

Ethnobotany of Medicinal Plants with Antidiabetic Potentials in Northern Nigeria

M. Usman¹ & M.D. Abdulrahman² & M. C. Emere¹ & G. A. Ajibade¹

¹Biological Sciences Department, Nigerian Defence Academy, Kaduna. Kaduna, Nigeria

²Department of Biology, Faculty of Education, Tishk International University Erbil, Iraq

Correspondence: M.Usman, Nigerian Defence Academy, Kaduna, Nigeria.

Email: othmanmshitu@gmail.com

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Abstract: Kaduna is known for its diverse wealth of traditional medicines and major markets of traditional medicines. However, the survey was conducted in these areas in order to have an inventory of the plants used traditionally for the treatment of Diabetes. A non-random sampling method was used in the selection of participants and open-ended questionnaires were administered to the age group of 20 and above for the collection of data. A total of 56 informants were interviewed. This study revealed 38 species of medicinal plants. Fabaceae and Rhamnaceae family have the highest abundance. The fidelity level of most agreed plant species are *Anisopus mannii* (74.48%), *Commiphora kerstingii* (70.58%) and *Annona senegalensis* (69.58). Bark accounted for 37.5% of the most utilized parts, while decoction and oral were the most utilized methods of preparation and utilization at 35.7% and 76.8% respectively. The study showed vast knowledge of the respondents and also enormous varieties of medicinal plants in the study area. Thus, conservation of these wild plants with diabetes therapeutic value to avoid extinction is necessary. However, this study recommends further biological investigations to confirm the compound responsible for antidiabetic activity.

Keywords: Diabetes Mellitus, Ethnobotany, Medicinal Plants, Nigeria

1. Background

Diabetes mellitus is a complex metabolic disorder characterized by the derangement of glucose homeostasis or chronic hyperglycaemia resulting from defects in insulin secretion, insulin action or both (Ozougwu et al., 2013). The liver, muscle and adipose tissue in the body system usually fails to take up and utilize glucose from circulation in the blood when insulin level is low (Ozougwu et al., 2013). This results in upraised blood glucose level, which resulted to a condition known as hyperglycaemia. Impaired insulin secretion and action resulting from persistent hyperglycaemia vitiates pancreatic β -cells, thus affecting glucose utilization in peripheral tissues (Manosroi, et al., 2011). Once blood glucose level remains high over a long period of time, can result to long-term damage of organs such as the kidneys, eyes, nerves, heart, and blood vessels. Complications in some of these organs can lead to death. Diabetes Mellitus is ranked seventh among the leading causes of death and is considered third when its fatal complications are taken into account. About 371 million people have been estimated worldwide to suffer from diabetes mellitus and thus, declared a global emergency of the 21st century because of its rising global prevalence (Gleeson, 2000). In Africa, 14.2 million people have been reported with diabetes mellitus as at 2015 and it's expected to raise 34.2 million by 2040 (Assah & Mbanya, 2017).

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Nigeria presently, has about 1.6 million people with diabetes mellitus which is the third most affected country in the Africa region and the reason for blowup in the prevalence have been adduced to demographic ageing, rapid urbanization and globalization of unhealthy lifestyles (Olaofe, 2015). It was reported by Mahmoud et al. (2019) there are relatively high prevalence of diabetes mellitus among urban communities (predominantly civil servant, businessmen and traders) in Kaduna State. Despite this reality, most individuals with diabetes are unaware of their state and therefore, are unable to take preventive measures to avoid complications (Abdulrahman, Ali, & Moneruzzaman). Also, lack of understanding of the enormities of the disease is a clear barrier at various levels, to effective preventive strategies that could help halt these trends (Lang & Rayner, 2007). In Africa, particularly Nigeria, medicinal plants are still the major source of medicine in primary health care among over 300 tribes of the country (Ibrahim et al., 2007). Medicinal plants have been used to treat several ailments such as malaria, epilepsy, sickle cell anaemia, bronchial asthma and diabetes (Oshikoya et al., 2008). Despite the tremendous advancement of the conventional drugs in the treatment of diabetes, but still have several limitations. Thus, this lead for further research to understand the causes of the disease for effective therapies in prevention and management of the disease (Alam et al., 2014). Plants are well known in traditional medicine for their hypoglycaemic activities and also the advantage of having no side effects. In this context, WHO has recommended studies on medicinal plants and herbs to be validated for their hypoglycaemic potentials (Gurib-Fakim, 2006). Scientists are still investigating various plant species for their potential effects due to the high demand of natural products and this includes an initial ethnobotanical study to ascertain Fidelity level and most frequently utilized species to further validate their use scientifically (Tounekti et al., 2019). Kaduna state of Nigeria is located between latitude 10° 20'N and 7° 45'E. It has the Sudan savannah type of climate and vegetation characterised by scattered short trees, shrubs and grasses which gradually gives way to semi-arid conditions northward. It is a part of the Hausa land where ethnomedicine is recognized and practiced (Negbenebor et al., 2017). The area is rich in plants with high medicinal value, it also has a long history of civilization as such the use of medicinal herbs is a heritage. Furthermore, the relative high cost of conventional drugs, economic challenges and side effects associated makes most people to return on the use of medicinal plants as an alternative medicine in the area. Our study therefore aims to document and also showcase the percentages of informants most preferred species used in the traditional treatment of diabetes in Kaduna so as to provide a base line for further biological investigations of the plant with highest percentage (Fidelity level)

2. Materials and Methods

2.1 Study Area

The study was conducted in Kaduna State Northern West, Nigeria. Kaduna state vegetation cover is Sudan savannah and also characterised by scattered short trees, shrubs and grasses. It is ranked 4th by land area and 3rd by population in Nigeria. Also lies along the Kaduna River, which is a major tributary of the Niger River, it is a centre of education with a large military academy and a few colleges located in the state. The inhabitants are mainly civil servants, Businessmen, traders, and farmers. Kaduna state comprises of three senatorial Zones referred to Kaduna North, Kaduna central and Kaduna South. The research was conducted in three traditional herbal markets of Kaduna state. A major herbalist market was selected in each of the three zones; (Zone one; kasuwa Monday herbal market, Zone two; kawo herbal market and Zone three; kasuwan magani herbal market).

2.2 Data Collection and Questionnaire

The data was collected from informants (traditional medical practitioners, herbalist, as well as herbal sellers) using semi structured questionnaire. The questionnaire was validated by three professional botanists and pre-tested before employed in the study. The procedures of non-random probability sampling (method of expert sampling) were applied in this research. Sampling size is therefore not needed to be determined in this sampling method. The informants received prior informed consent and research ideas was discussed. After prior consent with each participant, data were obtained through face-to-face interviews held with participants using semi-structured questionnaires. Only informants who attained the age of 30 and above were interviewed and a total of 56 informants were interviewed, and no prior appointment was made with the informants. The study was carried out between February and December 2020.

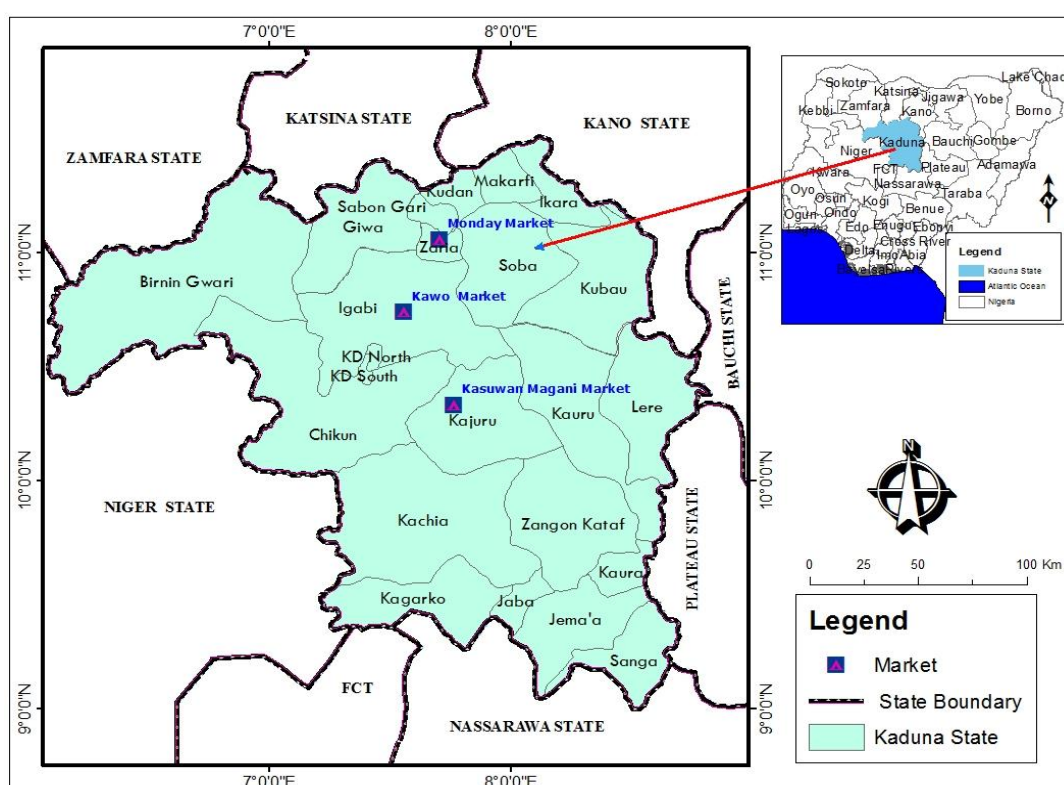


Figure 1: Geographic location of herbalist market in Kaduna State where the survey was carried out

2.3 Herbarium Deposition and Taxonomic Identification

Plant species were collected from home, gardens, and natural habitats. The collected plants local names were provided by the herbalist while the scientific names were validated and identified in the herbarium. The voucher specimens of the reported plants were prepared, labelled, and deposited in the Herbarium of the Department of Biological Sciences, Ahmadu Bello University Zaria, Nigeria.

2.4 Data Analysis

Descriptive analysis of obtained ethnobotanical data employed to determine the percentage and frequencies, thereafter, tabulated based on the information below:

1. Socio demographic profile of the informants
2. Taxonomic information, mode of preparations, mode of administrations, parts of plant utilized and growth form.
3. Quantitative analysis based on Fidelity level of the plants.

Fidelity level (FL) is the percentage of informants who mentioned the use of certain plant species to treat a particular ailment in a study area. The value was calculated using the formula $FL (\%) = \frac{NP}{N} \times 100$

Where: Np is the number of informants that claimed a use of a plant species to treat a particular disease and N is the number of informants that used plants as a medicine to treat any given disease (Friedman et al. 1986). The maximum FL indicates the frequency and optimal usage of the plant species for treating a particular ailment by the informants of that study area.

3. Results

3.1 Demographic information of the Informants

All the informants interviewed were either herbalist or traditional herbal practitioner. The study interviewed a total of 56 informants from three zones of Kaduna State Northern part of Nigeria. Among these informants, 71.4% were male and the remaining 28.6% were female (Table 1 and Figure 2). In general, informants with average age of 61-80 were mostly interviewed, accounting for 64.3% of the total number. This was closely followed by those whose age were between 41- 60 (21.4%) and the least category age of the informants interviewed was 20-40 with 10.7% (Table 1). Majority of the informants interviewed (39.3%) did not attend western education, while 42.9% attended basic education (primary school). 8.9% attend post basic education (secondary school) while only 8.9% of the informants had tertiary education (Table 1).

Table 1: Demographic Information of the informants in Kaduna Area

Variable	Frequency	Percentage %	Ratio
Gender			
Male	40	71.4	0.714
Female	16	28.6	0.286
Age			
20-40	6	10.7	0.107
41-60	12	21.4	0.214
61-80	36	64.3	0.643
81>	2	3.6	0.036
Education			
None	22	39.3	0.393
Basic	24	42.9	0.429
Post Basic	5	8.9	0.089
Tertiary	5	8.9	0.089

3.2 Detailed Information of Plants and Taxonomic Diversity

A total number of thirty species (30) of medicinal plants from thirty-eight (38) families were reported to be used by ethnic group in the Kaduna Areas of Northern part of Nigeria for the treatment of Diabetes. Detailed information of the plants is presented in (Table 2). It provides the comprehensive information on the family of the plant, botanical name of the plants, English and Hausa names of the plants, domestication status of the plants, form of growth, parts of plant used and mode of administration to the patient with Diabetes. Fabaceae and Rhamnaceae was reported to be more abundant, followed by Anacardiaceae, Moraceae and Meliaceae.

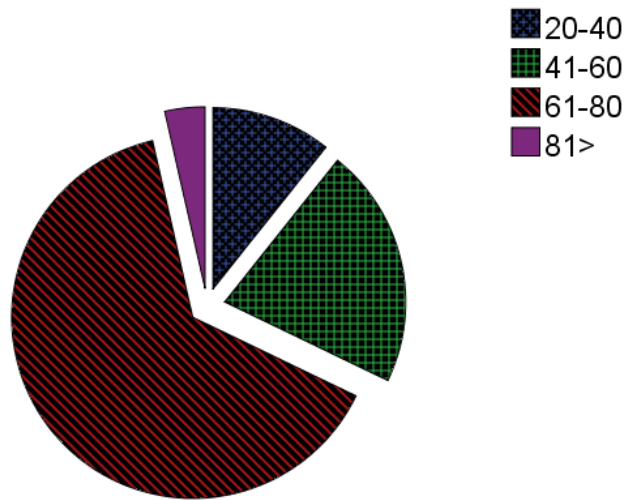


Figure 2: Demographic age of informants

3.3 Dosage, Parts of the Plants Utilized, Modes of Preparation and Administration

No recommended amount of dosage was reported by the informants in the study area, but some of the herbalist and traditional herbal practitioner believed that the factors considered for the dosage of patient with Diabetes are symptoms, severity, and age. The Bark were the most utilized plant part (37.5%) for the treatment, followed by the leaves (32.1%), whole plants (16.1%) and Roots (14.3%) (Figure 4). While the methods for preparation; Decoction constituted about 35.7%, Maceration 28.6%, Poultice 8.9%, Powdered 7.1% and Infusion 19.6%, respectively (Figure 5).

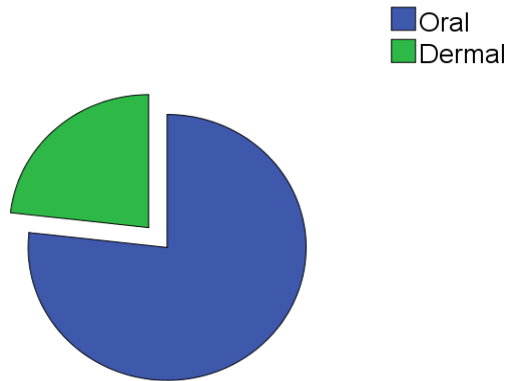


Figure 3: Method of administration of traditional medicine from the informant of Kaduna, Northern Nigeria

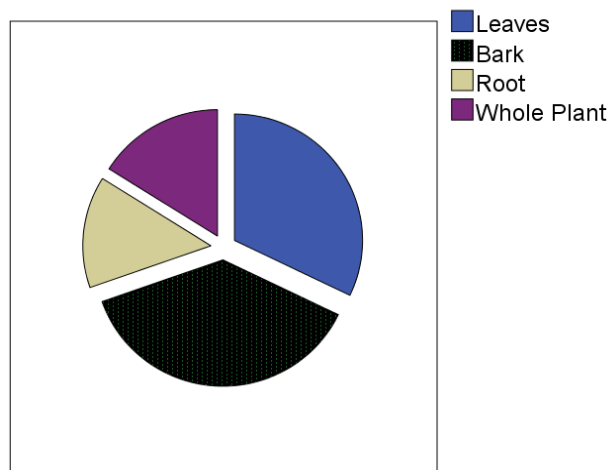


Figure 4: Parts of plant used in preparation of traditional medicine from the informants

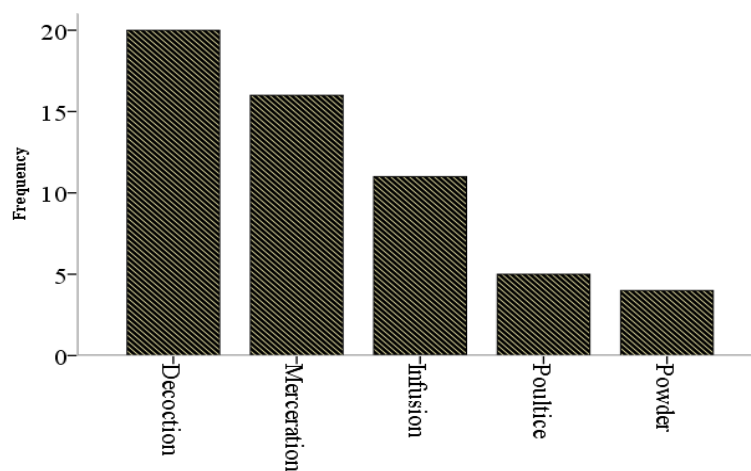


Figure 5: Methods of preparation of traditional medicine from the informants toxicity

The informants revealed that the species listed in this study have not been previously reported to be toxic, to the best of their knowledge. However, they also believed that information gathered from their forefathers that, medicinal plants could only be toxic as a result of over dosage or misidentification of plant species.

Table 2: Ethnobotanical list of plants used for the treatment of Diabetes in the Kaduna area

Punicaceae	<i>Punica granatum</i> L.	Pomegranate	Ruman	Stem bark	W/C	Shrub	37.50	ABU08172
Burseraceae	<i>Commiphora kerstingii</i> Engl.		Ararrabi	Leaves	W	Tree	70.58	ABU0671
Caricaceae	<i>Carica papaya</i> L.	Pawpaw	Gwada	Leaves	W/C	Tree	50.00	ABU04714
Combretaceae	<i>Guiera senegalensis</i> J.F.Gmel	Guiera	Sabara	Leaves/ Roots	W	Herbs	64.01	ABU05190
Curcubitaceae	<i>Momordica balsamina</i> Linn	Balsam apple	Garafuni	Whole plant	W	Shrub	64.35	ABU091156
Cyperaceae	<i>Cyperus articulatus</i> L.	Flat sedge	Kajiji	Seeds	W	Herbs	55.01	ABU06451
Euphorbiaceae	<i>Bridelia ferruginea</i> B.	Bridelia	Kirni	Root	W	Tree	40.00	ABU08903
Fabaceae	<i>Pterocarpus erinaceus</i> Poir.	African rosewood	Madobiya	Bark, Roots	W	Tree	47.00	ABU03712

Fabaceae	<i>Prosopis africana</i> Guill.et Perr.	Iron tree	Kiryra	Leaves/ Bark	W	Tree	35.00	ABU06538
Fabaceae	<i>Senna occidentalis</i> L.	Negro coffee	Raidore	Whole plant	W	Herbs	65.21	ABU01203
Moraceae	<i>Ficus platyphylla</i> Del.	Gutta percha tree	Gamji	Stem bark	W	Tree	32.85	ABU01138
Labiatae	<i>Clerodendrum capitatum</i> (willd) Schum.	Glory bower	Taba-Taba	Leaves/ Seeds	W	Shrub	25.70	ABU06662
Fabaceae	<i>Daniellia oliveri</i> (Rolfe) Hutch.	African copaiba balsam	Majee	Stem bark	W	Tree	26.00	ABU090023
Malvaceae	<i>Adonsonia digitata</i> L.	Boabab	Kuka	Bark/ Leaves	W	Tree	26.15	ABU07681
Meliaceae	<i>Khaya senegalensis</i> Desr.	Mahogany	Madachi	Stem Bark	W	Tree	64.00	ABU04590
Meliaceae	<i>Azadirachta indica</i> A. Juss.	Neem tree	Dogon yaro	Bark/ Leaves	W/C	Tree	56.66	ABU09768
Moraceae	<i>Ficus thonningii</i> B.	Loin cloth fig	Cediya	Leaves	W	Tree	42.85	ABU07821
Moraceae	<i>Ficus sycomorus</i> L.	Fig	Baure	Leaves/ Bark/ Root	W	Tree	36.00	ABU090057

Moringaceae	Moringa oleifera Lam	Drumstick	Zogale	Leaves	W/C	Tree	61.25	ABU0517
Musaceae	Musa acuminata Colla	Banana	Ayaba	Root	W/C	Herbs	52.15	ABU08471
Myrtaceae	Syzygium aromaticum L.	Clove	Kanunfari	Seed	W	Herbs	25.70	ABU08461
Myrtaceae	Psidium guajava L	Guava	Gwaiba	Leaves	W/C	Tree	45.21	ABU002
Nymphaeaceae	Nymphaea lotus L.	Water lily	Bado	Whole plant	W	Herbs	40.00	ABU07913
Olacaceae	Ximenia americana Linn.	Hog plum	Tsada	Stem Bark	W	Tree	32.85	ABU07512
Rhamnaceae	Ziziphus mauritiana L.	Indian jujube	Magarya	Leaves/ Bark	W	Tree	30.00	ABU0789
Rhamnaceae	Ziziphus spina-christi L.	Christ thorn	Kurna	Leave /bark/ root	W	Tree	33.75	ABU0612
Rhamnaceae	Ziziphus mucronata Willd	Buffalo thorn	Magaryar kurna	Leave	W	Tree	33.75	ABU09005
Sapindaceae	Lepisanthes tetraphylla (Vahl) Radlk		Karpa	Leaves	W	Tree	33.02	ABU00689

Santalaceae	<i>Thesiuim viride</i> A.W. Hill		Huntu	Root	W	Tree	40.00	ABU0060
Malvaceae	<i>Corchorus olitorius</i> L.	Jute	Rama	Leaves	W	Herbs	18.50	ABU0834
Lamiaceae	<i>Vitex doniana</i> L.	Black plum	Dinya	Leave/ bark	W	Tree	39.31	ABU04517

4. Discussion

It has been established that mankind has been utilizing plants for the cure of ailments for centuries. The traditional system of medicine is described as an integral part of the native community that continue to exist generation upon generation. The World Health Organization (WHO, 2010) described traditional medicinal system as the total knowledge, skills and practices that are based on theories, beliefs, and experiences indigenous to different cultures that are used to maintain health as well as to prevent, diagnose, improve or treat physical and mental illness. Nashriyah et al. (2012) also described traditional medicine as the summation of practice of trials and errors of past generations for the treatment of diseases to improve their health status. Observations from the present study revealed that most of the informants were men, and this might be due to the religious belief of the informants, that women are more domicile and do not often move around the community. The often usage of herbs is commonly observed among aged people is in conformity with the findings of Faleyimu and Oluwalana (2008) who reported that, the older in age makes them more experienced and knowledgeable in the use and the sourcing of the medicinal plants. Thus, this agreed with the demographic information of the informants in this study which showed that the age bracket 60-80 commonly associated with custody of the body of ethno knowledge were the predominant group. This study showcased an inventory that proved a great richness of medicinal plants in Kaduna state, which are also commonly used by the herbalist for the treatment of diabetes. The following are part of the plants mentioned by the informants which includes *A. indica*, *M. indica*, *C. papaya*, *M. acuminata*. This is also in conformity with study conducted in both the southern and western parts of the country on ethnobotany of medicinal plants for the treatment of Diabetes (Abo et al., 2007; Gbolade 2009; Ngbolua et al., 2014; Fred-jaiyesimi et al., 2015). Furthermore, this finding agrees with Shinkafi et al. (2015), who reported that 99% of the 51 respondents interviewed on ethnobotany study of antidiabetic plants used by Hausa-Fulani tribe in Sokoto, northwest Nigeria are males. Our study has documented 38 species of plants from 30 families and the collected plant species values range from 18.50 to 100% (FL) were reported. The informants do not specify any given dosage for administration of medicinal plants; therefore, it is considered as one of their limiting factors. Similarly, no actual dose has ever reported by previous authors with similar studies (Adetutu et al., 2013, Shinkafi et al., 2015, Negbenebor et al., 2017). The plant parts widely used as reported by the informants are bark and leaves, this could be linked to the active ingredients found in higher concentrations in them, thus considered as the most active ingredients (Yemele et al., 2015). This supports the findings of Adekunle 2008 and, Negbenebor et al. (2017). Water is used as solvent in all remedy preparation whilst Decoction was reported to be

most common method used for remedy preparation and has also been reported by recent ethnobotanical studies (Abdulrahman et al., 2020). The reasons why decoction is the most utilized method is as a result of the ability of hot water to extract almost all the compounds in the plant parts. Oral administration is also the most frequent form of utilization in the present study, also combination of more than one plant and plant parts were found to be more effective and believed that some plants enhance the action of other herbs in the treatment of diabetes. Comparatively, the modes of preparation in the north were totally different from that of the southern part of the country. Most of the herbal drugs in the north were in dried form (powder) while in the southern part, the herbal drugs are usually in crude form (liquid) from maceration and decoction process. Lack of regular dosage of traditional medicinal plants pose a serious challenge to the consumption of traditional medicinal plants. Although, traditional medicinal plants are known to be nontoxic but still if taken in excess it can pose a serious challenge to health (Abdulrahman et al., 2018). Despite the fact that this remedy is made from natural sources, their safety is not guaranteed. Most of the respondents claims that rear or no adverse effects occur from the use of remedy but only when misused or abused. This confirmed the findings from previous studies (e.g. Oreagba et al., 2011). Therefore, further investigations are necessary required to justify their claim.

5. Conclusions

The result indicates the vast knowledge of the respondents and also the study area showcased an enormous variety of medicinal plants that are used to treat diabetes. Also, of the 38 inventoried species *A. mannii* (74.48 %) was found to have the highest fidelity level followed by *C. kerstingii* (70.58 %) and *A. senegalensis* (69.58 %). Therefore, this study recommends further biological investigations to confirm, identify and isolate the compounds responsible for antidiabetic activity. Hence, conservation of these wild plants will protect the biodiversity from the treat of future extinction.

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