RESEARCH ARTICLE

ETHNOBOTANICAL SURVEY OF PLANTS USED IN THE MANAGEMENT OF DIABETES MELLITUS IN ABEOKUTA, NIGERIA

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ABSTRACT

An ethnobotanical survey of some plants used for management of diabetes in Abeokuta, Ogun State, Nigeria was conducted. A total of 100 questionnaires were administered; (50 herbal practitioners and 50 on patients). Investigations were carried out on the plant parts used, methods of preparation and administration including, dosage and duration of usage. The results showed that fifty (50) plant species belonging to 30 families used in herbal anti-diabetes recipes. The most frequently used plant was *Vernonia amygdalina* (54%), followed by *Azadirachta indica* (44%), *Ocimum gratissimum* (20%), *Mormodica charantia* (10%) and *Citrus aurantifolia* (10%)**.** Irrespective of the plant parts (leaves, fruits, stem- barks or roots) or combinations of the plant parts, water and alcohol were the main solvents. The most frequently used plant parts was leaf (62%) and mainly by decoction. Treatment regimens were by chewing or drinking of the aqueous herbal preparations (350-400ml) daily for 6-12 weeks or until symptoms of diabetes disappear**.**

Keywords: Anti-diabetic plants, ethnobotanical survey, herbs, plant parts.

INTRODUCTION

In Africa, the number of people suffering from diabetes has been rising steadily over the past two decades. Several reports have stressed the high mortality from diabetes especially among the blacks (Durmuskahya and Özturk, 2013).There are nearly 285 million (6.6% of population aged 20-79 years) diabetic patients across the globe. In 2005, it was reported that nearly 1.1 million people died worldwide due to this disease. It is estimated that the number of diabetes patients will reach 450 million in 2030 with 97% showing type 2 diabetes mellitus (T2DM; non-insulin dependent diabetes mellitus) if positive actions are not put in place (Israili 2010, Israili, 2011; Durmuskahya and Özturk, 2013)**.** Diabetes mellitus is a disease of metabolic impairment of carbohydrate, fat and protein due to either lack of insulin secretion or decreased sensitivity of the tissues to insulin. It is characterized by severe socio-economic importance such as hyperglycemia and glycosuria (Aguwa *et al.,* 2004). Diabetes mellitus and its associated complications have significant impact on health, quality of life and life expectancy of its sufferers.

Several findings indicated that traditional medicine is patronized by all segments of the society because it is affordable health care delivery system of people (Soladoye *et al.,* 2012; Aslan *et al.*, 2010; Inanç *et al.,* 2007; Onal *et al.* 2005; Ozbek *et al.*, 2004).

Many drugs have been developed and used globally in managing hyperglycemia in type 2 diabetes mellitus (Israili, 2011). However, therapy becomes less effective over time as more than 50% of patients do not achieve normal glycemic goals (Israili, 2010). Also, the few conventional drugs are characterized by appreciable level of toxicity, high cost and non availability. Thus, people seek relief from traditional healing which provides measures for the treatment of the disease (Farnsworth *et al.,* 1985; Morris, 2002). This is due to the general roles of plants in disease management as biological potentials (glibenclamide). Herbal medicine is used by more than 50%of the world population. In India 65% of population have used traditional medicine for management of several ailments (Pratul , 2011). A recent survey has revealed that 35 to 41% of diabetic patients use complementary and alternative medicines (mostly botanicals) in addition to conventional medicine (Ceylan *et al.*, 2009; Küçükgüçlü *et al.,* 2010). However, there has been increasing demand for the use of plant products with anti-diabetic activity due to low cost, easy availability, abundance and lesser side effects. Plant materials are continuously scrutinized and explored for their effect as hypoglycemic agents. The objective of the present study was to identify some plants used in the treatments of diabetes. This study was carried out to document ethnobotanical information of indigenous plants used to manage of diabetes mellitus in Abeokuta

MATERIALS AND METHODS

The Study Area

The study was conducted in Abeokuta, the capital city of Ogun State, South West Nigeria. A total of 10 Markets including Lafenwa, Odeda, Osiele, Kuto, Iberekodo, Elega, Alabata, Olodo, Itoku, Omida and various herbal shops of Abeokuta were visited.

The town has a population of about one million people who are mainly civil servants and traders. It is predominantly dominated by the Egbas with sizable proportion of Yewas, Ijebu and other Yoruba ethnic groups in Nigeria. There are two main Local Government Areas in Abeokuta: Abeokuta North and Abeokuta South. Abeokuta is in the tropical rain forest zone of South Western Nigeria but the vegetation now is that of derived savannah. The Nation's main air port, sea port and industrial centre, Lagos is 104 kilometers to the south while Ibadan the largest city in the country is 77 kilometers to the North. Abeokuta falls within the longitude 3° 21' East and latitude 7° 11'' North. The annual temperature range from 22.8^0 to 34.9^0C. The mean annual rainfall is about 107 mm (Adekunle and Akinlemibola, 2008).

Informed consent

The purpose of the study was explained to the local traditional practitioners, herb sellers, community leaders, market-head leaders and herbal shop owners in the town. Consent to was given by the head of traditional herb practitioners and community leaders. Informed consent was obtained from each of the participants. An approval for the study was obtained from market leaders and traditional heads of the communities in which the markets were located.

General questionnaire

A total of 100 structured questionnaire were administered using stratified method on traditional herbal practitioners, herb sellers and diabetic patients, to obtain information on commonly used herbs, names of plants, parts used, methods of herbal preparation, route of administration, mode of administration, dosage measurement and duration of usage. The questionnaires were administered by systematic random sampling method in such a way that only every fifth numbered respondent was chosen.

RESULTS

Socio-Economic Characteristics of Respondents

Gender. Age and education status

Of 100 questionnaires administered; 50 was to herbal practitioners who included traditional healers and herbal sellers and the other 50 to the patients (table 1). Larger number of (Traditional Herbal Practitioners) (THP); 28 representing 56% of the total traditional healers and herbal sellers were males while 22 (44%) of the respondents were females (table 1).

46% and 40% of the total population of the Traditional herbal practitioners and patients respectively were between the age group of 41-50 years, 4% was recorded at 20-30 years while at 61-70 years, 6% of the respondents was reported (table 1). Similarly, at age 41-50, 34% of the Traditional herbal practitioners were males while 12% were females. At age 40-50 years, 14% of patients were males while 26% were female. Meanwhile at age 20-30 years, equal percentage of male and female (2%) traditional herbal practitioners were reported. Although both males and females engaged in traditional herbal practices, the percentage of males (74%) was higher than female (26%) and males were less affected by diabetes (42%) than females (58%).

The educational status of respondents (THP) and patients showed that 4 traditional herbal practitioners and 16 patients representing 8% and 32% of the total had no formal education. Majority of THP were West African Examination Council certificate holders as represented by 42% while majority of patients were illiterates as represented by 32% (Table 1). This study revealed a total of fifty (50) species of plants belonging to 30 families as being used in the control and treatment of diabetes in Abeokuta. An ethnobotanical data of the identified plants were summarized in Table 2. 31(62%) plant species with leaves being used were *Aframomum melgueta, Azadirachta indica, Ageratum conyzoides, Alstonia boonei, Aloe vera, Blighia sapida, Cassia siamea, Carica papaya, Crudia klainei, Cymbopogon citrates, Ficus asperifolia, Glyphaea brevis, Hibiscus sabdariffa, Terminalia schimperiana, Jatropha curcas, Lawsonia inermis, Mangifera indica, Mormodica indica, Morinda lucida, Nicotiana tabacum, Ocimum gratissimum , Phyllantus amarus, Bambus vulgaris, Gossipium* spp, *Rauwolfia vomitoria, Solanum aethiopicum, Sida acuta, Senna podocarpa, Tridax procumbens, Uvaris afzelii* and *Vernonia amygdalina.* 5(10%) of the plants were prepared using roots naming *Alstonia congensis, Garcinia kola, Securidaca longepedunculata, Senecio biafrae, Tetrapleura tetraptera. Cucurneropsis mannii, Syzygium guineense* and *Bidens pilosa. Allium sativum* and *Allium cepa* used bulbs (4%). *Musa nana* and *Musa parasiadiaca* had stem (Culm). Bark from *Anacardium occidentale* was used, representing (2%). Rhizomes from *Zingiber officinale* (2%) while leaf/root and leaf/ bark combinations were represented as parts being used by 2 plants (4%) (Table2). The most frequently utilized plants were *Vernonia amygdalina* (54%), *Azadirachta indica* (44%), *Ocimum gratissimum* (20%), *Mormodica charantia* (10%) and *Citrus aurantifolia* (10%). Leaf (*Anacardium occidentals*), root (*Tetrapleura tetraptera*), seed (*Bidens pilosa*), stem (*Garcinia kola*), bulb (*Allium sativum*), rhizome (*Zingiber officinale*) and fruit (*Citrus aurantifolia*) (Table 3). The preparations were measured by the patients with either glass cup (350-400ml) and taken orally 2-3 times daily for 6-12 weeks (Table 2).

The life forms of plants covered by this study ranges from trees to herbs. 32% was trees, 14% was shrubs, 2% was climbers while 52% was herbs (table 4). 46% of the plants were cultivated, 36% were wild while 18% were both cultivated and wild

The preparations were decoction (46%), juice (14%), maceration (12%), essence (10) juice or powder (14%) with the least being infusion (4%) (Table 4).

Majority of the respondents showed preference to aqueous preparation (64%), some mixed the preparations with pap (12%), alcohol (12%), lime (4%), honey (4%) and bile of cow (2%) while others made use of the plants as chewing sticks for easy administration (2%). It was observed that the herbal preparations were reported as being measured with the use of cup (76%), tea spoons (22%), and tablets (2%). Some of the THPs recommended other remedies such as beans and its derivatives (26%), vegetables and fruits (60%), No diet (10%) while others non- plant materials(4%) such as potash, honey, alum etc(table4). The duration of usage was month (72%), week (20%) and the year (8%) before the symptoms of the diseases such as frequent urination, weight loss and fatigue disappear(table 4). Majority of the respondents preferred mainly drinking (350-400ml) of the preparations 2 to 3 times daily.

Table 1: Demographic structure of the respondents (traditional healers and herbal material sellers) sampled in Abeokuta, Ogun State Nigeria

Socio-demographic data (Sex)	Traditional healers (Frequency)	Herbal material sellers (Frequency)	Total	%Total	Mode
Male	23	5	28	56	56
Female	10	12	22	44	
Total	33	17		100.00	
Age Class (Herbal practitioners) (Years)	(Male)	(Female)			
20-30	1	1	2	4	
31-40	10	4	14	28	
41-50	17	6	23	46	46
51-60	6	1	7	14	
61-70	3	1	4	8	
Total	37	13		100.00	
Age Class (Patients) (Years)	(Male)	(Female)			
20-30	3	2	5	1	
31-40	4	5	9	18	
41-50	7	13	20	40	40
51-60	6	7	13	26	
61-70	1	2	3	6	
Total	21	29		100.00	
Education level (THP)					
Illiterates	1	3	4	8	
Primary School	9	6	15	30	
Secondary school	12	9	21	42	42
Tertiary	7	3	10	20	
Total	29	21		100.00	

Table 2: Some plants species used in treating diabetes in Abeokuta, Ogun State, Nigeria

Family/botanical name	Common/local name	Part used	Habit	Route of administration	Frequency of mention (%)
Alliceae					
Allium cepa	Onion *Alubosa*	Bulb	H C	Oral	1(2%)
Alliaceae					
Allium sativum	Garlic *Ayu*	Bulb	HC	Oral	1(2%)
Anacardiaceae					
Anacardium occidentale	Cashew *Kaju*	Leaves /barks	T C	Oral	1(2%)
Anacardiaceae					
Mangifera indica	Mango *Mangoro*	Leaves	T C	Oral	4(8%)
Annonaceae					
Uvari afzelii	Monkey finger *Gbogbonise*	Leaves	H W	Oral	3(6%)
Apocynaceae					
Alstonia boonei	Stool – wood	Leaves	T, W	Oral	1(2%)

	Awogba-arun				
Apocynaceae					
Alstonia congensis	Stool wood *Ahun*	Root	T, W	Oral	1(2%)
Apocynaceae					
Saccharum officinarum	Sugar cane *Ireke*	Root/ Leaves	G, C	Oral	2(4%)
Apocynaceae					
Rauwolfia vomitoria	Swizzle stick *Asofeyeje*	Leaves	T, C/W	Oral	4(8%)
Asphodelaceae					
Aloe vera	Aloe		H, C	Oral	1(2%)
Asteraceae					
Ageratum conyzoides	Goat weed *Imi*-esu	Leaves	H, W	Oral	1(2%)
Asteraceae					
Senecio biafrae	Bologi Worowo	Root	H, W	Oral	1(2%)
Asteraceae					
Tridax procumbens	Tridax *Igbalode*	Leaves	H, W	Oral	2(4%)
Asteraceae					
Vernonia amygdalina	Bitter leaf *Ewuro*	Leaves	S,C/W	Oral	27(54%)
Bromeliaceace					
Ananas comosus	Pineapple *Opon-oyinbo*	Fruits	H, C	Oral	1(2%)
Caesalpiniaceace					
Senna podocarpa	Sennas *Asunwo*	Leaves	H, W	Oral	3(6%)
Caricaceae					
Carica papaya	Pawpaw *Ibepe*	Leaves	S, C	Oral	2(4%)
Combretaceae					
Terminalia schimperiana	Tuit *Idi*	Leaves	T, W	Oral	4(8%)
Cucurbitaceae					
Citrullus lanatus	Water melon *Egusi bara*	Seeds	H, C	Oral	1(2%)
Cucurbitaceae					
Cucurneropsis mannii	white seed melon *Egusi –itoo*	Seeds	H, C	Oral	1(2%)
Cucurbitaceae					
Mormodica charantia	African-cucumber *Ejinrin wewe*	Leaves	H, W	Oral	5(10%)
Euphorbiaceae					
Jatropha curcas	Gig nut plant *Batuje*	Leaves	S, C/W	Oral	1(2%)
Euphorbiaceae					
Phyllanthus amarus	Sleeping plant *Ehinolobe*	Leaves	H,C/W	Oral	2(4%)
Fabaceae					
Crudia klainei	Wind tree *Afomo*	Leaves	CL, W	Oral	2(4%)
Fabaceae					
Tetrapleura tetraptera	Aidan tree *Arindan*	Roots	T, W	Oral	2(4%)
Guttiferae					
Garcinia kola	Bitter kola *Orogbo*	Roots	H, C	Oral	4(8%)
Laminaeae					
Ocimum gratissimum	Tea bush	Leaves	H, C	Oral	10(20%)

	Efinrin				
Leguminosae					
Cassia siamea	Cassia *Kasia*	Leaves	T, W	Oral	1(2%)
Lythraceae					
Lawsonia inermis	Henna *Laali*	Leaves	T, W	Oral	1(2%)
Malvaceae					
Hibiscus sabdariffa	Roselle *Isapa*	Leaves	H, C	Oral	2(4%)
Malvaceace					
Gossipium barbadense	Cotton *Owu*-akese	Leaves	S, C	Oral	4(8%)
Malvaceae					
Sida acuta	Were weed *Esekutu*	Leaves	H, W	Oral	1(2%)
Moraceae					
Ficus asperifolia	Sound paper tree *Ipin*	Leaves	T, W	Oral	1(2%)
Musaceae					
Musa paradisiaaca	Plantain *Ogede agbaagba*	Stems	G, C	Oral	4(8%)
Musaceae					
Musa nana	Banana *Ogede wewe*	Stems	G, C	Oral	1(2%)
Myrtaceae					
Syzgyium guineense	Snake bean tree *Ori*	Seeds	T, W	Oral	2(4%)
Phllanthaceae					
Bidens pilosa	black jack *Abere*	Seeds	S,W/C	Oral	1(2%)
Poaceae					
Azadirachta indica	Neem *Dogoyaro*	Leaves	T, W/C	Oral	22(44%)
Meliaceae					
Bambus vulgaris	Bamboo *Oparun*	Leaves	S, C/W	Oral	3(6%)
Poaceae					
Cymbopogon citrates	Lemon grass *Waapa*	Leaves	G, C	Oral	1(2%)
Poaceae					
Sorghum caudatum	Sorghum *Oka baba*	Shafts	G, C	Oral	1(2%)
Polygalaceae					
Securidaca longipedunculata	Violet tree *Ipeta*	Roots	T, W	Oral	1(2%)
Rutaceae					
Morinda lucida	Brimstone tree *Owuro*	Leaves	T, W	Oral	4(8%)
Rutaceae					
Citrus aurantifolia	Lime *Osanwewe*	Fruits	T, C	Oral	5(10%)
Sapindaceae					
Bighia sapida	Akee apple *Isin*	Leaves	T,W/C	Oral	3(6%)
Solanaceae					
Nicotiana tabacum	Tobacco *Taba*	Leaves	H, C	Oral	1(2%)
Solanaceae					
Solanum aethiopicum	Mack tomato *Osun*	Leaves	H, W	Oral	1(2%)
Tiliaceace					

Glyphaea brevis	----- *Atori*	Leaves	S, W	Oral	1(2%)
Zingiberaceae					
Aframomum melgueta	Alligator pepper *Atare*	Leaves	H, C	Oral	2(4%)
Zingiberaceae					
Zingiber officinale	Ginger *Atale*	Rhizomes	H, C	Oral	2(4%)

Key

No of plant species = 50, No of families = 30, T- Tree, S- Shrub, H- Herb, G- Grass, CL- Climber. C- Cultivated, w- wild, W/C- Wild and Cultivated.

Table 3: Some plants species used **and** their mode of preparation and administration in Abeokuta, Ogun State, Nigeria

No	Plant species singly or combination	Preparation type	Solvent	Preparation	Mode of administration
1	*Vernonia amygdalina*	Macerated juice is mixed with salt	Water	Juice extract	20-25 tablespoonfuls of the preparation is taken every morning.
2	*Momordica charantia*	Boil leaves in water.	Water	Decoction	About 350ml of the preparation is taken daily.
3	*Allium sativum,* *Aframomum melegueta,* *Carica papaya*	Grind dried leaves of *C. papaya*, bulb of *A. sativum* and root of *A. melegueta*.	Pap	Powder	A cup-full of the preparation with hot pap is taken daily.
4	*Rauwolfia vomitoria* *Cirus aurantifolia*	Macerate *Rauwolfia vomitoria* leaves in water mix with *C. aurantifolia* juice and boil for 10 minutes.	Water	Decoction	A cup-full (370ml) of the preparation is taken daily.
5	*Solanum aethiopicum*	Macerate leaves in hot water.	Water	Infusion	The preparations are taken with glass cup-full, thrice daily
6	*Saccharum officinarum* *Morinda lucida*	Macerate fresh leaves of *S. officinarum* and *M. lucida* then mix in water.	Water	Juice	Take a cup-full of the preparation daily.
7	*Lawsonia inermis*	Boil fresh leaves of *L. inermis* and potash with water.	Water	Decoction	1 cup-full (350ml) of the decoction is taken every morning for 2 weeks.
8	*Jatropha curcas*	Burn the fruits into ashes.	Pap	Powder	Taken a full-cup of the preparation with pap every morning before break- fast.
9	*Bidens pilosa,* *Vernonia amygdalina* *Momordica charantia* *Ocimum gratissimum*	Soak *B.pilosa* seeds, *V.amygdalina* leaves, *M. charantia* fruits, and *O. gratissimum* leaves in local gin for 2 to 3 days.	Gin	Essence	About (350ml) of the preparation is taken every morning.
10	*Vernonia amygdalina* *Bidens pilosa* *Uvaria afzelii*	Soak leaf, seeds and root of *V. amygdalina*, *B. pilosa and U. afzelii* root for 2 to 3 days. .	Water	Maceration	A cup-full of the extracts is drank thrice daily.
11	*Vernonia amygdalina* *Allium cepa*	Soak leaves *V. amygdalina* and bulb of *A. cepa* in water for 4 days.	Water	Maceration	1 cup-full (350-400ml) of the preparation is taken daily.
12	*Carica papaya*	Boil unripe fruits of *C. papaya* in water.	Water	Decoction	25 tablespoonfuls of the preparation are taken daily.
13	*Anana comosus* *Carica papaya* *Ficus asperfolia*	Boil Fruits of *A. comosus*, unripe fruit of *C.papaya* and leaves of *F. asperfolia* in water.	Water	Decoction	A cup-full of the extracts is drank twice daily
14	*Cucumeropsis mannii* *Citrus aurantifolia*	Mix the fruit juice of *Cucumeropsis mannii*	Lime	Juice	20-25 tablespoonfuls of the preparation are

		and *C. aurantifolia* in potash.			taken in the morning or at night.
15	*Bidens pilosa*	Grind dried roots into powder, mix in hot pap and honey.	Honey/ pap	Powder	25 tablespoonfuls are taken daily
16	*Vernonia amygdalina* and *Glyphaea brevis*	Boil Leaves of *V. amygdalina* and *G. brevis* in water for 20min.	Water	Decoction	A cup-full of the preparation is taken before break- fast daily.
17	*Citrullus lanatus*	Boil fruit of *C. lanatus* and potash with water.	Water	Decoction	1 cup is drunk every 3 days.
18	*Allium sativum* *Vernonia amygdalina* *Ocimum gratissimum*	Boil bulb of *A. sativum*, leaves of *V.amygdalina*, and *O. gratissimum* and potash in water.	Water	Decoction	Take a cup-full (350ml) daily before break- fast.
19	*Allium cepa* and *Carica papaya* *Aframomum melegueta*	Grind into powder dried bulb of *A. cepa*, root of *C. papaya* and seeds of *A. melegueta*.	Pap	Powder	The powder form of the plants sample is taken with hot pap.
20	*Securidaca longipedunculata*	Soak root of *S. longipedunculata* in local gin for 3 days.	Gin	Essence	1 cup-full of the extracts is taken every 3 days.
21	*Nicotiana tabacum* *Bidens pilosa* *Alstonia congensis*	Boil with water *N. tabacum* leaves, *B. pilosa* seeds, *A. congensis* root and potash.	Water	Decoction	1 cup-full (350-400ml) of decoction is taken every 3 days interval before break-fast.
22	*Uvaria afzelii* *Securidaca longipedunculata*	Grind into powder form root and bark of *Securidaca longipedunculata* and *U. afzelii*.	Pap	Powder	The powder are mixed with hot pap and taken twice daily.
23	*Jatropha curcus*	Boil Leaves of *J. Curcas* and palm oil with water.	Water	Decoction	1 cup-full of the preparation is taken every morning.
24	*Citrus aurantifolia*	Mix *C. aurantifolia* fruit juice and potash with cow bile.	Cow bile	Juice	18 tablespoonfuls of juice are taken every 3 days.
25	*Ficus asperifolia*	Boil *F. asperifolia* root and *C. aurantifolia* juice in water.	Water	Decoction	400ml of the preparation is taken daily before break-fast.
26	*Musa nana*	Mix Juice of flower of *M. nana* with honey.	Honey	Juice	20 tablespoonfuls are taken daily.
27	*Musa parasidiaca*	Soak Stems of *M. parasidiaca* in water for 2 to 3 days.	Water	Maceration	21 tablespoonfuls of macerate are taken daily.
28	*Garcinia kola*	Boil roots of *G. kola* with water for 1 hour	Water	Decoction	1 cup-full (350ml) is taken every 3 days interval.
29	*Zingiber officinale* *Allium sativum*	Boil rhizomes of *Z. officinale* and bulbs of *A. sativum* in hot water.	Water	Decoction	1 cup-full (350ml) of herbal preparation is taken twice daily.
30	*Azardirachta indica* *Anacardum occidentale*	Boil leaves of *A. indica* and *A. occidentales* with water.	Water	Decoction	25 tablespoonfuls are taken at night.
31	*Gossipium spp.*	Boil leaves of *Gossipium* in water.	Water	Decoction	20 tablespoonfuls of the decoction is taken twice daily.
32	*Bambus vulgaris*	Soak leaves of *B. vulgaris* in cold water for 3 days	Water	Macerate	The cold extract is taken every morning for six weeks.
33	*Azadirachta indica* *Garcinia kola*	Boil seeds of *A. indica* and *G. kola sp* in water for $1_{1/2}$ hours.	Water	Decoction	1 cup-full (330ml) is taken every day before eating.
34	*Garcinial cola* *Cymbopogon citrates*	Macerate juice of *G. kola* sp and *Cymbopogon citratus* leaves in	Water	Juice	20 tablespoonfuls of juice are taken daily.

		little amount of water.			
35	*Cassia siamea*	Boil C. *siamea* leaves in water for 1 hr.	Water	Decoction	1 cup-full of decoction is taken every 2 days.
36	*Gossipium spp.*	Boil roots/ leaves of *Gossipium* in water for 1 hour.	Water	Decoction	The decoction is taken daily.
37	*Azadirachta indica* *Lawsonia inermis*	Boil leaves of A. *indica* and *Lawsonia inermis* in water for1 hr	Water	Decoction	A cup-full of the preparations is taken every day.
38	*Azadirachta indica* *Ageratum conyzoides*	Boil leaves of A. *indica* and A. *conyzoides* in water for 1 hour.	Water	Decoction	20-22 tablespoonfuls of the decoction is taken twice daily before break-fast.
39	*Terminalia schimperiana*	Soak leaves of *T. schimperiana* and *Gossipium* in water for 2-3days.	Water	Maceration	340ml of the extract is taken daily.
40	*Azadirachta indica*	Grind into powder fruits of *A. indica*.	Pap	Powder	The powder of the is drunk with hot pap daily
41	*Cassia siamea*	Macerate Leaves of *Cassia siamea* water.	Water	Infusion	18-22 tablespoonfuls of the preparation are taken daily.
42	*Azadirachta indica*	Soak in local gin, leaves of *Azadirachta indica indica* for 2 to 3 days. .	Gin	Essence	1 cup-full of the decoction is taken daily.
43	*Gossipium sp.* *Ocimum gratissimum*	Boil leaves of *Gossipium* and *O. gratissimum* in water.	Water	Decoction	A cup-full (400ml) of the extract is drunk before break-fast daily.
44	*Mangifera indica* *Terminalia schimperiana*e	Soak leaves of *M. indica T. schimperiana*e in water for 3 days.	Water	Macerate	The cold preparation is taken daily every morning.
45	*Cassia siamen*	Soak bark of *C. siamen* in local gin for 2 days.	Gin	Essence	20 tablespoonfuls are taken every 3days.
46	*Morinda lucida*	Grind bark of *M. lucida* into powder and take with pap.	Pap	Powder	The powder is mixed with pap. Drink daily.
47	*Tridax procumbens* *Rauwolfia vomitoria*	Boil leaves of *T. procumbens* and *Rauwolfia vomitoria* in water.	Water	Decoction	The decoction is taken every morning for at least 6 weeks.
48	*Zingiber officinale*	Soak rhizomes of *Z. officinale* in local gin for 3 days.	Gin	Essence	1 cup-full (300-320ml) of essence is taken.
49	*Azadirachta indica*	Boil Seeds and leaves of A. *indica* in water for one hour.	Water	Decoction	A full-cup (340ml) of the preparation is taken every morning before break-fast.
50	*Terminalia schimperiana*	Chew roots of *T. schimperiana*.	Saliva	Juice	The root is chewed every morning for one month.

Table 4: Life forms, habitat, plant parts used, solvents, dosage measurement and non- plant materials used in treating diabetes mellitus

Plant forms	Frequency	% of total	Mode
Tree	16	32	
Shrubs	7	14	
Climber	1	2	
Herbs	26	52	42
Total	**50**	**100**	
Habitat			

Cultivated	23	46	46
Wild	18	36	
Both	9	18	
Total	**50**	**100**	
Commonly used plant parts			
Root	5	10	
Leaf/root	1	2	
Leaf/bark	1	2	
Leaf	31	62	62
Seed	4	8	
Fruit	2	4	
Rhizome	1	2	
Shaft	1	2	
Stem (Culm)	2	4	
Bulb	2	4	
Total	**50**	**100**	
Common preparation methods			
Juice	7	14	
Decoction	23	46	46
Powder	7	14	
Infusion	2	4	
Essence	5	10	
Macerate	6	12	
Total	**50**	**100**	
commonly used solvents			
Water	32	64	64
Pap	6	12	
Gin	6	12	
Lime Juice	2	4	
Honey	2	4	
Bile of cow	1	2	
Saliva	1	2	
Total	**50**	**100**	
Daily dosage measurement of herbal preparation			
Tablet	0	0	
Capsule	1	2	
Cups	38	76	76
Drops	0	0	
Total	**50**	**100**	
Teaspoons	11	22	
Duration of usage			
Weeks	10	20	
Months	36	72	
Years	4	8	
Total	**50**	**100**	
Other recommendations			
Non - plan material recommended	2	4	
Beans and its derivatives	13	26	
vegetables and fruits	30	60	60
No diet	5	10	

DISCUSSION

The observation that larger percentage of respondent (Traditional herbal practitioners) was males could be an indication that males involved in herbal practice than their female counterparts**.** This is contrary to the finding of Durmuşkahya and Öztürk (2013) who reported that women aged between 39 and 61 years use much more herbal plants than men. Unlike in the olden days when traditional practitioners were illiterates and consequently could not document the observation of their herbal practices hence, the present study have shown that majority of the respondents were educated. The basic education attainment enhanced them the necessary proficiency needed for documentation of their herbal practice. Similar observation was reported by Kadiri *et al.,* (2013); Durmuşkahya and Öztürk, (2013). Islam and Christianity were the predominant religions of the respondents. This is an indication that herbal practice is not affected by any religion affiliation.

The traditional healers consulted in the study claimed to have detected diabetes mellitus in their patients by observing symptoms such as weight loss, fatigue and excessive or frequent urination. The practitioners also claimed to have treated diabetes for up to 3-35years, having acquired the knowledge mainly through training and parental inheritance. Some of the respondents claimed to use mainly herbs while non–plant materials such as honey, local gin and minerals like alum and potash were also recommended in combination with plant materials. These results are in line with findings of Adebayo, (2009).

Most diabetic patients interviewed were between the 20-70 years, indicating predominance of type-2 diabetes (Jouad *et al.,* 2001; Sobngwi *et al.,* 2001**).** The preparations were claimed to have been used successfully for the treatment of diabetes for weeks, months and years depending on the severity of the disease without side effects in any of the plants.

The plant families with the highest occurrence of species include asteraceae and apocynaceae with 4 species respectively followed by Cucurbitaceae, malvaceae and poaceae having 3 species in that order. The frequent occurrence of other families also suggests their importance as repository of useful plants which may be explored for treatment of diabetes and other diseases.

The most frequently employed life form of plants covered by this study was herbs, followed by tress. Similar observation was reported by Raut *et al.,* (2012).

Results also revealed that 50 traditional medicinal plants were used by people of Abeokuta for the treatment of diabetes. The observation that leaves were reported as the most frequently used plant parts is in conformity with the finding of Pratul, (2011); Koumba Madingou *et al.,*(2012) Manishayadav *et al.,* (2012); Raut *et al.,* (2013): Vinatha and Estari, (2013). This observation may be an indication that leaves are major site of deposition of plant secondary metabolites.

It is difficult to say precisely which method of preparation is most commonly accepted because it is different from one therapeutist to another. According to Audrey and Dehin (2004), extraction of active ingredients is made by boiling the plant while Thomson (1981) reported that preparation methods vary depending on the types of plant. As regard this study, preference was given to boiling in water than soaking in alcohol or honey. This is believed to be more economically efficient and contrary to the report of Idowu *et al.,* (2009). The plant materials prepared as decoction, infusion in milk or honey were used for the treatment of diabetes as also reported by Thirumalai *et al.,*(2012).

Soaking was preferred by its users as they believe that the ingredients will be extracted without being exposed to heat which may have adverse effect on the efficacy of the preparations. The mode of administration of these different recipes is by oral route (350-400ml) which is the most used not only in traditional medicine but also in modern medicine. Apart from herbal therapy, appropriate diets such as beans and its derivatives, non-starchy vegetables, fruits and exercises were also recommended by THPs as also reported by Adebayo, (2009).

These plants preparations can be used isolated or in combination as a concoction. The respondent claimed that the recipes are effective despite their mode of preparation.

Majority of the recipes documented in the study were multi – component in nature. Mono - component recipes have also been found to be effective (Haddad *et al* 2003: Kareru *et al.,* 2007). Also, combination of plant parts mainly by decoction was reported as most common recipe used in the treatment of diabetes mellitus (Vinatha and Estari, 2013; Koumba Madingou *et al.,* 2012). This may support the reports that herbal preparations are more potent in the treatment of disease when the plant secondary metabolites are in combined form (Dinet *et al.,* 2011; Kadiri *et al.,* 2013; Vinatha and Estari, 2013. The information recorded from herbal healers indicates that they possess good knowledge of anti-diabetic herbal drugs. Documentation of traditional knowledge of local traditional healers is very useful for future generation (Vinatha and Estari, 2013)

CONCLUSION

This study showcased the use of indigenous flora of Abeokuta used for management of diabetes, hence, sustainable management of the forest is highly advocated.

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