Ethnobotanical Survey of Plants used in the Management of Sickle Cell Disease in Two Local Government Areas of Kwara State, North-Central Nigeria

Bilqis A. Lawal[1,2*] and [2]Jones O. Moody[2]

[1]-*Department of Pharmacognosy and Drug Development, Faculty of Pharmaceutical Sciences, University of Ilorin, Ilorin, Nigeria*

[2]-*Department of Pharmacognosy, Faculty of Pharmacy, University of Ibadan, Ibadan Nigeria*

*Corresponding author:
B. A. Lawal; Phone No: 234-8033717230 E-mail: umufaridah2013@gmail.com; lawal.ba@unilorin.edu.ng

ABSTRACT

Background: A lot of sufferers of sickle cell disease are left with physical disabilities, low self-esteem and confidence, little or no education and sometimes abject poverty. Medicinal plants have been a source of succour in the control of many diseases in developing countries and sickle cell disease is no exception. This study is aimed at carrying out an ethnobotanical survey for the purpose of documentation of plants used in the management of sickle cell disease (SCD) in one rural area (Irepodun Local Government) and one urban area (Ilorin-West Local Government) of Kwara State.

Methods: Interviews were conducted on plant species and remedies used in the management of sickle cell disease using semi-structured questionnaires and asking open-ended questions. The respondents (n = 40) were mostly traditional medical practitioners. Others were herb sellers, religious healers and patients. The Use Mention Index was calculated for all the plants mentioned both in single and multiple-species remedies; and the frequency and percentage was employed for data analysis.

Result: The ethnobotanical survey afforded a list of some plants used locally for the treatment of sickle cell disease by the people of Irepodun and Ilorin East Local Government Areas, Kwara State. A total of 57 plant species belonging to 34 families were identified. The most prominent among these plant families are the Fabaceae and Euphorbiaceae.

Conclusion: This study showed that Kwara State is blessed with abundant medicinal plant which can be a tool in the search for the management of sickle cell disease. Thus, research interest in medicinal plant as a potential source of new and reliable antisickling agent should be encouraged and adequately funded due to the fact that plants have been established as a reservoir of leads/hits chemical compounds in the drug discovery research.

Key words: Sickle cell disease, Medicinal plants, Ilorin-West Local Government, Irepodun Local Government, Kwara State

INTRODUCTION

Sickle-cell disease (SCD) also known as drepanocytosis, is a chronic hereditary blood disorder characterized by red blood cells that assume an abnormal, rigid, sickle shape caused by a single base substitution in the gene encoding the human hemoglobin subunit[1]. SCD affects millions of people throughout the world[2] but the disease is most prevalent in tropical regions especially among people with recent ancestry in malaria-stricken areas, particularly sub-Saharan Africa, India and the Middle-East[3]. Due to the adaptive advantage of the heterozygote, the prevalence of sickle-cell anaemia where there is no endemic malaria such as among blacks in the USA is lower (approximately 0.25%) than in West Africa (approximately 4.0%) [4]. The abnormally high health-selective pressure through slavery may be the most plausible explanations for the lower prevalence of sickle-cell anaemia (and, possibly, other genetic diseases) among African-Americans compared to Sub-Saharan Africans[5].

Despite the good understanding of the molecular nature of the disease, a cure for sickle cell anemia is still unavailable and life expectancy is shortened. The clinical symptoms of patients suffering from the disease vary widely. Some lead a normal life while others suffer from a variety of life threatening complications. In 2010, there were about 29,000 deaths attributed to sickle cell disease globally[6]. About 90% of patients survive to age 20, and close to 50% survive beyond the fifth decade[7]. In 2001, the estimated mean survival for sickle cell patients was 53 and 58 years for men and women with homozygous SCD respectively[8]. Some of the orthodox modes of treatment include induction of fetal hemoglobin, use of anti-sickling agents that specifically bind to HbS[9], certain amino acids[10], 2-imidazolines such as clotrimazole[11], blood transfusion and hematopoietic cell transplantation[12], as well as the recently developed vaso-active molecules like endothelins[13]. Natural plant extracts and products discovered from medicinal plants have also provided numerous drugs which are being used clinically for different diseases. In spite of various challenges encountered in the medicinal plant-based drug discovery, natural products isolated from plants will remain an essential component in the search for further new medicines[14].

In Nigeria and most parts of developing countries, medicinal plants have been used in the treatment of painful crises associated with sickle cell disease, especially among the lower socio-economic class who cannot afford the high cost of western medicine as well as traditionalists who simply believe in their efficacy. Scientific evaluations are then undertaken to authenticate the traditional use of the plants. However, several recent reports have been documented regarding the *in vitro* and *in vivo* antisickling properties of the extracts from different medicinal plants[15]. Although there is a rich reservoir of some of these medicinal plants, the scientific validation of the potency, quality, safety, and efficacy as well as dosage standardization is still lacking for many of the plants. The socio-economic state of the urban areas as well as the cultural orientation of the rural areas of Kwara state combine to produce a health seeking behavior characterized by low patronage of orthodox medical care and the seeking of alternative medical care such as the exploitation of traditional and herbal medicine practice in the State[16].

Therefore, this study was carried out to identify, document and analyze the traditional knowledge regarding the practice and use of plants as well as methods of preparation of the species used in the management of sickle cell disease in Kwara State.

MATERIALS AND METHODS

Study setting

The study was conducted in two major Local Government Areas (LGA) of Kwara State, namely Ilorin-West and Irepodun Local Government areas. Ilorin West Local Government Area of Kwara State is in the transitional zone between Northern and Southern parts of Nigeria. It has an area of 105 km² and a population of 364,666 at the 2006 census with its headquarters in the town of Oja-Oba (Figure 1). Irepodun is a Local Government Area in Kwara State, Nigeria with its headquarters in the town of Omu Aran. It has an area of 737 km² and a population of 148,610 at the 2006 census. It has very significant Yoruba cultural and historical significance. Irepodun LGA shares boundary with Ifelodun L.G.A. to the North, Osun State to the South, Ekiti and Offa

Local Government to the East and West respectively. It is endowed with Savannah and Rain forest vegetation on a plain terrain with patches of Rivers and Streams (Figure 2).

Figure 1: The map of Ilorin City (Urban Area)

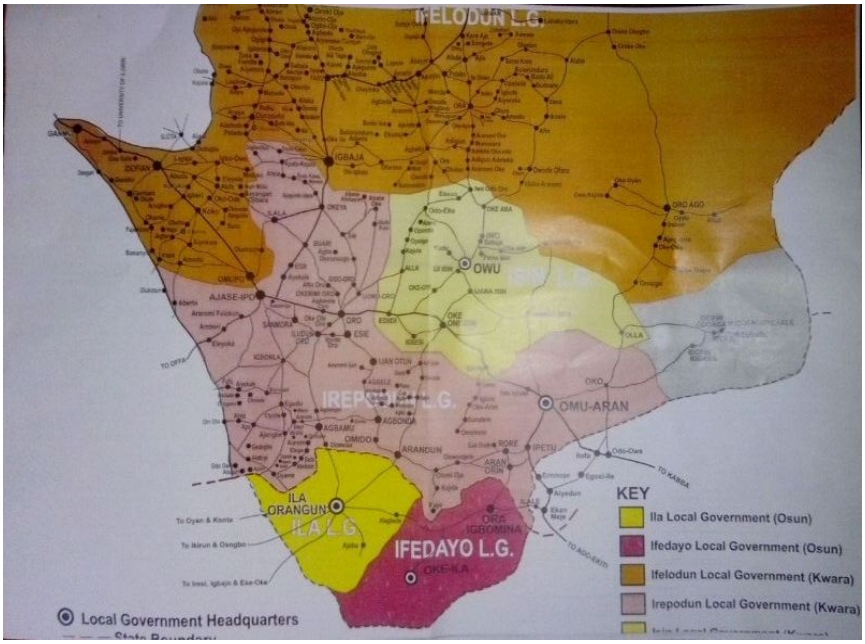

Figure 2: The Map of Irepodun Local Government (Rural area)

Data collection

Information was collected by conducting interview using semi-structured questionnaires and open ended conversation method. The contents of the semi-structured questionnaires were organized using a standard protocol[17,18]. Basic information about locality, scientific and vernacular names, part(s) used, method(s) of preparation of herbal medicines and the record of their similar use in ethnomedicine were collected[19]. Most respondents including the herb sellers and traditional healers were interviewed in the local language for clarity. Informed consent was obtained orally from all participants before the administration of the questionnaires and commencement of interview. The questionnaire was divided into two sections; the first section was demographic information while the other section was knowledge of medicinal plants for management of sickle cell disease through the local name. Samples of the relevant plants were collected in the field while voucher specimens were deposited at the Forest Herbarium Institute of Nigeria for taxonomic identification. The Use Mention Index which is a measure of the validity of the cited plants was calculated by dividing the number of each mentioned plant by the number of respondents for all the plants, both in single and multiple-species remedies. Frequency

and percentage were also employed for data analysis.

RESULTS

The ethnobotanical survey afforded a list of some plants used locally for the treatment of sickle cell disease by the people of Ilorin West and Irepodun Local Government Areas, Kwara State. A total of 57 plant species belonging to 34 families were identified. Table 1 shows the list of identified plant species, families, local names and plant parts used with their UMI and percentages. The most prominent among these plant families are the Fabaceae, with 14% and Euphorbiaceae, with 9%, of the total medicinal plant species mentioned by the respondents. Some of the other reported families include Cucurbitaceae, Asteraceae, Anarcardiaceae, Olacaceae and Combretaceae (Table 2).

The mode of preparation and administration reported in this survey indicated that remedies could be prepared as powders, decoctions (taken orally or used for bath), maceration, and infusion or as a mixture but the powder form was the major method of preparation. Commonly mentioned excipients include potash, camphor and stones. The preparations could also be administered

along with hot pap or palm oil, palm oil base or shea butter (Table 3).

The most used plant part is the leaf accounting for 32.0% of the recipes followed by the roots, fruits and seeds at 18.1%, 13.9% and 12.5% respectively as shown in Figure 3.

Table 1: Medicinal plants used in the management of sickle cell disease in Ilorin West and Irepodun Local Government Area, Kwara State

Scientific Name	Family	Local name (Yoruba)	Part Used	Ilorin -West	Irepodun	UMI (%)
Adenopus breviflorus (Benth.) Roberty	Cucurbitaceae	Tagiri	Fruit	+	-	0.100 (10)
Aframomum melegueta K. Schum.	Zingiberaceae	Atare	Pods Seeds	+	+	0.200 (20)
Ageratum conyzoides L.	Asteraceae	Imi esu	Whole plant	-	+	0.025 (2.5)
Allium ascalinicum L.	Liliaceae	Alubosa elewe	Bulb	+	-	0.050 (5)
Allium cepa L.	Liliaceae	Alubosa funfun	Bulb	+	-	0.025 (2.5)
Allium sativum L.	Liliaceae	Alubosa ayu	Bulb	+	+	0.100 (10)
Alstonia boonei De Wild	Apocynaceae	Awun	Bark	-	+	0.050 (5)
Amaranthus viridis L.	Amaranthaceae	Tete adayeba	Leaves	-	+	0.025 (2.5)
Annona senegalensis Pers.	Annonaceae	Abo	Young leaves Roots	-	+	0.075 (7.5)
Aristolochia ringens Vahl	Aristolochiaceae	Akogun	Root	-	+	0.050 (5)
Artocarpus altilis	Moraceae	Berefurutu	Fruit	+	-	0.025 (2.5)

(Parkinson ex F. A. Zom) Fosberg						
Boerhavia diffusa L.	Nyctaginaceae	Etipon ola	Leaves	+	-	0.025 (2.5)
Bridellia micrantha (Hoschst.) Baill.	Euphorbiaceae	Asa tutu	Leaves (fresh & fermented)	+	-	0.075 (7.5)
Byrsocarpus cocccineus Schumach. & Thonn.	Connaraceae	Amuje wewe	Leaves	-	+	0.025 (2.5)
Cajanus cajan (L.) Millsp.	Fabaceae	Feregede	leaves seeds	+	+	0.025 (2.5)
Calliandra portoricencis (Jacq.) Benth.	Mimosaceae	Tude	Root	-	+	0.075 (7.5)
Capsicum frutescens L.	Solanaceae	Ata ijosi	Fruits	-	+	0.050 (5)
Carica papaya L.	Caricaceae	Ibepe	Fruit Leaves	+	-	0.050 (5)
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Egusi baara	Fruit	-	+	0.025 (2.5)
Citrus x aurantifolia (Christm.) Swingle	Rutaceae	Oronbo	Juice	+	-	0.050 (5)
Culcasia scandens P.Beauv.	Araceae	Agunmona	Leaves	-	+	0.025 (2.5)
Daniellia thurifera Benn.	Fabaceae	Iya	Leaves	-	+	0.025 (2.5)
Elaeis guineensis Jacq.	Araceae	Ewe Ope Ekuro	Dried leaves Seed	-	+	0.050 (5)
Enantia chlorantha Oliv.	Annonaceae	Awopa	Root	-	+	0.050 (5)
Euphorbia hirta L.	Euphorbiaceae	Emi-ile	Whole plant	-	+	0.025 (2.5)
Euphorbia laterifolia Schumach.	Euphorbiaceae	Enu opiye	Root	+	+	0.100 (10)
Euphorbia unispina (L.) Pax	Euphorbiaceae	Oro adete	Leaves	-	+	0.050 (5)
Ficus platyphylla Delile	Moraceae	Epo obo	Bark	+	-	0.100 (10)
Glycine max (L.) Merr.	Fabaceae	Ewa soya	Seeds	+	-	0.025 (2.5)
Hypoestes forsskaolii (Vahl) Sol. ex Roem. & Schult	Acanthaceae	Ogbigbo	Leaves	+	-	0.025 (2.5)
Ipomoea asarifolia (Desr.) Roem. & Schult	Convolvulaceae	Gboro ayaba	Young leaves	+	-	0.025 (2.5)
Kigelia Africana (Lam.) Benth.	Bignoniaceae	Pandoro	Fruits	-	+	0.025 (2.5)
Lecaniodiscus cupanoides Planch. ex Benth.	Sapindaceae	Aka	Bark	-	+	0.025 (2.5)
Lophira alata Banks ex Gaertn.	Onchnaceae	Epo ponhan	Bark	-	+	0.025 (2.5)
Mangifera indica L.	Anacardiaceae	Mangoro	Bark Leaves	-	+	0.075 (7.5)
Musa x paradisiaca L.	Musaceae	Ogede agbagba	Peel	-	+	0.025 (2.5)
Musa x sapientum L.	Musaceae	Ogede abalaye	Fruit	-	+	
Nauclea latifolia Smith.	Rubiaceae	Egbesi	Root	-	+	0.025 (2.5)
Nicotiana tabacum L.	Solanaceae	Taba	Leaves	-	+	0.025 (2.5)

Olax subscorpioidea Oliv.	Olacaceae	Ifon	Root	-	+	0.075 (7.5)
Parinari excelsa Sabine	Chrysobalanaceae	Eso Abeere	Seed	-	+	0.025 (2.5)
Parkia biglobosa (Jacq.) G. Don	Fabaceae	Lasaa igba	Leaves	-	+	
Pericopsis laxiflora (Baker) Meeuwen	Fabaceae	Seedun	Root	+	+	0.025 (2.5)
Piliostigma reticulatum (DC.) Hochst.	Fabaceae	Abafi	Leaves	+	+	0.025 (2.5)
Piper guinnense Schumach. & Thonn.	Piperaceae	Iyere	Seed	+	+	0.225 (22.5)
Psorospernum febrifugum Spach.	Clusiaceae	Legunoko	Bark Root	+	-	0.050 (5)
Pterocarpus osun Craib	Fabaceae	Osun igba	Seeds	-	+	0.025 (2.5)
Rauwolfia vomitoria Afzel.	Apocynaceae	Asofeyeje	Leaves	-	+	0.050 (5)
Securidaca longipedunculata Fresen	Polygalaceae	Ipeta	Roots	-	+	0.100 (10)
Securinega virosa (Roxb. Ex Wild) Baill.	Euphorbiaceae	Iranje	Root	-	+	0.025 (2.5)
Sorghum bicolor L.) Moench.	Poaceae	Poroporo okababa	Leaves	+	-	0.075 (7.5)
Spondias mombin L.	Anacardiaceae	Iyeye	Bark	-	+	0.025 (2.5)
Synedrella nodiflora (L.) Gaertn.	Asteraceae	Atanaposo	Root	-	+	0.025 (2.5)
Terminalia catappa L.	Combretaceae	Igi frutu	Bark	+	-	0.025 (2.5)
Tetrapleura tetraptera (Schum. & Thonn) Taub.	Fabaceae	Aidan	Pod	-	+	0.025 (2.5)
Uvaria afzelii G. F. Scott-Elliot	Annonaceae	Gbogbolese	Leaves	+	-	0.025 (2.5)
Xylopia aethiopica (Dunnal) A. Rich	Annonaceae	Eeru	Pod Seed	+	+	0.050 (5)

Key: + = present; - = absent

TABLE 2: Plant species in each family for management of sickle cell disease

Family	Frequency	Percentage (%)
Acanthaceae	1	1.75
Amaranthaceae	1	1.75
Anacardiaceae	2	3.50
Annonaceae	4	7.00
Apocynaceae	2	3.50
Araceae	1	1.75
Arecaceae	1	1.75
Aristolochiaceae	1	1.75
Asteraceae	2	3.50
Bignoniaceae	1	1.75
Caricaceae	1	1.75
Chrysobalanaceae	1	1.75
Clusiaceae	1	1.75
Combretaceae	1	1.75
Connaraceae	1	1.75
Convolvulaceae	1	1.75
Cucurbitaceae	2	3.50

Euphorbiaceae	5	8.75
Fabaceae	8	14.00
Liliaceae	3	5.25
Mimosaceae	1	1.75
Moraceae	2	1.75
Musaceae	2	3.50
Nyctaginaceae	1	1.75
Olacaceae	1	1.75
Onchnaceae	1	1.75
Piperaceae	1	1.75
Poaceae	2	3.50
Polygalaceae	1	1.75
Rubiaceae	1	1.75
Rutaceae	1	1.75
Sapindaceae	1	1.75
Solanaceae	2	3.50
Zingiberaceae	1	1.75

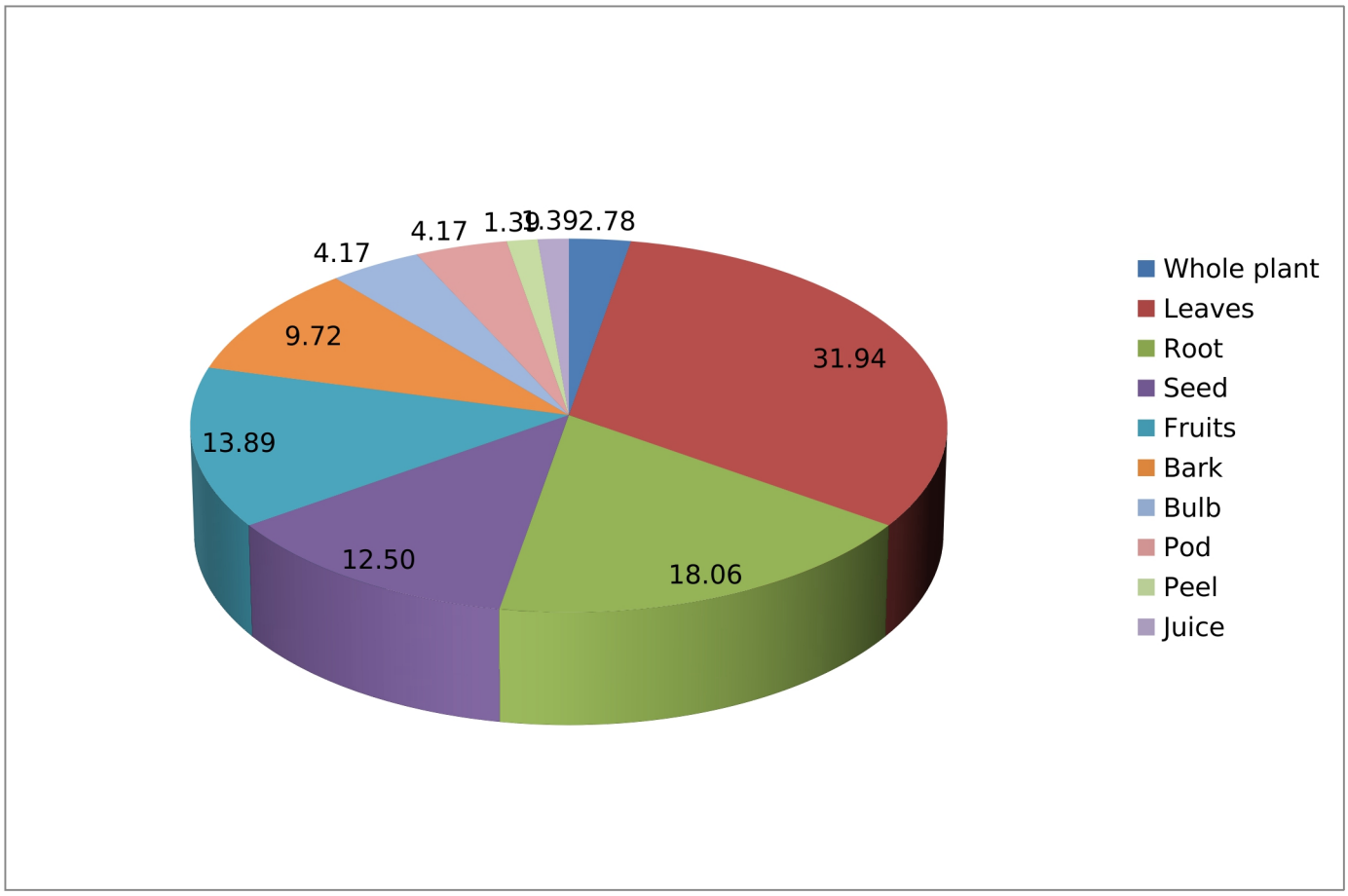

Figure 3: Percentage occurrence of the plant parts used in management of sickle cell disease

Table 3: Herbal recipes for managing sickle cell disease

S/no	Recipe preparation	Type of preparation	Dosage
1.	The dried root of *Calliandra portoricencis* and *Piper guinnense* is added to some dry reptiles (chameleon), ground into powder and poured into coconut oil and cook as stew.	Mixture	One spoonful twice daily.
2.	The dried root of *Securidaca longipedunculata* is ground into powder together with dried toad. The powder is then poured into hot drink and decanted carefully	Mixture	Take two spoonful immediately and one spoonful once daily from the second day.
3.	The dried roots of *Olax subscorpioidea, Securidaca longipedunculata, Rauwolfia vomitoria* and *Annona senegalensis* are powdered and used to take cold pap.	Powder	One spoonful twice daily
4.	The young leaves of *Annona senegalensis, Boerhaevia diffusa, Piliostigma reticulatum* and *Daniellia thurifera* are powdered and used to cook cat fish. *Piper guineense* is used to spice it up and shea butter is also added; this fish is to be eaten at once.	Mixture	Prepared fish to be eaten at once
5.	The leaf of *Carica papaya* (male) is squeezed with *Citrus x aurantifolia* juice and the spent leaf (shaft) is cooked with shea butter and the concoction is taken at once.	Juice	At once
6.	Fresh fruit of *Kigelia africana is cut into* pieces and soaked in water for three days. The water is drained off and the residue is cooked with black soap.	Maceration	One shot twice daily
7.	The roots of *Calliandra portoricensis*, *Securidaca longipedunculata, Annona senegalensis* are burnt together and shea butter is added. The concoction is mixed with black soap and divided into small pieces.		One piece is to be swallowed within three days (induces vomitting)
8.	The husk of *Musa x paradisiaca* is burnt and the powdered root of *Aristolochia ringens* and camphor is added and mixed with shea butter.	Mixture	Rubbed on affected area.
9.	The fresh leaves of *Ageratum conyzoides* and *Amaranthus viridis* are pounded and dried in the sun. It is then powdered with the seed of *Parinari species* and used to take pap	Powder	One spoonful once daily (adult) Half spoonful twice daily (children)
10.	The root bark of *Synedrella nodiflora is* peeled off, cut into pieces, dried and powdered. This is then added to palm oil base	Mixture	Lick three times daily (It can darken stool).
11.	The leaves and roots of *Securidaca longipedunculata and Olax subscorpioidea* are boiled with the the pods of	Decoction	Take half-glasscup once daily

	Tetrapleura tetraptera put at the bottom of the pot. It could also be powdered and used to take pap in the morning.	Powder	One spoonful daily
12.	The mixture of the sap of *Euphorbia unispina* and seed of *Pterocarpus osun* is added to incisions	Juice	Added to incisions
13.	*Sorghum bicolor* is made into pap and the powdered leaves of *Euphorbia hirta* is added	Mixture	One cupful in the morning
14.	The roots of *Nauclea latifolia, Citrullus colocynthis* and fruits of *Lecaniodiscus cupanoides* is boiled in a pot (with seven stones at the base for female and nine stones at the base for male)	Decoction	Take half-glasscup twice daily
15.	The bark of *Rauwolfia vomitoria* is cut into pieces soaked with small quantity of potash and *Capsicum frutescens* for seven days.	Maceration	A shot twice daily
16.	The root of *Calliandra portoricensis* together with the bark of *Mangifera indica, Alstonia boonei* and *Sorghum bicolor* is washed and boiled.	Decoction	One spoonful twice daily
17.	The pods of *Xylopia aethiopica* is pound together with potash and pour into red oil	Powder	One spoonful twice daily
18.	The roots of *Pericopsis laxiflora,* is boiled and used to bath	Decoction	One glasscup twice daily Bath once daily
19.	The dried leaves of *Elaeis guineensis*, and *Culcasia scandens* are pounded with tilapia fish, and used to take hot pap	Powder	One spoonful twice daily
20.	The seed of *Parinari species* and *Allium sativum* are cut into pieces, and put in a bottle. Cold water is added and decanted for use. It can also be powdered and taken with pap	Maceration Powder	One teaspoonful thrice daily One spoonful twice daily

DISCUSSION

Mining of nature for the therapeutic management of diseases has been on since time immemorial[20]. Medicinal plants have been a source of succor in the control of many diseases in developing countries and sickle cell disease is no exception. Sickle cell disease is known to be one of the diseases ravaging most world populations cutting across nations and ethnic divide. It is believed that the treatment regimen to be chosen depends on 'age' of the patient. Majority of the respondents claimed that their recipes are devoid of side effects, that side effects could only be experienced if the recommended dose is exceeded.

In this study, the ethnobotanical survey carried out revealed some 57 plant species belonging to 34 plant families. Approximately 70% of these plants have been reported to be efficient in the management of sickle cell anaemia. However, the most prominent plant species in the recipes are *Piper guineense*, *Aframomum melegueta* and *Allium sativum* with Use Mention Index (UMI) of 0.225, 0.200 and 0.100 respectively. *P.guineense* among other plant species (*Euphorbia caryophyllata, Pterocarpus osun,* and *Sorghum bicolor*) are the herbal components of the Yoruba recipe upon which the antisickling drug Niprisan™ is based. Phytocannabinoids and vanilloids present in *E. caryophyllata* and *P. guineense* were suggested as the likely principles for the useful effects of Niprisan™ in sickle cell crisis[21]. Allicin (isolated from *Allium sativum*) has also been reported to enhance low-density lipoprotein (LDL) oxidation and to oxidize the iron of hemoglobin in red blood cell with methemoglobin formation. It produces water-soluble S-allylcysteine that inhibits formation of dense cells in blood samples from patients with sickle cell disease[22]. *Aframomum melegueta* is also a major excipient in medicinal plant recipes for herbal formulations. Incidentally, *A. melegueta*, like *P. guineense*, is considered to have several medicinal applications[23]. Other commonly mentioned plant is *Securidaca longipedunculata, Adenopus breviflora*, *Euphorbia laterifolia* and *Ficus platyphylla*.

The result of this study also revealed that the plant families with the highest occurence of plant species are the Fabaceae and the Euphorbiaceae. The Fabaceae family is widely distributed and is the third-largest land plant family in terms of number of species, behind only the Orchidaceae

and Asteraceae, with 730 genera and over 19,400 species which contain around 9.4% of all flowering plant species[24]. *Euphorbiaceae*, the spurge family, is a large family of flowering plants with 300 genera and around 7,500 species. Medicinal uses have also been reported for lots of the species in the family for a variety of diseases[25]. The Fabaceae and Euphorbiaceae families have been reported to be the dominant plant families mentioned in an ethnomedicinal survey of plants used in the management of sickle cell disease in Southern Nigeria[26].

The most used plant part is the leaf accounting for 32.0% of the recipes followed by the roots, fruits and seeds at 18.1%, 13.9% and 12.5% respectively as shown in Figure 3. Other plant parts used include bark, bulb, pod, whole plant, peel and juice. Leaves have been reported to be the main synthesis site of secondary metabolites in plants and are the most commonly used plant parts by traditional medicine practitioners[27]. This also constitutes an advantage as harvesting leaves on a sustainable manner ensures continuity of the plant.

The excipients and/or ingredients mentioned in this study enhance the effect of the herbal preparations or are simply used to make the preparations palatable. In addition to pure herbal preparations, some recipes also included non-plant and animal materials. Solid components like potash are usually used to provide electrolyte buffer and balance pH, which may be necessary for absorption and bioavailability of the active principles[28]. Sickle cell disease is also referred as *'Foniku foladide'*, *'Alore arun'*, *'Ile-tutu' 'Awee'* and *'Lagunlagun'* (to mention a few) in the communities where this survey was carried out. The management of this disease with the intervention of medicinal plants is based on the knowledge of traditional herbal practitioners employing the use of various herbal remedies. The findings from this survey carried out in Kwara state show some of the cultural approach of the practitioners to traditional medicine, such as the incorporation of animal parts to plant mixtures.

Previous studies have been carried out on providing information and documentation of medicinal plants used in the management of sickle cell disease, especially in the Southwest region of Nigeria [29-32]. However, there is still lack of proper record and documentation regarding the use of

medicinal plants in the management of this disease in the North-Central region of Nigeria, despite the abundance of traditional knowledge of these herbal remedies. Thus, there is a need for proper documentation to preserve such vital information concerning valued medicinal plants in this region and other unexploited regions of Nigeria. This is encouraged by the continuous search for information covering natural plant products through ethnobotanical surveys, which is known to vary from one ethnic group to another[33].

Formulation of the dosage of the extracts should also be encouraged and adhered to for maximum efficacy and also the avoidance of over dosage which may lead to other complications in patients.

CONCLUSION

In conclusion, this study has been able to identify, document and analyze fifty-seven medicinal plants from one rural and urban LGAs in Kwara state used in the management of sickle cell diease as well as various methods of preparation of the species mentioned. The results of this study has therefore provided a database and a basis for further studies on the phytochemical constituents of the medicinal plants mentioned as potential sources of new and reliable antisickling agents, or as leads/templates in the discovery and development of drugs that may be used in the management of sickle cell disease.

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