



Article Info

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Ethnobotanical survey of some medicinal plants used in the treatment of schistosomiasis in Sokoto mteropolis, Sokoto State, Nigeria

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Schistosomiasis is a parasitic disease that affect the well-being of people in Sokoto State-Nigeria. A survey of medicinal plants used in the treatment of schistosomiasis was conducted in Kware/Wammakko Local Government areas of the state through the administration of structured questionnaire. The survey from 48 respondents revealed total 9 plant species belonging to different families were found to be frequently used in treatment of schistosomiasis. Qualitative and quantitative phytochemical analyses on the plants revealed the presence of secondary metabolites. In *Acacia nilotica*, flavnoids (3.53 %), alkaloids (2.3 %), saponins (1.507 %), tannins (64 mg/dl), glycosides (0.32 g%), and steroids (79 mg%) were found to be present. In *Balanites aegyptiaca*, flavnoids (2.66 %), alkaloids (2.6 %), saponins (1.05 %), tannins (72 mg/dl), glycosides (0.30 g%) and steroids (91 mg%) were present. In *Khaya senegalensis*, flavnoids (0.77 %), alkaloids (1.8 %), saponins (0.5 %), tannins (23 mg/dl), glycosides (0.23 g%), and steroids (65 mg%) present. The snails were exposed to different concentrations of plant extracts for 96 hours. Ten experimental snails were exposed to 3 L of water containing 3 plant extracts. Mortality was recorded after every 24hr. to 96hr. No response to needle touch was taken as evidence of death. Dead snails were removed immediately to avoid contamination. The toxicity of the three the plant extracts decreased from 255.10 mg/L (42.7%) 24 hr, 91.61 mg/L (21.1%) 48 hr, 66.74 mg/L (21.6%) 72hr and 100% mortality in 96 hr. The toxicity was found to be time and dose dependent. The data obtained from this research have provided the scientific basis for the use of these plants in treatment of schistosomiasis and these plant could serve as effective, cheap and affordable source of medicinal agents for control of schistosomiasis in the State.

Keywords: Ethnobotanical, Survey, schistosomiasis, Sokoto Nigeria.

1. Introduction

Schistosomiasis control could be sustainable only through the successful application of plant molluscicides with low toxicity to non-target organism (Labe *et al.*, 2012). Despite more than a century of control effort and the introduction of highly effective anti-Schistosomal drug therapy in 1980's the disease still exists in tropical countries (Fayez and Bakry, 2009). Synthetic molluscicides kills fish and other non-target organism instead of snail vector and resulted to high environmental impacts (Rug and Ruppel, 2000). Search of plant molluscicides with no effect to non-target organisms, easily biodegradable has become panacea for scientists in the control of snail intermediate hosts of schistosomiasis. It is appropriate, inexpensive technology for snail vector control in the endemic poor nations of the world which make it to be receiving greater

attention (Labe *et al.*, 2012). Medical plant represents the oldest and widest spread form of medication known to man and have become the focus of attention as source of molluscicidal agents, since they are less expensive and less hazardous to the environment than their synthetic counterpart (WHO,1993). Despite the remarkable effort in synthetic medicine, over 25% of prescribed medicines in the industries are derived directly or indirectly from plant (Mathias *et al.* (2000); and Adebisi and Ayandele, (2007). Knowledge of the chemical constituents of plants is desirable due its complex substance in disease control (Mojab *et al.*, 2003). Praziquantel remains the only available drug of choice for all forms of *Schistosoma* diseases thus, demonstrated resistance, high cost of drugs, prolong biodegradable impact to the environment

and high toxicity to non-target organisms in some endemic areas of the world (Fenwick *et al.*, 2006).

The study area has been endemic of schistosomiasis over decades as a result flow of River Sokoto in the area that harbored freshwater snails intermediate host for the disease. Based on the occurrences, epidemiology, prevalence, intensity and the status of schistosomiasis in the study areas by (Mungadi and Malami, 2007; Kabiru *et al.*, 2013; Bello *et al.*, 2014; Singh and Mudassiru, 2014 and Singh *et al.*, 2016). The study was based on the report of abundant medicinal plant materials to possess molluscicidal activity and used by traditional herbalist in curing schistosomiasis in the State (the study area). Molluscicides has been very effective and efficient in the control of schistosomiasis through the control of freshwater snail intermediate hosts (Ebele, 1997). Plants stand a good position in effective snails control especially in tropics and other developing nations of the world because of its advantage of being highly effective, culturally accepted, inexpensive, easily biodegradable, safe to non-target organisms and with little environmental hazard, readily available. Certainly, increased attention has been focused on the search and utilization of plants molluscicides. Thus, there is need to foster research in plants species as molluscicides in snail vector control management alongside with mass drug administration (MDA), this in line with WHO roadmap of eliminating schistosomiasis as a public health problem by 2030 (WHO, 2020). Systematic review of chemical-based molluscicides, recommend the regular mollusciciding in the control of snail intermediate host in the elimination of schistosomiasis in the endemic areas of the world as the best approach (Sokolow *et al.*, 2016). It serves as the most reliable method of choice in achieving drastic reduction in snail intermediate host population density and eradication of schistosomiasis

disease in the tropical countries of the world (WHO, 2013). There is dearth of literature on the molluscicidal potentials of *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* stem-bark extracts, if found effective, it will offer a double functions of causing death of snails and cercarial stages of *Schistosoma* specie as suggested by (Mandefro *et al.*, 2018). The screening of medicinal plants with molluscicidal activities by herbalist in Sokoto State may offer alternative solution on synthetic molluscicides in the endemic areas of the world if found effective. Result obtained in the study can serve as baseline data for further research work on the plants.

2. Materials and Methods

2.1 Study Area

The study was conducted at Sokoto along Usmanu Danfodiyo University Sokoto road (Kwalkwalawa) and Illela road (More) of Kware and Wamakko Local Government Sokoto State, Nigeria. The area is located between latitude 06°N120 and Longitude 05°180E. The two areas share a boundary in the North-South of the state and are known for its farming and fishing activities in the State. Kware is situated in the North-West of the State on a total area of 554 kilometer squares and has the total population of 133,899 as at 2006 census. A research conducted by National Bureau of statistics in the year 2010, showed that estimated rural-urban migration in the area is about 181,000. Wamakko is located in North-South of the State with an area of 697 kilometer squares and a population of 179,619 as at 2006 census. A similar research conducted by National Bureau of statistics in the year 2010 showed that the estimated rural-urban migration in the area is about 4,536 and is increasing at the rate of 10% annually. The state is endowed with abundant plant materials used by herbalist in treatment of different human and animal diseases.

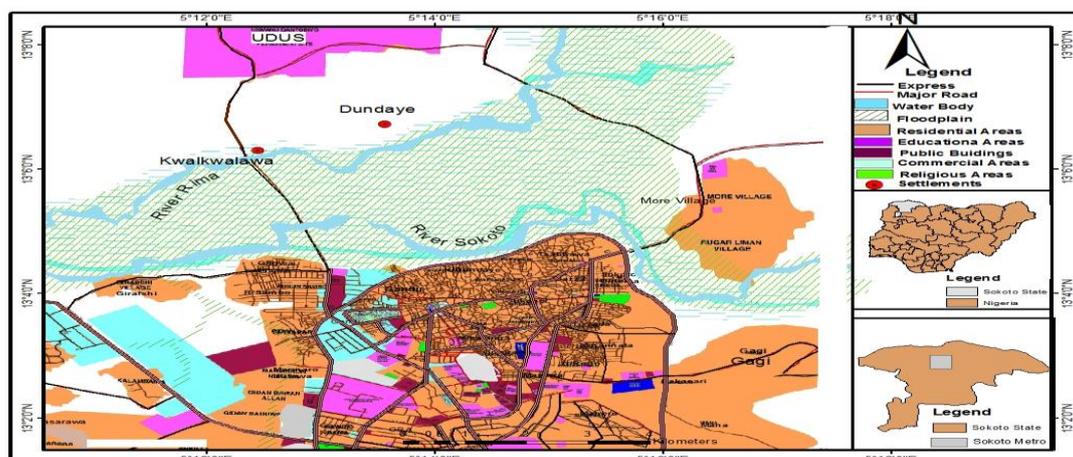


Figure 1. Map of the study area showing River Sokoto, sites for snails sampling and all the sites experiencing risk factors of schistosomiasis and fascioliasis. **Source:** GIS Generated by GIS Lab.

2.2 Ethical approval

Prior to the commencement of this study, approval was obtained from Ministry of Health Sokoto. The protocol of the study was reviewed and given expedited approval (Assigned Number: SMH/1580/V. IV) by Sokoto State health research ethics committee.

2.3 Study Design

The survey was undertaken through the interviewing of Traditional Medicine Practitioners (TMPs) in Kwarkwalawa, Kware and Wamakko Local Government areas of Sokoto State, Nigeria on the use of medicinal plants for treatment of schistosomiasis in the study area. The survey was conducted into six different collection sites, where the plant samples collected were documented. The study area was grouped into two Local Government Areas of Sokoto State, Nigeria. Each of these groups was further sub-grouped randomly into three (3) collection sites, making a total of six collecting sites for the two Local Government Areas of the State. Three sites from Kware Local Government Area (Rugar Liman, Gidan Manomi and More) and three sites from Wamakko Local Government Area (Kwarkwalawa, Dundaye and Gidan Gara). Questionnaires (Appendix 1) were administered to traditional healers and farmers in each of the collection sites to collect and identify information on the types of plants and parts they used in curing schistosomiasis in the study area.

2.4 Plant Collection and Identification

The plant samples commonly used for the treatment of schistosomiasis in the study area were collected with the help of traditional healers and farmers by means of hand picking, axe and cutlass from the healthy part of plants from their natural habitats. The samples were taken to the Herbarium Department of Biological Sciences, Faculty of Sciences UDU, Sokoto for identification; the collected plant samples were identified and assigned with voucher number by Mal Abdulaziz Salihu. The plant name that appeared most frequently in each of the collecting sites was chosen as one of the candidate plants in the site. Thus, nine plants were selected as candidate plants in the study area; four plants (*Balanites aegyptiaca*, *Moringa oleifera*, *Azadirachta indica* and *Ricinus communis*) from Kware and five plants (*Acacia nilotica*, *Khaya senegalensis*, *Senna occidentalis*, *Vernonia amygdalina* and *Allium sativum*) from Wamakko Local Government Area of the State. The collected plants were authenticated at the Department of Biological Science, Botany Unit, Usmanu Danfodiyo University, Sokoto, Nigeria. Deposited with voucher specimen number at the Herbarium of the Department.

2.5 Drying and preparation of plants

A quantity of 2 kg of the stem bark of *Acacia nilotica*, *Balanites aegyptiaca* and *Khaya senegalensis*; the leaves of *Senna occidentalis*, *Vernonia amygdalina* and *Moringa oleifera*; the seeds of *Azadirachta indica* and *Ricinus communis*; and *Allium sativum* bulb were shade-dried for the period of 7 days and then pounded with pestle and mortar, sieved to obtain fine powder of 1.8kg from each plant. The fine powder was stored in a dry plastic container covered with a lid.

2.6 Phytochemical Analysis of the Plant Materials

A quantity of 2 g powder of each of the plants used was taken to the Department of Biochemistry of the Faculty of Sciences, Usmanu Danfodiyo University Sokoto, Nigeria for screening test to conduct qualitative and quantitative phytochemical analyses according to standard procedure prescribed by El-Oley *et al.*, 1994, Trease and Evans, 1999, Bohm and Kocipal, 1994, Harbone, 1998, Harbone, 1973 and Mensah, 2009.

2.7 Extraction of Plant Materials

The stem-bark of *Acacia nilotica*, *Balanites aegyptiaca* and *Khaya senegalensis* powder were weighed and soaked in one litre of tap water with occasional vigorous shaking for 12 hours and then filtered using muslin cloth.

2.8 Snail samples Collection, Acclimatization and Identification

Snail collection was undertaken between March 2020 to July 2021 in six potential transmission sites, three sites from two Local Government Areas, collected freshwater snails were taken to General Biology Laboratory in the Department of Animal and Environmental Biology and put into an open wide container with dechlorinated tap water and fed with grounded lettuce for 48h for acclimatization (WHO, 2012). The samples were also taken to the Museum of Natural History Department of Biological Science Ahmadu Bello University Zaria, Kaduna State Nigeria for identification and assigning of voucher number (WHO, 2012). The samples were identified using relevant keys, external features and morphological characteristics (Danish Bilharziasis Laboratory Manual, 1979) as *Bulinus globosus*.

2.9 Molluscicidal Activity of the Aqueous Extracts of the Experimental Plants on freshwater snail

Toxicity experiments were performed according to standard procedures described in WHO

guidelines (WHO, 2012). Adult freshwater snails *Bulinus globosus* (3mm \pm 25mm in length and width) were used for the study at 25°C to 28°C and PH of 7 \pm 0.5. Ten experimental snails were kept in a prepared aquarium containing 3 litres of water and exposed continuously for 96 hours to 100 mg/L, 200 mg/L and 300 mg/L concentrations of the plant extracts. The experiments were conducted in triplicates and each dose was represented by six aquaria. Mortality was recorded after every 24 hours up to 96 hours. No response against a touch by needle would be taken as evidence of death. Dead snails were removed at each observation to prevent contamination of the body in the experimental aquarium. Control animals was kept in similar condition without treatment.

2.10 Statistical Analysis

Data obtained were statistically analyzed using Probit analysis method by Finny (1971), through the SPSS (Version 22, IBM Software Group, Chicago, IL, USA). Statistical package for the social sciences SPSS computer software package. Student's 't' test was applied to determine the significant ($p < 0.05$) differences between treated and control snails, the effective doses (LC_{50} and LC_{90} values), upper and lower confidence limit, slope value, 'g' value and 't' ratio. Product moment correlation coefficient was applied in between exposure time and lethal concentrations.

Table 1. Plant samples

S/N	Plant name	Voucher number
1	<i>Azadiracta indica</i>	UDUH/ANS/0755
2	<i>Allium sativum</i>	UDUH/ANS/0838
3	<i>Ricinus communis</i>	UDUH/ANS/0643
4	<i>Moringa oliefera</i>	UDUH/ANS/0663
5	<i>Acacia nilotica</i>	UDUH/ANS/0660
6	<i>Balanites aegyptica</i>	UDUH/ANS/0631
7	<i>Khaya senegalensis</i>	UDUH/ANS/0835
8	<i>Vernonia amygdalina</i>	UDUH/ANS/0686
9	<i>Senna occidentalis</i>	UDUH/ANS/0633

Table 2. Frequency of plants used for treatment of schistosomiasis.

S/N	Plant specie	Family	English name	Frequency	Percentage %
1	<i>Senna occidentalis</i>	Leguminosae	Senna	3	7
2*	<i>Khaya senegalensis</i>	Astraceae	Mahogany	14	29
3	<i>Vernonia amygdalina</i>	Meliaceae	Bitter leaf	2	7
4	<i>Moringa oliefera</i>	Moringaceae	Moringa	3	7
5	<i>Ricinus communis</i>	Euphorbiaceae	Castors	2	4
6*	<i>Balanites aegyptica</i>	Zygophyllaceae	Thron	10	21
7	<i>Allium sativum</i>	Amaryllidaceae	Garlic onion	2	4
8*	<i>Acacia nilotica</i>	Fabales	Gum Arabic	8	17
9	<i>Azadiracta indica</i>	Meliaceae	Neem tree	4	8

3. Results and Discussion

3.1 Plant collection and Identification

The results of the plants collected and frequency of citation are presented in Tables 1 and 2.

Ethnobotanical survey of collected plant materials in the study area revealed that, about fifty-four (54) questionnaires were distributed and administered to sought the information about the efficacy of native plant materials that were used as medicine for curing the schistosomiasis by herbalist in Kware and Wamakko Local Government areas of sokoto State, Nigeria. A total of nine (9) plants *Azadiracta indica*, *Allium sativum*, *Ricinus communis*, *Senna occidentalis*, *Vernonia amygdalina*, *Moringa oliefera*, *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* were found to be commonly used by the traditional healers in the study area. Out of these plants, three (3) *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* were selected for the study because of the high constituents used as molluscicides according to phytochemical analysis, high frequency in the questionnaire administered, their availability and affordability in the study area. In recent years, there are gaining increased attention for newly plant molluscicides as they may be highly effective, rapidly biodegradable, less expensive than synthetic molluscicides, readily available and probably easily applicable with simple techniques, (Fayez and Bakry, 2009).

Table 3. Quantitative phytochemical analyses of three plants used for the study

S/N	Parameters	<i>Acacia nilotica</i>	<i>Khaya senegalensis</i>	<i>Balanites aegyptica</i>
1	Flavonoids	3.53%	2.66%	0.77%
2	Alkaloids	2.3%	2.6%	1.8%
3	Saponins	1.507%	1.05%	0.5%
4	Tannins	64mg/dl	72mg/dl	23mg/dl
5	Glycosides	0.32mg%	0.30mg%	0.23mg%
6	Steroids	79mg%	91mg%	65mg%

Table 4. Molluscicidal Activity of *A. nilotica* + *B. aegyptica* + *K. senegalensis* stem-bark extracts against *Bulinus globosus* snail Exposed to different concentrations.

Exposure periods (Hours)	Effective dose(mg/L) LC ₅₀	Limits (mg/L)		Slope value	't' ratio	'g' value
		LCL	UCL			
24h	255.10	176.9	1278.7	1.1±0.2	2.4	0.01
48h	91.61	7.8	137.5	1.2±0.2	2.5	0.02
72h	66.74	31.6	90.18	2.8±0.5	4.1	0.01
96h	100% mortality					

Key:- UCL = Upper Confidence Limit
 LCL = Lower Confidence Limit
 "t" value = Regression Test
 "g" value = Potency estimation Test

3.2 Phytochemical analysis

The results of the quantitative phytochemical analyses are presented in Table 3. The preliminary phytochemical screening of the three candidate plants is presented in Table 3. The results showed the presence of various secondary metabolites in which include: flavonoids, alkaloids, saponins, tannins, glycosides and steroids in *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* stem-bark extracts.

3.3 Molluscicidal activity of *A. nilotica* + *B. aegyptica* + *K. senegalensis* stem-bark extracts on *Bulinus globosus* snail

The toxicity of *A. nilotica* + *B. aegyptica* + *K. senegalensis* stem-bark extracts against *Bulinus globosus* snail showed that, the LC₅₀ values decreased from 255.10 mg/L (42.7%) 24 hours, 91.61 mg/L (21.1%) 48 hours to 66.74 mg/L (21.6%) 72 hours and 100% mortality in 96 hours in (Table 4).

Phytochemical screening of the stem-bark extracts of three plant used in the study for their bioactive constituents have been shown in the mortality of exposed freshwater snails and influenced by time taken in the extracts and quantity of doses used in the experiment. The plant extracts present of high content of saponin, tannin, alkaloids, glycoside and steroids could cause high snail mortality as suggested by Akinfelu *et al.*, 2012, Guraswamy *et al.*, 2017,

Mandefro *et al.*, 2018, Bashay *et al.*, 2018, Abdullahi *et al.*, 2018 and Elamin 2005.

The present study showed that, the stem-bark aqueous of *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* possess molluscicidal potentials through the high mortality recorded on the exposed freshwater snails with the increasing concentrations of the extract for all the plant used. The toxicity of these plants are both time as well as concentration-dependent, there was significant negative correlation between LC₅₀ values and exposure periods. Thus, with increase in exposure periods and LC₅₀ values decreased in all the three plant extracts exposed to different concentrations against freshwater snail (*Bulinus globosus*) in (Table4). It is similar with study by (Vijay, 2020) who reported that aqueous extracts of *B. aegyptica* leaves possess molluscicidal properties and it activities toward *Lymnaea natalensis* snail was both time and concentration-dependent.

The LC₅₀ at exposure period of 96 hours was the most effective treatment amongst all other exposure period i.e. 24 hours, 48 hours, 72 hours and 96 hours. It is strong evident from toxicity result section that, *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* stem-bark extracts possess molluscicidal activity against freshwater snail (*B. globosus*) this may be as a result of varying consistencies of secondary metabolites contained by each of the plants used in different concentrations. It is in agreement with (Brimer *et al.*, 2007) who opined that presence of more than one compound in plant extract could

be the reason for high mortality of exposed snail, thus high molluscicidal potentials.

4. Conclusion

It can be concluded that combination of three plants *Acacia nilotica*, *Balanites aegyptica* and *Khaya senegalensis* extracts used for this study presented molluscicidal potentials phytochemically. This justify the used of native plant materials in the traditional medicine for the treatment of schistosomiasis in the state. They are therefore available, affordable in the study areas of Kware and Wamakko Local Government of Sokoto State, Nigeria.

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Conflict of interest

The authors declare no conflict of interest.

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