Trop J Nat Prod Res, July 2024; 8(7):7828-7839 **ISSN 2616-0684 (Print)**
ISSN 2616-0692 (Electronic)

Tropical Journal of Natural Product Research

Available online at https://www.tjnpr.org

Original Research Article

Ethnobotanical Survey of Some Medicinal Plants Used Against Trypanosomiasis in Zuru Local Government Area, Kebbi State, Nigeria

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ARTICLE INFO

Article history:
Received : 19 May 2024
Revised : 30 May 2024
Accepted : 03 July 2024
Published online 01 August 2024

ABSTRACT

The *lelna* people of Zuru, Kebbi State, North-western Nigeria, predominantly prefer the use of medicinal plants as viable treatments against different ailments, including trypanosomiasis, as the area is endowed with viable medicinal plants, despite a gradual decrease in the traditional knowledge of usage. This study seeks to document medicinal plants used for the treatment of trypanosomiasis among *lelna* people. A survey was conducted from October 2021 to January 2022 among the *lelna* tribes. Information was collected from 104 respondents using the purposive sampling technique and interviews using semi-structured questionnaires. Descriptive statistics were used to present the data. The survey documented 34 medicinal plant species belonging to 31 genera and 20 families. The highest fidelity level and relative frequency of citation of commonly mentioned plants were observed for *Rogeria adenophylla* J. Gay and *Ricinus communis* Linn. Fabaceae family, represented by 8 species, appears to be the most commonly utilized family. The most frequently cited species were wild-derived trees or shrubs and most herbal remedies were mainly prepared by decoction (45%) and administered orally (100%). Leaves (39%) and stem bark (16%) accounted for the highest proportion of the biological parts of plants used in remedy preparation. Parasitic diseases presented the highest informant consensus factor (ICF = 0.68) among the cited species. This study has documented potential traditional medicinal plant species for treating trypanosomiasis in Zuru, Kebbi State. Pharmacological studies to identify the active principles of the cited species are required to validate their uses and unveil new potential trypanoside agents.

***Keywords*:** *Lelna* people, Traditional medicinal plants, Trypanosomiasis, Ethnobotanical survey, Traditional knowledge of usage, Trypanoside agents.

Introduction

In most Nigerian local communities, trypanosomiasis seems to re-emerge as a livestock-threatening disease in small ruminants, extending to previously designated tsetse-free zones.[1] Domestic and wild animals have been implicated in the spread of the disease to new areas and in local outbreaks. A wild animal reservoir is thought to be responsible for sporadic transmission to hunters and visitors to game parks.[2] This has led to an increase in the prevalence rate of the disease from 8.4% to 15.53% in different breeds of animals and even in humans over the past few years.[3] Recently, the estimated population at risk is 65-70 million people, and countries such as Burkina Faso, Ghana, Kenya, and Nigeria have reported sporadic cases in the last 10 years.[4, 5] Unfortunately, the current therapies against trypanosomiasis have numerous side effects, and there is no immediate prospect of a vaccine.[5] This calls for the need for safe, affordable, and more effective treatments, which has led to several studies on medicinal plants for the treatment of trypanosomiasis from traditional pharmacopeia.

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Citation: Ukwuani-Kwaja, AN, Sani I, Nuhu, UD. Ethnobotanical Survey of Some Medicinal Plants Used Against Trypanosomiasis in Zuru Local Government Area, Kebbi State, Nigeria. Trop J Nat Prod Res. 2024; 8(7): 7828-7839 https://doi.org/10.26538/tjnpr/v8i7.29

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria

The *lelna* people of Zuru, Kebbi State, north-western Nigeria, among other communities, have for decades recognized the value of medicinal plants as viable treatments against different ailments, including trypanosomiasis, without a specific tool for diagnosis, as the patients are mostly presented to the traditional healer for consultation at the late stage of infection. Trypanosomiasis remains a potential fatal human and animal disease caused by the parasitic protozoa of the genus *Trypanosoma*.[6] *Trypanosoma* species can infect diverse hosts, ranging from plants to higher mammals. Trypanosomes are the causative agents of animal African trypanosomiasis (AAT) and human African trypanosomiasis (HAT), the former affecting domestic animals prevalent in Sub-Saharan Africa, causing more than 3 million animals to die each year, with 50 million animals at risk of infection.[6, 7]

Medicinal plants have long been considered valuable natural product sources of therapeutic agents for treating a variety of diseases, ailments, and afflictions.[8] Amit-koparde *et al.*[9] highlighted that an estimation of about 75,000 species of flowering plants are known to exist on earth, out of which only about 10% have been investigated for possible therapeutic value against any condition, and out of this 10%, only 1-5% have been scientifically investigated for any bioactivity. Most developing countries, like Nigeria, have a large rural population that frequently uses herbal remedies for treating different diseases and ailments as basic healthcare. In several instances, herbal recipes are the only readily available healthcare option due to the worldwide inflationary tendency, which undermines the sustainable supply of conventional medicines and lowers people's purchasing power in such growing areas.[10] Hence, the increase in unselective use of plant extracts is further aggravated by the belief that plants are safe simply

because they are natural in origin. Unfortunately, over time, human activities that have led to unregulated development have caused some plants to gradually head towards extinction.

Ethnobotanical surveys on medicinal plants continuously offer a platform for the potential discovery of novel compounds from uninvestigated and scarcely investigated plants.[11] Scientific investigations of medicinal plants have been initiated in many parts of the world due to ethnomedicinal plants' contributions to the fight against various diseases. Unfortunately, overexploitation of these plants and the conversion of natural habitats to cropland have critically reduced the size of common medicinal plant communities and their economic contribution to local communities.[12] The number of professionals with knowledge of the use of local medicinal plants is rapidly decreasing in rural areas, and in most developing countries, such as Nigeria, their existence is now threatened by rapid urbanization. Therefore, ethnobotanical studies have to be undertaken on the largest scale possible, as recommended by WHO, [13] to preserve this fast- vanishing knowledge. This survey seeks to provide data about the useful pharmacopoeia of antitrypanosomal plant species traditionally used by *lelna* people in some villages or districts of Zuru Local Government Area, Kebbi State, Nigeria, that could be useful for drug discovery in the present and the future.

Materials and Methods

Description of the study area

The survey was carried out in Zuru Local Government Area (LGA), which covered Anai, Dabai, Bedi, Isgogo, Rikoto, Manga, Rafin Zuru and Tadurga districts. Zuru is the headquarters of Zuru Emirate in Kebbi State, which comprises of Fakai, Danko/Wasagu, Sakaba, and Zuru LGA. It had a population of 165,547 as of the 2006 census, with an area of 653 km^2 (252 sq mi). Its geographical coordinates are 11° 25' 49" North, 5° 14' 15" East (Figure 1) and its climatic condition is hot and oppressive, with a year round temperature range of 14.44 °C to 37.78 °C and occasional dips below or above 40.56 °C.[14] The main language spoken by the Zuru people is *C'lela,* and the people are called *lelna*. Their major occupations are farming, blacksmithing, animal rearing, hunting, and traditional herbal practice. They are also known for their successful use of plants as traditional medications for the prevention and treatment of various diseases.

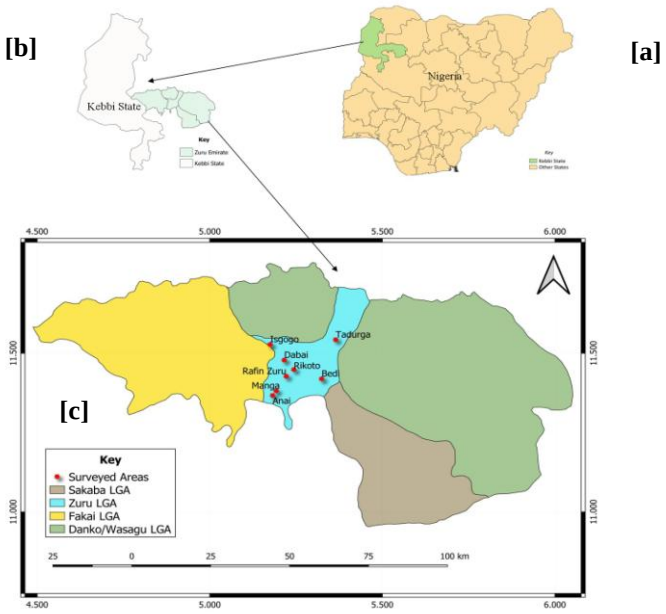

Figure 1: Geographical map of the survey study area
LEGEND: [a]- Kebbi State location in Nigeria, [b]- Zuru Emirate location in Kebbi State and [c]- Location of Zuru LGA in the Emirate with specific surveyed areas).

Survey sampling technique and interview sessions

The survey was conducted in Zuru Local Government Area, Kebbi State, Nigeria, from October 2021 to January 2022. A purposive sampling technique, also known as non-random probability and expert sampling, which does not require any sampling size, was adopted in this study.[15,16] The respondents interviewed were primarily composed of traditional medicine practitioners, herbalists, native doctors, farmers, hunters, housewives, apprentices, and elderly people with the claim of traditional plant knowledge. The interview was conducted in the local dialect of Zuru people with an in-depth questionnaire as a guide. Prior to the survey, ethical consent was sought from the local authorities and institutional ethical approval was obtained with the following reference no. KSUSTA/DVCR&I/RECC/007. Prospective respondents were fully informed about the importance of the study, and only respondents who voluntarily gave their consent were involved in the study. All interviews were conducted in accordance with the International Society for Ethnobiology's (ISE) Code of Ethics.[17]

Data collection

A total of 150 semi-structured questionnaires were distributed, and a total of 104 respondents, comprising traditional medicinal healers, herbalists, native doctors, farmers, the elderly, and others, were interviewed. Respondents were selected based on their prominent knowledge of the use of medicinal plants and were interviewed on a voluntary basis using *lelna* dialect. They were asked about the local name of the plants, parts used, mode of preparation and administration, dosage, duration of administration, and years or duration of experience with plant usage. A literature search was conducted using Google Scholar, PubMed., Web of science, and Scopus for the antitrypanosomal activity of the plants mentioned by the respondents so as to obtain reports of published research on the plants.

Plant collection and identification

The plant samples were collected from January to October 2022 and identified botanically. The plant samples were issued voucher numbers and placed in the herbarium of Kebbi State University of Science and Technology, Aliero, and Federal University Birnin Kebbi, Kebbi State, Nigeria. The world flora (theworldfloraonline.org.) and PlantNet applications were used to verify the identity of the plant names.

Data analysis

Information gathered from the semi-structured questionnaires was tabulated and analyzed using descriptive statistics with the aid of Microsoft Excel computer software. Frequencies and percentages were used to summarize ethnobotanical data. The following parameters were used to check for fidelity level (FL), relative frequency of citation (RFC), and informant consensus factor (ICF). The fidelity level was used to get the percentage of respondents claiming to use a particular plant species for the same major purpose. These indices are mostly applied to select potential plant species for further pharmacological studies and recommendations in drug development.[18, 19]

Frequency of citation (FC) of each plant was presented as the sum of respondents that cited the use of the species to treat trypanosomiasis.

Fidelity level (FL) is the percentage of respondents who mention the use(s) of a certain plant species to treat a particular ailment. The maximum FL indicates the frequency and high use of the species for treating a particular ailment by the informants in the study area. FL is designed to quantify the importance of a species for a given purpose. It indicates the respondents' choice of a potential plant species to treat a given ailment[20, 21] and was calculated using the formula given in equation (1):

$$FL\ (\%) = N_p/N \times 100 \quad (1)$$

Where N_p is the number of respondents that claimed to use a particular plant species for a particular disease, and N is the total number of respondents citing the species for any disease.

Relative frequency of citations (RFC) expressed the relative relevance of plant species used as medicinal plants. A high RFC indicates high use reports for the species, implying its relative importance to the local community for health care needs.[21, 22] The RFC for each plant species was estimated using equation (2):

$$RFC = n/N \times 100 \quad (2)$$

Where n is the total number of respondents that listed a specific plant species, and 'N' is the total number of respondents.

Informant consensus factor (ICF) was calculated in order to estimate the agreement about the use of plants to treat given ailments,[23] using equation (3):

$$ICF = (N_{ur} - N_t)/(N_{ur} - 1) \quad (3)$$

Where, N_{ur} number of use-reports in each disease category, N_t number of species used for that use category. ICF values range between 0 and 1, where 1 indicates the highest level of respondents' consensus on the species to be used in the treatment within a category of illness.[23]

Results and Discussion

Demographic characteristics of the study respondents

A total of 104 respondents comprising 68 males (65%) and 36 females (35%) of distinct ages between 15 and above 66 years from different villages or district belonging to the study area were interviewed (Table 1). Although men are the predominant respondents, the participation of women in this study is due to the culture and traditions of *lelna* people, as both men and women are actively involved in medicinal plant practice. The majority of the respondents (98.08%) selected in this study have no formal education, as they are mainly traditionalists and seem to reserve their folkloric knowledge of herbal medicine. The traditional use of medicinal plants among *lelna* people is similar in many parts of the country (northern and south-western parts of Nigeria, for instance, Jigawa, Katsina, and Ogun States), as seen in other African communities, traditional healing is practiced by both men and women.[16, 24-28]

The respondent knowledge on antitrypanosomal plants mentioned by different age groups was reportedly gained from parents, community, and learning from other traditional healers, while the majority of respondents (42%) were between 36-55 years of age (Table 1). It is a common practice among the *lelna* people that children and grandchildren accompany their parents during the collection of medicinal plants and at the time of treatment of patients and infected animals. This is how indigenous knowledge is acquired over time as it is transferred from parents to children and friends. The transfer of knowledge of medicinal plants from one generation to another mentioned in this study has also been noted by other researchers.[22, 27, 29]

The respondents also constitute 36 traditional medicinal practitioners or herbalists, 17 native doctors, 31 farmers, and 20 others (hunters, elderly, apprentices, and housewives) who had an idea of antitrypanosomal plants were also recorded. Results on the occupational status of the respondents revealed that farmers and housewives contributed significantly to the study, as some traditional medicinal practitioners and herbalists hardly reveal information on specific species (Figure 2). Majority of the *lelna* people are into herbal practice and mostly prefer the use of herbs as their primary source of health care. A similar report on the occupational status of *lelna* people and the knowledge of medicinal plant species was demonstrated by Kankara *et al.*[28] Interestingly, *lelna* people are well known for their active participation in herbal practices, as both men and women, young and elderly, are keenly involved.[30, 31] Several studies conducted recently among these people highlight the indebted knowledge of medicinal plants acquired and the significant contributions made in providing vital information on herbal recipes used as primary health care for diverse diseases, including cancer, jaundice, diabetes, viral diseases, and snakebites.[11, 31- 34]

Plant information and taxonomic biodiversity

In this study, a total of 34 medicinal plant species belonging to 20 families were reported to treat human and animal trypanosomiasis among the inhabitants of Zuru. These plants' families constitute Fabaceae (42.11%), Combretaceae (21.05%) and Euphorbiaceae (15.79%) as the most abundant taxa reported (Figure 3). The plants' botanical names, family names, local names, plant parts used, number of respondents citation, relative frequency of citation, report of published research on trypanosomiasis, duration of experience in the use of plant, method of preparation and routes of administration are shown in (Table 2). The local names and botanical names were sorted from online and hard copy literature.

The prevalence of Fabaceae, Combretaceae, and Euphorbiaceae families in medicinal use in this study is not new as previous studies have reported similar findings.[27, 35] Fabaceae are known as the third-largest family and are of great ethnobotanical importance in indigenous and urban communities throughout the world.[36] The therapeutic potentials of Fabaceae have been attributed to the presence of flavonoids, tannins, saponins, alkaloids, and terpenes which are known to possess high levels of bioactivity.[37,38] This could be the rationale for the treatment of trypanosomiasis as reported in this study. The high occurrence of the Fabaceae could be explained by the fact that most species belonging to the Fabaceae family are mostly found throughout the seasons because they are adapted to withstand the adverse effects of dry regions.[39] Frequent use of Fabaceae family might also be due to the presence of glycosides, tannins, flavonoids, saponins and sterols and triterpenes, as well as antioxidant activities in the members of the family.[27, 38, 40]

Table 1: Socio-demographic data of respondents.

Biodata	Frequency	Percentage (%)
Gender		
Male	68	65.38
Female	36	34.62
Total	104	100
Age Distribution (Years)		
15-25	7	6.73
26-35	18	17.31
36-45	21	20.19
46-55	23	22.12
56-65	16	15.38
>66	19	18.27
Marital Status		
Married	73	70.19
Unmarried	6	5.77
Widowed	25	24.04
Educational Background		
Illiterate	102	98.08
Elementary School level	2	1.92
Secondary School level	None	None
High School level	None	None
Higher education	None	None

The study also revealed that, the most frequently cited plants against trypanosomiasis are *Rogeria adenophylla*, *Ricinus communis* J. Gay.Ex Delile, *Combretum collinum* (Fresen.), *Jatropha curcas* (Linn.) and *Combretum molle* R. Br.ex G.Don while *Mangifera indica* (Linn.), *Boswellia dalzieli* (Hutch), *Carica papaya* (Linn.), *Psidium guajava* (Linn.) and *Hibiscus sabdariffa* (Linn.) were the least cited

plant species (Figure 4). *Rogeria adenophylla* J.Gay.Ex Delile, *Bauhinia rufescens* (Lam.), *Balanites aegyptiaca* (Linn.) Delile and *Boswellia dalzieli* (Hutch) have been shown to be in use for decades as traditional remedy against trypanosomiasis while *Combretum collinum* (Fresen.) and *Psidium guajava* (Linn.) were recorded as least traditional remedy used against trypanosomiasis based on the duration of usage of the plant species (Table 2). This study was able to identify the former mentioned plant species as the species with a prolonged knowledge of use against trypanosomiasis over the later mentioned plant species.

The Relative frequency of citations (RFC) of commonly mentioned plants is *Rogeria adenophylla* J. Gay.Ex Delile and *Ricinus communis* (Linn.) (9.62%), *Combretum collinum* (Fresen.), *Jatropha curcas* (Linn.) and *Combretum molle* R. Br.ex G.Don (8.65%), *Acacia nilotica* (DC.) and *Parkinsonia aculeate* (Jacq.) R.Br.ex G.Don (7.70%), *Combretum hypopilium* (Diels) and *Moringa oleifera* (Lam.) (6.73%), *Piliostigma reticulatum* (DC.) Hochst, *Vitex diniana* (Sweet), *Khaya senegalensis* (Desr.) A. Juss. and *Hymenocardia acida* (Tul.) (5.77%) (Figure 5). The result also revealed that most (79.41%) of the antitrypanosomal remedies mentioned by the respondents have been duly validated scientifically by a literature search (Table 2). *Rogeria adenophylla* J. Gay. Ex Delile, *Ricinus communis* (Linn.) and *Combretum collinum* (Fresen) had a fidelity level of 100%, 91% and 82% as presented in (Table 3) and ranked highest in treatment of trypanosomiasis respectively. The potential of these plants to treat trypanosomiasis has not been reported in the literature at the time of this research report, as shown in (Table 2).

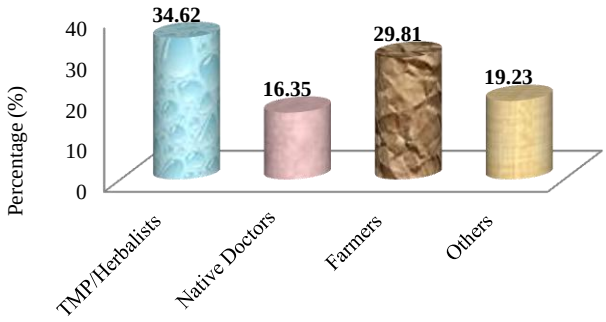

Figure 2: Occupational Status of the Respondents
TMP – Traditional Medicine Practitioners, Others- (hunters, housewives, the elderly and apprentices)

The Informant consensus factor (ICF) of the cited plants specie is presented in (Table 4). The result revealed that disease categories such as neglected tropical parasitic diseases, respiratory and throat diseases, metabolic disorders, general health conditions and blood or cardiovascular disorders had the highest ICF values, between 0.60-0.68. This means that there is agreement among all the respondents who cited the specific species used in the treatment of those ailments. This implies that Zuru Local Government Area of Kebbi State is enriched with the aforementioned medicinal plants despite the effect of human activities on different plant species.

Plant parts, mode of preparation and administration against trypanosomiasis

The plant parts most often utilized as herbal preparations against trypanosomiasis are the leaves (39%) followed by stem bark (16%), roots (14%), Seeds or Fruits (10%), whole plant (7%) and flowers (4%) respectively (Figure 6). The respondents have shown preference for the use of leaves and stem-bark for traditional treatment of trypanosomiasis. It was reported that the predominance in the use of leaves could also be due to their fast regeneration, effectiveness, easier collection, the photosynthetic and biosynthetic activities which lead to the production of most bioactive substances Adia *et al.*[41,81] and avoiding the extinction of the plant species as in the case of plant root collection.[27] Previously, it was reported that leaves and stem bark are the ideal areas for secondary metabolite manufacturing and storage, which are responsible for the plant's biological characteristics.[42]

The most common methods of preparation and administration of the traditional remedies were decoction (45%) and oral intake respectively (Figure 7). Similarly, the mode of herbal remedy preparation and administration reported herein are related to the recently reported study by Asiimwe *et al.*[27,81] Previous reports have revealed that unauthenticated consumption of medicinal plants as traditional medication presented a serious toxicological effect.[43, 44] Therefore, this calls for the need to document and scientifically validate such medicinal plants so as to create awareness about any observed toxicological consequences.

Mode of diagnosis of trypanosomiasis by lelna herbal practitioners

The *lelna* people of Zuru, Kebbi State, have not developed any specific tool for diagnosis, as the patients are mostly presented to the traditional healer for consultation most often at the late stage of infection, showing clinical signs of trypanosomal infection such as skin rash and itching, fatigue, weakness, personality changes, disturbance in the sleep-wake cycle, poor coordination, confusion, and difficulty walking and speaking in humans while in animals fatalities, abortions, odd aggression, aimless running and collapse in severely stressed and overworked animals, similar symptoms were reported by WHO. [5]

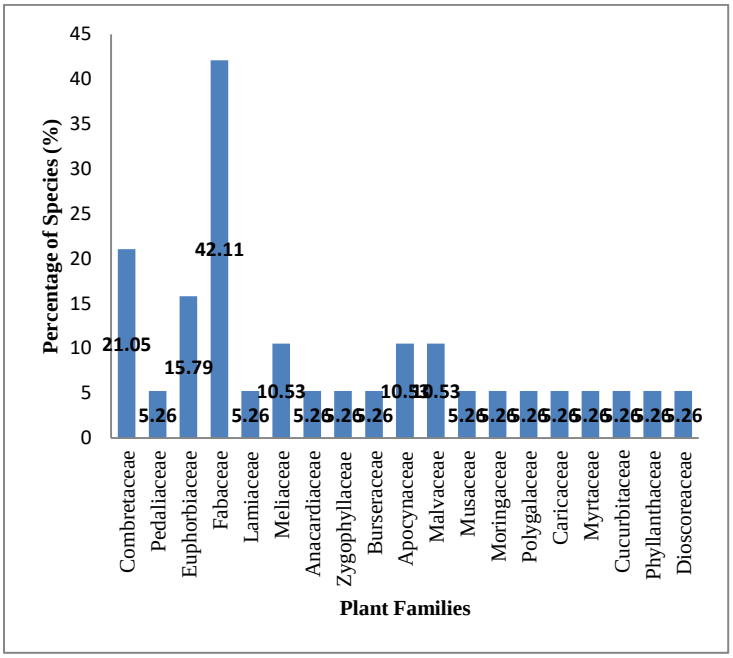

Figure 3: Family distribution of the documented plants use for traditional herbal treatment of trypanosomiasis in Zuru, Kebbi State

Conclusion

This study has documented some potential medicinal plants utilized against trypanosomiasis for both human and animal treatment in Zuru, Kebbi State, Nigeria. This is reflected in the high diversity of the recorded species used as antitrypanosomal and other medicinal purposes. Pharmacological studies on the plants with high relative frequency of citation, fidelity level, informant consensus factor and duration of use value are needed to validate their use in the treatment of trypanosomiasis and other therapeutic applications. Further research on the identification of the plants' active principles could lead to unveiling of new potential trypanoside drugs and determine their safety through toxicological studies

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

Acknowledgments

The authors are grateful to Prof. Dharmendra Singh of the Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology, Aliero and Mr. Obadiah Caleb Dikko, Department of Biological Sciences, Federal University Birnin Kebbi, Kebbi State, Nigeria for their contributions during plant authentication exercise. This study is based on the information obtained from the rural *Lelna* people in Zuru Local Government Area, Kebbi State, Nigeria who acquired the knowledge for over many decades. Without this knowledge of traditional use of plants to treat trypanosomiasis this information could not be put together.

Table 2: Medicinal plants used for the treatment of trypanosomiasis in Zuru Local Government Area, Kebbi State, Nigeria

Botanical Name	Family	Local Name (Hausa/C'lela)	PPU	VN	FC	DPU	RFC	Other Traditional Uses	Method of Preparation	Routes of Administration	RPRT
Combretum collinum (Fresen)	Combretaceae	taramniya fara/urgu púsú	RB., L.	KSUSTA/PSB/H/321A	9	17.73	8.65	Cough, wound healing	Decoction and powder	Oral	[45]
Combretum hypopilium (Diels)	Combretaceae	jár táráuníyá/urgu jozo	R., L.	FUBK/H/155	7	20.67	6.73	Malaria, diabetes, bleeding, diarrhea	Powder and Decoction	Oral	Nil
Rogeria adenophylla J. Gay. Ex Delile	Pedaliaceae	báábáá ròòdóó/ninmolo	L., F.	KSUSTA/PSB/H/152A	10	43.40	9.62	Wounds and inflammations	Powder.	Oral	Nil
Ricinus communis (Linn.)	Euphorbiaceae	dán kwásáré/kwonko toro	L., S.	KSUSTA/PSB/H/249A	10	20.40	9.62	Constipation, muscle/backaches, menstrual cramps	Powder and Decoction	Oral	Nil
Jatropha curcas (Linn.)	Euphorbiaceae	bíí ní dá zúgúú/loglogo	SB. S	FUBK/H/146	9	31.00	8.65	Contra septic pills, heart burn, tooth ache	Decoction	Oral	[46, 47]
Acacia nilotica (Linn.)	Fabaceae	bagaruwa/ghogoruwa	S., L.	KSUSTA/PSB/H/284	8	27.20	7.70	Cough, liver problems, ulcer, dysentery, toothache	Decoction or Maceration	Oral	[48-50]
Piliostigma reticulatum (DC.) Hochst.	Fabaceae	kalgo/boma	SB.	KSUSTA/PSB/H/109	6	29.17	5.77	Malaria, cough, liver problems and diarrhea	Decoction	Oral	[51]
Vitex doniana (Sweet)	Lamiaceae	dinyaa/rhon	SB., L.	KSUSTA/PSB/H/307	6	32.67	5.77	Dysentery, pores, diarrhea	Decoction	Oral	[46, 52]
Acacia	Fabaceae	farar	L,	KSUS	3	22.	2.8	Rheumatism,	Decoction	Oral and	[49]

sieberiana (DC.)		kaya/hilokpusni	SB.	TA/PSB/H/284A		67	8	eye inflammation	and Direct	Dermis	
Bauhinia rufescens (Lam.)	Fabaceae	matsagi (*hausa*)	R.	KSUSTA/PSB/H/253	2	40.00	1.92	Syphilis, leprosy, chest pain and diarrhea	Maceration	Oral	Nil
Khaya senegalensis (Desr.) A. Juss.	Meliaceae	mádàácíí/komo	SB.	KSUSTA/PSB/H/61A	6	32.33	5.77	Skin infection, syphilis, typhoid, ulcer and sores	Decoction or Maceration	Oral and dermal	[53 - 55]
Anogeissus leiocarpus (DC.) Guill. & Perr.	Combretaceae	márkéé/hyuru	R., L.	KSUSTA/PSB/H/512	3	26.67	2.88	Malaria fever, Stomach disorders, ulcer	Decoction, Maceration and Powder	Oral	[56]
Mangifera indica (Linn.)	Anacardiaceae	màngwàrò/c'mongoro	L., FR.	KSUSTA/PSB/H/063	1	35.00	0.96	Bacterial infection, liver problems	Decoction, Direct and Juice	Oral	[57, 58]
Balanites aegyptiaca (Linn.) Delile	Zygophyllaceae	ádúúwàà/baro	FR.	KSUSTA/PSB/H/029	2	41.00	1.92	Liver diseases, ulcer, skin infections	Maceration	Oral and Bathing	[59]
Boswellia dalzielii (Hutch)	Burseraceae	hano/kosmahun	SB., L.	FUBK/H/147	1	41.00	0.96	Boost milk production	Decoction and Maceration.	Oral and Bathing	[48, 60]
Azadirachta indica (A. Juss.)	Meliaceae	dogon yaro (hausa)	SB., L.	KSUSTA/PSB/H/061	2	37.00	1.92	Malaria, jaundice, dysentery, skin diseases	Decoction	Oral	[61]
Calotropis procera (Aiton) W.T.Aiton	Apocynaceae	tùmfááfìyáá/pukpuku	L., SB.	KSUSTA/PSB/H/003	3	37.67	2.88	Jaundice, Skin infection, neural disorders, antidote	Powder	Oral	[62, 63]
Waltheria indica (Linn.)	Malvaceae	hànkúfáá (*hausa*)	L.	FUBK/H/148	1	28.00	0.96	Malaria fever, diarrhea and hypertension	Decoction and Powder	Oral	[64, 65]
Tacazzea apiculata (Oliv.)	Apocynaceae	yààdííyár kádàà (*hausa*)	L.	FUBK/H/149	4	28.25	3.85	Pains, Skin infection, cancer	Powdered form	Oral	Nil
Musa sapientum (Linn.)	Musaceae	àyàbà/c'áyaba	F., FR.	FUBK/H/150	3	36.33	2.88	Ulcer, diarrhea hypertension	Direct, Juice and Decoction	Oral	Nil
Euphorbia hirta	Euphorbiac	nòònòn	L.,	KSUS	4	28.	3.8	Lungs	Power.	Oral and	[66, 67]

(Linn.)	eae	kùrcìyàà/yomgorba	R.	TA/PSB/H/279		00	5	disorders, wound healing, gonorrhea, tumor		Dermal	
Moringa oleifera (Lam.)	Moringaceae	zógálé/zeggroghandi	L., S.	KSUSTA/PSB/H/121	7	26.86	6.73	Malaria, paralysis, manage high blood pressure	Decoction and Direct	Oral	[54, 68]
Hibiscus sabdariffa (Linn.)	Malvaceae	zóóbàródòò/c'barkta	L., S.	FUBK/H/151	1	24.00	0.96	Manage high blood pressure	Decoction and Direct	Oral	[69]
Securidaca longepedunculata (Fresen.)	Polygalaceae	úúwár máágúngúnà (*hausa*)	R., SB.	KSUSTA/PSB/H/287	2	37.00	1.92	Chest pain, cough, dislocation, tuberculosis	Decoction	Oral	[70]
Carica papaya (Linn.)	Caricaceae	gwándà/c'gonda	L., S.	KSUSTA/PSB/H/066A	1	37.00	0.96	Malaria, Stops vomiting in children	Decoction and Powder.	Oral	[57]
Psidium guajava (Linn.)	Myrtaceae	gwéébàà/c'gweba	L., FR.	KSUSTA/PSB/H/067	1	16.00	0.96	Low sperm count, malaria, Cholera, stop vomiting, menstruation	Decoction and Maceration	Oral and Bathing	[71-73]
Citrullus lanatus (Thunb.)	Cucurbitaceae	kánkánáá/guna	FR., S.	KSUSTA/PSB/H/285A	2	20.50	1.92	Kidney stone, alcohol poisoning, gonorrhea, diabetes	Direct and Juice	Oral	[74]
Hymenocardia acida (Tul.)	Phyllanthaceae	ján yáárò (*hausa*)	L., SB., RB.	FUBK/H/152	6	29.17	5.77	Sickle cell, malaria, chest pain, migraine, eye infection	Decoction	Oral	[48, 75]
Parkia biglobosa (Jacq.) R.Br.ex G.Don	Fabaceae	dóòráwà/golo	F., L., SB.	KSUSTA/PSB/H/281	4	29.00	3.85	Wound, Stomach disorders and dysentery	Decoction and Juice.	Oral	[76]
Senna occidentalis (Linn.)	Fabaceae	sàngáásàngàà/c'sangasanga	L., S., R.	KSUSTA/PSB/H/071	2	38.50	1.92	Malaria and typhoid fever, hepatitis, cough	Decoction	Bathing and Oral	[77]

Combretum molle R.Br.ex G.Don	Combretaceae	wuyan damo/whirya	R., L.	FUB K/H/145	9	26.44	8.65	Typhoid, malaria, inflammation syphilis, tuberculosis	Decoction and Maceration	Oral	[78]
Parkinsonia aculeate (Linn.)	Fabaceae	bagaaruuwar makka (*hausa*)	SB., L.	FUB K/H/153	8	24.50	7.70	Virginal infection, malaria, fever, diabetes	Decoction and Maceration	Oral	[62]
Detarium macrocarpum (Harms)	Fabaceae	taura/goga	R., L., FR.	FUB K/H/154	3	21.50	2.88	Diarrhea, dysentery and gonorrhea	Decoction/ Maceration and Direct	Oral	[79]
Dioscorea bulbifera (Linn.)	Dioscoreaceae	tuwon biri/legale	R., L., FR.	KSUSTA/PSB/H/121	1	24.00	0.96	Asthma, ulcer, pneumonia and dysentery	Decoction/ Maceration and Direct	Oral	[80]

Abbreviations: PPU- Plant Parts Used, VN- Voucher Number, FC- Frequency of Citation, DPU- Duration of Plant Use, RFC- Relative frequency of citations, RPRT-Reports of Published Research on Trypanosomiasis, R-Root, S-Seed, SB-Stem Bark, L-Leaves, F-Flower, FR-Fruits, RB-Root Bark.

Table 3. Fidelity levels of the most frequently reported plants and their major uses

Plant species	Family	Therapeutic use	N_p	N	FL (%)
Combretum collinum (Fresen)	Combretaceae	Trypanosomiasis	9	11	82
Combretum hypopilium (Diels)	Combretaceae	Cough and Sore throat	7	8	88
Rogeria adenophylla J. Gay. Ex Delile	Pedaliaceae	Trypanosomiasis	10	10	100
Ricinus communis (Linn.)	Euphorbiaceae	Trypanosomiasis	10	11	91
Jatropha curcas (Linn.)	Euphorbiaceae	Contra septic pills	7	9	78
Acacia nilotica (Linn.)	Fabaceae	Dysentery	8	10	80
Piliostigma reticulatum (DC.) Hochst.	Fabaceae	Diarrhea	5	6	83
Vitex doniana (Sweet)	Lamiaceae	Dysentery	6	19	32
Khaya senegalensis (Desr.) A. Juss.	Meliaceae	Ulcer and Sores	6	10	60
Moringa oleifera (Lam.)	Moringaceae	Hypertension	7	16	44
Hymenocardia acida (Tul.)	Phyllanthaceae	Typhoid	6	9	67
Combretum molle R.Br.ex G.Don	Combretaceae	Syphillis	9	13	69
Parkinsonia aculeate (Linn.)	Fabaceae	Malaria	8	18	44

Key: N_p- number of respondents who use specie(s) for a specific ailment, N- total number of respondents who mentioned the plant for any other use, FL- fidelity level

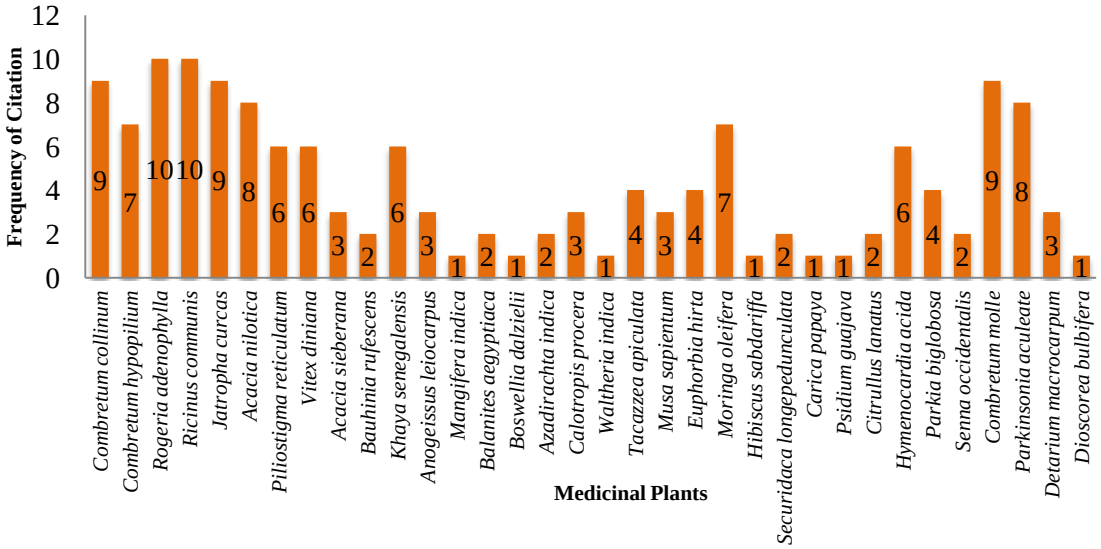

Figure 4: Medicinal plants cited for traditional treatment of trypanosomiasis in Zuru, Kebbi State

Table 4. ICF values of Medicinal Plants used for Treatment of Trypanosomiasis in Zuru, Kebbi State, Nigeria.

Disease Categories	Some Recorded Ailments	No. species (N_t)	No. use-reports (N_{ur})	ICF
Neglected tropical parasitic diseases	Human African Trypanosomiasis, Malaria, Onchocerciasis	34	104	0.68
Blood and cardiovascular disorders	Anemia, Heart burns, Bleeding, High Blood Pressure, Stroke	7	16	0.60
Nervous system disorders	Psychotic disorders, Migraine, Convulsions, Epilepsy etc	2	3	0.50
Gastro-intestinal tract (GIT) disorders	Diarrhoea, Dysentery, Dyspepsia, Gallbladder, Stomach Pains, Liver Infections, Pancreas Problems, Oedema, Typhoid, Cholera, Ulcer etc	34	63	0.47
General health conditions (GHC)	Pains, Headache, Allergies, Fevers, Sun Burns, Flu, Colds, Cough, Vomiting, weakness and Appetite lost.	17	44	0.63
Skeletomuscular disorders	Muscle, Joint, Bones pain, Rheumatism	3	4	0.33
Skin and hair diseases	Eczema, Acne, Ringworm, allergies	5	8	0.43
Respiratory and throat diseases	Ear, Nose, Eyes, Lungs and Mouth Infections, Asthma, Pneumonia	4	10	0.67
Poison infection due to stings/bites	Scorpion stings and snake bites	2	3	0.50
Metabolic Disorders	Diabetes, Gaucher's Diseases etc	3	7	0.67
Urogenital Disorders	Urinary Tract and reproductive organs infections.	11	23	0.55

Key: N_t - number of species used for that use category, N_{ur} - number of use-reports in each disease category, ICF - Informant Consensus Factor.

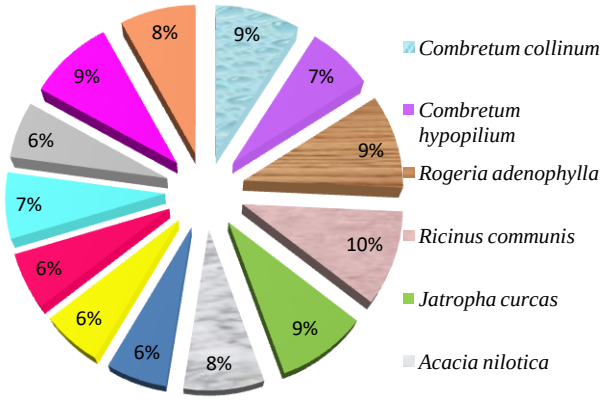

Figure 5: Use value index ranking of most frequently used medicinal plant species against trypanosomiasis.

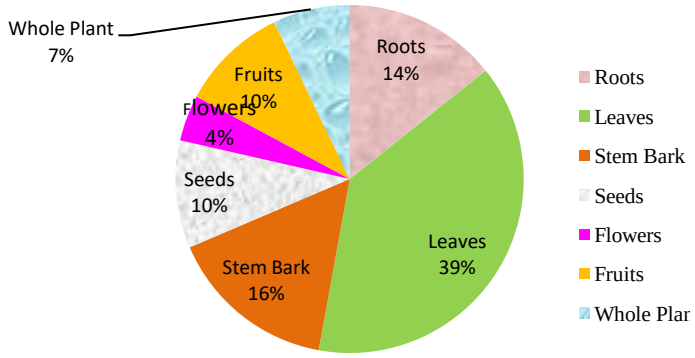

Figure 6: Plants parts used for traditional treatment of trypanosomiasis in Zuru, Kebbi State

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