. polyacantha*, *A. leiocarpus* and *E. hirta*.

Antidiarrhoea activity

Castor oil (1.0 ml) induced copious diarrhoea in all the rats within 2 - 3 h after administration of the drug. All the ten selected plants exhibited some degrees of inhibition against castor oil induced diarrhoea in rats. *A. nilotica*, *L. acida*, *E. hirta*, *A. grantii* and *B. dalzieli* showed the most significant results ($P < 0.005$) (Table 3). Diphenoxylate was used as a standard antidiarrhoea agent.

Table 1. Ethnobotanical profile of plants used as antidiarrhoeal agents in Sokoto state.

Botanical name	Common name	Hausa name	Family name	Plant parts	Frequency of citation	Rank Order
<i>Boswellia dalzielii</i> *	Papery bark tree	Hano	Burseraceae	Bark	18	1
<i>Acacia nilotica</i> *	Thorn mimosa	Bagaruwa	Mimosaceae	Bark	16	2
<i>Psidium guajava</i> *	Guava	Gwaiba	Myrtaceae	Leaf	16	2
<i>Lannea acida</i> *	Atina barteri	<i>Faru</i>	Anacardiaceae	Bark	10	4
<i>Euphorbia hirta</i> *	Dove mil	Nonan kurchiya	Euphorbia pilulifera	Aerial part	10	4
<i>Acacia polyacantha</i> *		Karo	Campylacantha	Bark	8	6
<i>Terminalia macroptera</i> *		Bayankada	Combretaceae	Bark	8	6
<i>Ampelocissos grantii</i> *		Gogododo	Vitaceae	Root	6	8
<i>Anogessus leiocarpus</i> *	Chewstick tree	Marke	Cambretaceae	Bark	6	8
<i>Myrtagne Africana</i>		Dafa	Rubiaceae	Bark	5	10
<i>Andropogon gayanus</i>	Gamba grass	Gamba	Formicidae	Bark	4	11
<i>S.longipendunculata</i>	Violet tree	Sanya	Polygulaceae	Bark	4	11
<i>Anacadium occidentale</i>	Cashew	Kanjuu	Anacardiaceae	Leaf	4	11
<i>Pilostigma reticulatum</i>	Thoingii pilostigma	Kalgo	Leguminosae	Bark	4	11
<i>Veronica kotschyana</i>	Angular winter cherry	Doomashii	Scrophuliriaceae	Root	3	15
<i>Bridelia frerruginea</i>		Kisni	Euphorbiaceae	Bark	3	15
<i>Ficus thoningii</i>		Chediya	Urticaceae	Leaf	2	17
<i>Ziziphus abyssinica</i> , Hochst	Patch thorn	Magaryaa	Rhamnaceae	Root	2	17
<i>Cajanus cajan</i>	Pigeon-pea	Aduwa	Fabaceae	Bark	1	19

S = *Securidaca* ; * = plants selected for screening based on Informant consensus.

Table 2. Phytochemical constituents of the selected plants.

Plant Specie	Phytochemical Constituents		
	Alkaloid	Tannin	Flavonoid
<i>Boswellia dalzielii</i>	+	+	+
<i>Psidium quajava</i>	+	+	-
<i>Acacia nilotica</i>	-	+	-
<i>Terminalia macroptera</i>	-	+	+
<i>Myrtagne africana</i>	-	+	-
<i>Lannea acida</i>	+	+	-
<i>Ampelocissus grantii</i>	-	+	-
<i>Acacia polyacantha</i>	-	+	-
<i>Anogiessus leiocarpus</i>	+	+	-
<i>Euphorbia hirta</i>	+	+	+

+ = present; - = Not detected.

DISCUSSION

In this study, 19 medicinal plants were cited by Herbalists in Sokoto state as antidiarrhoea agents. This number of plant species recorded used traditionally for the treatment of diarrhoeal diseases is an indication of the rich plant diversity of this area. This was earlier recognized by Scoones et al. (1995). This situation is being adversely affected by rapid urbanization, deforestation and desert encroachment. Therefore, there is an urgent need to document and screen more medicinal plants available in the north western region of Nigeria.

Previous reports have demonstrated the antidiarrhoeal activity of tannins (Mukherjee et al., 1998), flavonoids (Galvez et al., 1993) and saponins (Otshudi et al., 2000) these compounds were screened for in this study and only tannins was detected in all the plant materials. This may illustrate the importance of tannins in antidiarrhoeal property of medicinal plants.

The oral administration of 3000 mg/kg of the various extracts did not produce any death in the animals. This indicates that, the lethal median dose (LD₅₀) of the extracts is greater than 3000 mg/kg. Clark and Clark (1977) were of the opinion that any substance whose LD₅₀ is greater than 1000 mg/kg should be regarded safe especially when administered through the oral route where absorption might not be complete due to inherent factors limiting absorption in the gastrointestinal tract.

Administration of castor oil (1.0 ml) induced copious diarrhoea in all the rats. This method has previously been used by Robert et al. (1976); Etuk et al. (2006); Bala and Adamu (2008). Castor oil is reported to contain ricinoleic acid which when liberated cause irritation and inflammation of the intestinal mucosa, leading to the release of prostaglandins which results in stimulation of secretion (Pierce et al., 1971), thereby preventing thereabsorption of sodium chloride and water (Galvez et al., 1993). The oral administration of 200 mg/kg of the various extracts produced a varying degree of inhibition of the induced diarrhoea in the rats (Table 3). *L. acida* and *E. hirta* extracts produced the highest degree of inhibition.

Table 3. Showing the antidiarrhoea effects of the selected medicinal plants.

Treatment(mg/kg)	Onset of wet stool (h)	Average number of wet stool	Standard deviation	P values Student t-test
<i>Acacia nilotica</i>	3	0.63 ± 0.18***	0.518	5.76 × 10 ⁻⁶
<i>Terminalia macroptera</i>	1	4.51 ± 0.16*	0.463	4.30 × 10 ⁻⁴
<i>Myragne africana</i>	1	4.30 ± 0.19*	0.535	3.56 × 10 ⁻⁴
<i>Lannea acida</i>	5	0.38 ± 0.18***	0.518	1.17 × 10 ⁻⁶
<i>Ampelocissus grantii</i>	3	0.63 ± 0.35***	0.518	5.76 × 10 ⁻⁶
<i>Boswellia dalzielii</i>	2	0.89 ± 0.35***	0.991	2.61 × 10 ⁻⁶
<i>Acacia polyacantha</i>	3	1.95 ± 0.36**	0.756	8.99 × 10 ⁻⁴
<i>Anogiessus leiocarpus</i>	1	2.87 ± 0.27*	0.756	8.99 × 10 ⁻⁴
<i>Euphobia hirta</i>	5	0.56 ± 0.14***	0.518	1.17 × 10 ⁻⁶
<i>Psidium quajava</i>	2	1.13 ± 0.35**	0.991	7.70 × 10 ⁻³
Diphenoxylate (5mg/kg)	7	0.25 ± 0.14	0.463	2.76 × 10 ⁻⁷
Normal Saline(Control)	1	12.43 ± 0.43	0.463	-

Dose of extracts = 200 mg/kg; *** = Highly significantly different from control; ** = significantly different; *different.

According to Geiger's criteria for acceptance of a drug as antidiarrhoea, the ability of the drug to inhibit the production of wet or unformed faeces in animals is important (Akah, 1988). All the plants extracts tested showed this property in varying degrees making them potential sources of antidiarrhoeal agents. It is also important to note that the ten plants were selected based on informant scoring index and they all show positive antidiarrhoea activity. This selection method for pharmacological screening is reported to show greater percentage yield of bioactive useful medicinal compounds over other methods of random selection and screening (Khafagi and Dewedar, 2000). The antidiarrhoea activities of *P. quajava*, *B. dalzielii*, *E. hirta* and *A. nilotica* have been previously reported (Etuk et al., 2006; Galvez et al., 1993; Bala and Adamu, 2008). While others like *L. acida* and *A. grantii* have never been reported to our knowledge. Overall, the present study has documented 19 medicinal plants used as antidiarrhoea agents in Sokoto state. *L. acida* and *E. hirta* are the plants with the highest antidiarrhoea potentials. And informant consensus is shown to produce a high yield of pharmacological positive result when adopted to select medicinal plants for screening.

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