Original Research Article

Ethnosurvey of Medicinal Plants Used in Treatment of Diabetes by the People of Nsukka, South Eastern-Nigeria

ABSTRACT

Introduction: Diabetes Mellitus is a widely prevailing Disease condition. Prior to the advancement of synthetic medicine, local remedies have been used in different parts of the world for the management of this disease. This study aims to identify the plants used by the people of Nsukka Local Government Area of Enugu State, Nigeria in the management of diabetes, and document all relevant information on them.

Methodology: A survey was conducted using semi-structured and personal oral interview methods. Consent was obtained from a total of 130 respondents, (women and men) who were interviewed on the plants used in the management of diabetes in the local government area. Available literature was searched for information on the identified plants.

Results: The study revealed 41 plant species belonging to 29 families are commonly used for treatment of diabetes in Nsukka LGA. *Annonaceae, Liliaceae* and *Rubiaceae* were the families most represented, with 3 species each. The leaves of the plant were mostly used (37.7%), and Decoction was the main mode of preparation (58.5%).

Conclusion: The forests and bushes of Nsukka Local Government Area, South Eastern-Nigeria is habitat to more than 40 plants belonging to 29 families that are used in ethnomedicinal practice as anti-diabetic agents. The plants have medicinal (including antidiabetic) uses in other places. Some of these plants have been scientifically evaluated for phytochemical composition and pharmacologically screened for anti-diabetic, and other activities.

Keywords: Diabetes, antidiabetic activity, medicinal plants, ethnomedicine, phytomedicine, Nsukka.

INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder characterized by the presence of chronic hyperglycemia accompanied by greater or lesser impairment in the metabolism of carbohydrates, lipids and proteins [1]. Diabetes is a serious, chronic disease that occurs either when the pancreas does not produce enough insulin (a hormone that regulates blood glucose), or when the body cannot effectively use the insulin it produces [2]. DM being a metabolic, endocrine disorder is directly connected to carbohydrate, lipid and protein metabolism [3]. Type 2 diabetes mellitus is closely related to life style factors including diet, physical activities, alcohol and smoking as well as obesity and a family history of diabetes. Obesity – particularly, abdominal obesity (a diet related disorder) is a risk factor for increased mortality, hypertension, type 2 DM, hyperlipidaemia and various endocrine dysfunctions. This may explain the higher incidence of DM in the current generation than in the past when diet and life style were different. Because some of these plants formed part of the food of the

indigenous people, the lower incidence among native tribes in Nigeria and other West African countries can be explained.

Based on cost estimates from a recent systematic review, it has been estimated that the direct annual cost of diabetes to the world is more than US$ 827 billion [4]. Bloom et al. [5] estimated that losses in GDP worldwide from 2011 to 2030, including both the direct and indirect costs of diabetes, will total US$ 1.7 trillion, comprising US$ 900 billion for high-income countries and US$ 800 billion for low- and middle-income countries.

Management of diabetes involves the use of insulin and oral hypoglycemic drugs. Insulin is indicated in all patients with type 1 diabetes mellitus and in about one-third of patients with type 2 DM. Insulin is usually administered by subcutaneous injection. Oral hypoglycaemic drugs are useful in type 2 diabetes as adjuncts to continued dietary restraint. They fall into four groups: Biguanides, Sulphonylureas, thiazolidinediones and α-glucosidase inhibitors. A number of plants have been identified in ethnomedicinal surveys as potent agents in management of diabetes. Examples include *Moringa oleifera, Momordica charantia, Garcinia kola, Citrus aurantiifolia, Caesalpinia bonduc* [6], *Scoparia dulcis Linn (Scrophulariaceae)* [7], *Alafia barteri Oliv, Alstonia boonei De Wild, Thaumatococcus danielli Benth* [8], *Glycyrrhiza glabra* [9], *Allium cepa (Onion), Allium sativum (Garlic), Aloe vera, Cinnamomum cassie* [10], *Ceiba pentandra* [11], *Combretum dolichopetalum* [12], *Acalypha wilkesiana* [13], *Loranthus micranthus* [14], *Combretum micranthum* [15] *and Starchytarpheta jaimaicensis* [16]. Pharmacological activities, hence, medicinal uses of plants derive from their secondary metabolite content. Such secondary metabolites include alkaloids, flavonoids, saponins, tannins, terpenoids, steroids etc. This study aims to identify and document the plants used by the people of Nsukka Local Government Area of Enugu State, South-eastern, Nigeria in treatment of diabetes.

METHODOLOGY

Description of Study Area

Nsukka local government area of Enugu state in eastern Nigeria has an area of 484 km2 at an elevation of 1,810 m. By the 2006 national census in Nigeria Nsukka LGA had a population of 309,448 with a density of 863/ km2. In2016. 48.3 % of the population was male while 51.7 % were female. 36.2% were aged 0-14, 60.5 % were aged 15-64 while 4.3 % were aged 65 and above.

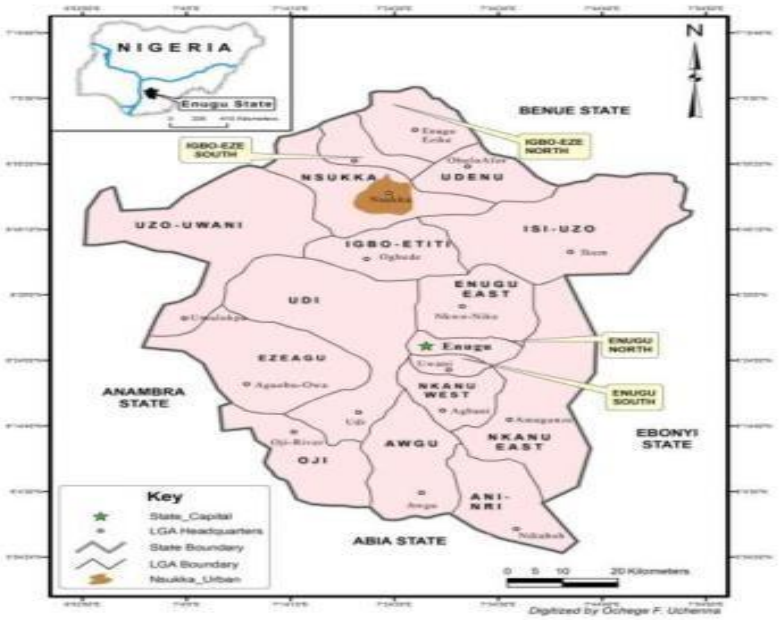

Figure 1: Map of Enugu State showing the Local Government Areas (GIS Unit, Department of Geography, University of Nigeria, Nsukka).

Figure 2: Map of Nsukka LGA

Data collection

Data was collected through a semi-formal interview which comprised respondents answering questions based on a previously designed questionnaire and personal discussions with the researchers. The set questions contained the biodata of the respondents, diagnosis of diabetes mellitus, the names of plants, their local names, common names, habit, parts used, status of domestication, availability, methods of preparation, duration of treatment, adverse effects and mode of administration, efficacy of plant treatment, traditional healers claim of total cure. The towns visited include Edem ani, Ibagwa ani, Obukpa, Ala unor, Okpuje, Okpaligbo, Eha alumona, Eha ndiagu, Obimo, Opiagu, Opi unor, Ede oballa, Okwutu, Nsukka Central and Lejja. The visits were usually made on the market days during the day in the market and their homes. The questionnaires were filled by us after getting their responses since most of the

respondents were not able to write. The questions were asked in English Language and the local language (Igbo). The aim of the research was carefully explained to the respondents after a proper introduction has been made and their consent obtained. A total of 130 respondents were interviewed. Most of the respondents were willing to divulge information while a few others hesitated. The plants were identified and authenticated by Mr. Felix Nwafor, a taxonomist in the Department of Pharmacognosy and Environmental Medicine, University of Nigeria, Nsukka.

RESULTS

Results of the biodata of the respondents

The biodata of the respondents showed that most of them were in the age bracket of 41-50 (43 %) while the least number of the respondents were in the age bracket of 51-60 (9 %). There were also more females (55 %) than males (45 %). The respondents were mostly traders (26 %) and farmers (21%) while very few were students (10 %). There were mostly married (59 %) and few were single (22 %) while some respondents did not indicate (18%). They were all Nigerians (100 %). Most were Christians (90 %) while the rest did not indicate (10 %). A greater percentage of the respondents had no formal education (34.1 %) while those that attended only primary school were least (17 %). Most claimed that their source of knowledge was from their parents (34 %) followed by those who are users (29 %) while few people were in the category of parental/training (16 %). None of the respondents had any other treatments apart from herb (Table1).

Results of the plants used in treating diabetes in Nsukka LGA

The study revealed 41 plant species belonging to 29 families that are commonly used. Annonaceae, Liliaceae and Rubiaceae had the highest number with 3 species. Asteraceae, Lauraceae, Musaceae, Rutaceae, Apocynaceae and Anarcardiaceae had 2 species each while other families had one specie each. The leaves of the plant were mostly used (37.7%), followed by the fruits (18.9%), roots (16.9%), barks (9.4%), seeds (7.6%), nuts and bulbs (3.8%) each and whole plant (1.9%). It also revealed that *Vernonia amygdalina* was the most used plant (31.1%), followed by *Gongronema latifolium* (12.7%) and *Ocimum gratissimum* (10.5%) as is shown in Table 2.

Results of the methods of preparation and modes of administration

Forty- eight different recipes were obtained. The most common solvent used was water. This is because water is readily available, easily administered, even to children and other adults who do not take alcohol. Also it is inert and doesn't interact with the plant phytoconstituents. The most common method of preparation used was decoction which involves heating the plant materials over a period of time, then cool and take as prescribed. The common mode of administration was 1 tumbler (approximately 50ml) twice daily (Table 3).

Results of the methods of diagnosis of diabetes mellitus used in Nsukka LGA

The diagnosis was made using the signs and symptoms presented by the patients. 100 % of the respondents reported that the patients presented with signs and symptoms such as loss of body weight, body weakness, excessive urination, excessive eating, presence of sugar in urine (manifested by the presence of sugar ants around the urine), and fatigue. 84% of the respondents reported excessive thirst, 94% of the respondents reported swollen legs, 15% of the respondents reported slow wound healing while there were no reports on low sex drive and short temperedness as shown in Table 4.

Results of the duration of treatment
Most (64 %) of the preparations were taken orally for a long duration of time (> 1 month) as seen in Table 5.

Results of the efficacy of plant treatments on patients
The efficacy of the plants treatment on the patients were seen as improvement in the signs and symptoms of presented earlier in Table 5 in equal proportion as shown in Table 6.

Results showing claim of no adverse effect after treatment
There was a 95% claim of no adverse effect while the remaining 5% claimed that there were few side effects (Table 7) which included nausea, vomiting, weakness and urine colouration.

Results of claim of total cure after treatment
Most of the respondents (60 %) claimed that there was total cure after treatment while 40 % of the respondents claimed there was no total cure (Table 8). This was seen as relapse or monitoring of blood sugar.

Table1: Results of the biodata of the respondents

Characteristics	**Number of respondents (%)**
Age	
21-30	13(10)
31-40	36(28)
41-50	56(43)
51-60	12(9)
61 and above	13(10)
Total	130 (100)
Sex	
Male	58(45)
Female	72 (55)
Total	130 (100)
Occupation	
Traditional medical practitioners	15(11)
Herb sellers	18(14)
Farmers	27(21)
Civil servants	23(18)
Herbalists	0(0)
Traders	34(26)
Students	13(10)
Total	130 (100)
Marital status	
Married	77(59)
Divorced	0(0)
Single	29(22)
Widow (er)	0(0)
Not indicated	24 (19)
Total	130 (100)
Nationality	
Nigerian	130(100)
Non-Nigerian	0(0)

Total	130 (100)
Religion	
Christianity	117(90)
Traditional	0(0)
Islam	0(0)
Not indicated	13(10)
Total	130 (100)
Educational status	
Tertiary institution	31(24)
Secondary school	34(26)
Primary school	22(17)
No formal education	43 (33)
Total	130 (100)
Source of knowledge	
Parental	44(34)
Training	28(22)
Parental/training	21(16)
Divination	0(0)
User	37(28)
Total	130 (100)

Table 2 Plants used in treating diabetes in Nsukka LGA

S/N	Botanical Names	Family	Local Names (Igbo)	Frequency	Common Names	Voucher No	Habit (type of plant)	Part Used	Cultivated/ Wild	Availability
1	*Abelmoschus esculentus*	Malvaceae	Okwuru	2	Okro	PCG/UNN/0361	Shrub	Fruit	C	A
2	*Acanthus montanus*	Acanthaceae	Agamusoso	2	Mountain thistle	PCG/UNN/0073	Tree	Root	W	R
3	*Allium cepa*	Liliaceae	Yabas	1	Onion	PCG/UNN/0061	Herb	Bulb	C	A
4	*Allium sativum*	Liliaceae	Galik	8	Garlic	PCG/UNN/0012	Herb	Bulb	C	A
5	*Aloe barbadensis*	Liliaceae	Aloe vera	9	Aloe vera	PCG/UNN/0058		Leaf	C	A
6	*Alstonia boonei*	Apocynaceae	Egbu	3	Cheese wood	PCG/UNN/0034	Tree	Bark	W	A
7	*Anarcardium occidentale*	Anarcardiaceae	Kashu	2	Cashew	PCG/UNN/0031	Tree	Leaf /bark	C	A
8	*Annona muricata*	Annonaceae	Sawashop	1	Soursop	PCG/UNN/0026	Tree	Leaf/ fruit	C	A
9	*Anthocleista vogelii*	Gentianaceae	Odogwu	1	English cabbage tree	PCG/UNN/0014	Tree	Leaf/root	C	A
10	*Azadirachta indica*	Meliaceae	Dongoyaro	2	Neem	PCG/UNN/0041	Tree	Leaf	W	A
11	*Buchholzia coriacea*	Capparidaceae	Wondafu Kola	3	Wonderful kola	PCG/UNN/0360	Shrub	Nut	C	A
12	*Carica papaya*	Caricaceae	Okwuru Bekee	8	Pawpaw	PCG/UNN/0029	Tree	Fruit/root (unripe)	C	A

13	*Chrysophyllum albiolum*	Sapotaceae	Udara	2	African cherry	PCG/UNN/0359	Tree	All the parts	W/C	A
14	*Cinnamonium verum*	Lauraceae	Cinnamon	1	Cinnamon	PCG/UNN/0358	Tree	Bark	W	R
15	*Citrus aurantifolia*	Rutaceae	Oroma nkirisi	6	Lime	PCG/UNN/0054	Tree	Leaf / Fruit	C	A
16	*Citrus limon*	Rutaceae	Lemon	1	Lemon	PCG/UNN/0357	Tree	Fruit	C	A
17	*Cucumis sativus*	Cucurbitaceae	Kukumba	1	Cucumber	PCG/UNN/0356		Fruit	C	A
18	*Cymbopogon citrates*	Poaceae	Lemon grass	1	Lemon grass	PCG/UNN/0046	Grass	Leaf	C	A
19	*Dioscorea alata*	Dioscoreacea	Abala	3	Water yam	PCG/UNN/0355	Root Plant	Fruit	C	A
20	*Garcinia kola*	Clusiaceae	Aki ili	4	Bitter kola	PCG/UNN/0020		Nut	C	A
21	*Glycyrrhiza glabra*	Fabaceae	Likworice	1	Liquorice	PCG/UNN/0354	Herb	Leaves	C	A
22	*Gongronema latifolium*	Asclepadiaceae	Utazi	29	Amaranth globe	PCG/UNN/0343	Herb	Leaf	C	A
23	*Irvingia gabonensis*	Irvingiaceae	Ogbonno	3	African mango	PCG/UNN/0017	Tree	Bark	C	A
24	*Magnifera indica*	Anarcadiaceae	Mangoro	1	Mango	PCG/UNN/0022	Tree	Leaf /bark	C	A
25	*Moringa oleifera*	Moringaceae	Agbadi	13	Moringa	PCG/UNN/0043	Tree	Leaf/seed/root	C/W	A
26	*Musa acuminata*	Musaceae	Ogede	1	Red banana	PCG/UNN/0044	Tree	Fruit(unripe)	C	A
27	*Musa paradisiaca*	Musaceae	Ojioko	1	Plantain	PCG/UNN/0353	Tree	Fruit (unripe)	C	A
28	*Nauclea diderichii*	Rubiaceae	Uvuru uso	1	Pin cushion tree	PCG/UNN/0052	Tree	Root	W	A
29	*Nauclea latifolia*	Rubiaceae	Uvuru Ili	1	African peach	PCG/UNN/0053	Tree	Root	W	A
30	*Ocimum gratissimum*	Labiatae	Nchanwu	24	Scent leaf	PCG/UNN/0021	Herb	Leaf	C	A
31	*Persea americana*	Lauraceae	Ube oyibo	2	Avocado Pear	PCG/UNN/0351	Tree	Seed (dry) / leaf	C	A
32	*Petersianthus macrocarpus*	Rubiaceae	Anwushi	1	English stinkwood tree	PCG/UNN/0032	Tree	Leaf	W	A
33	*Psidium guajava*	Myrtaceae	Gova	1	Guava	PCG/UNN/0045	Tree	Leaf	C	A
34	*Securidaca longepeduncu lata*	Polygalaceae	Aga egu	3	African violet tree	PCG/UNN/0050	Tree	Root	C	A
35	*Strophanthus hispidus*	Apocynaceae	Kagoro	1	Kombe seed	PCG/UNN/0024	Shrub	Root	W	A
36	*Tapinanthus globiferas*	Loranthaceae	Owube	3	African mistletoe	PCG/UNN/0352	Shrub	Leaf	W	A
37	*Uvaria chamae*	Annonaceae	Uda-egu	1	Black pepper	PCG/UNN/0033	Tree	Seed	C	A
38	*Vernonia*	Asteraceae	Olugbu	71	Bitter leaf	PCG/UNN/	Herb	Leaf	C	A

	amygdalina					0030				
39	*Vernonia conferta*	Asteraceaee	Olugbu egu	4	Wild bitter leaf	PCG/UNN/ 0037	Herb	Leaf	C	A
40	*Xylopia aethiopica*	Annonaceae	Uda	1	Ethiopian pepper	PCG/UNN/ 0072	Tree	Seed	C	A
41	*Zingiber officinale*	Zingiberaceae	Jinja	4	Ginger	PCG/UNN/ 0059	Herb	Fruit	C	A

Table 3: Methods of preparation and doses used

S/N	Recipes	Solvent of Choice	Method of Preparation	Dose
1	Leaves of *Gongronema latifolium,Ocimum gratissimum,Vernonia amygdalina* + roots of *African peach* + potash	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
2	Leaves of *Gongronema latifolium,Ocimum gratissimum,Vernonia amygdalina*	Water	Decoction	1 tumbler (approximately 50 ml) 3 times daily
3	Bark of *Alstonia boonei*	Water or dry gin	Decoction or Maceration	1 shot (approximately 10ml) three times daily
4	Nuts of *Bulchhozia coriaceae*	Water	Decoction	1 shot (approximately 10ml) three times daily
5	Seeds of *Uvaria chamae*	Water	Decoction	1 shot (approximately 10ml) three times daily
6	Leaves of *Gongronema latifolium,Ocimum gratissimum*	Water	Squeezing	Half tumbler (approximately 25 ml) once daily
7	*Musa acuminata* (unripe fruit)	Water	Cooking & Pounding	Eaten with soup
8	*Musa paradisiaca* (unripe fruit)	Water	Cooking & Pounding	Eaten with soup
9	Fruit of *Dioscorea alata*	Water	Cooking & Pounding	Eaten with soup
10	*Carica papaya* fruits	Water	Maceration	Half tumbler (approximately 25 ml) twice daily
11	Dry seeds of *Persea americana*	Water	Grinding	Prepared and taken as pap
12	Leaves of *Gongronema latifolium and Vernonia amygdalina*	Water	Squeezing	1 tumbler (approximately 50 ml) twice daily
13	*Vernonia amygdalina* leaves	Water	Squeezing	1 tumbler (approximately 50 ml) twice daily
14	Seeds of *Moringa oleifera*		Grinding	Taken with pap
15	Leaves of *Gongronema latifolium,Ocimum*	Water	Pound in a mortar, add water ,sieve and transfer in	1 shot (approximately 10ml) three times daily

	gratissimum,Vernona, Citrus aurantifolium, Citrus limon and potash		a neat gallon	
16	Roots of *Securidaca longepedunculata*	Water	Decoction	1 tumbler (approximately 50 ml) 3 times daily
17	Roots/leaves of *Anthocleista vogelli*, leaves of *Gongronema latifolium,Ocimum gratissimum,Vernonia amygdalina*	Water	Decoction	1 tumbler (approximately 50 ml) 3 times daily
20	Leaves of *Gongronema latifolium,Ocimum gratissimum,Vernonia amygdlina,Citrus aurantifolium* and *Zingiber officinale*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
21	Leaves of *Gongronema latifolium,Vernonia amygdlina and Annona muricata*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
22	Leaves of *Vernonia conferta* and *Petersianthus macrocarpus*	Water	Decoction	Half tumbler (approximately 25 ml) once daily
23	Nuts of *Bulchhozia coriaceae*	Water/ alcohol	Maceration	Half shot (approximately 5ml) twice daily
24	Leaves of *Vernonia amygdalina,Tupinanthus globiferas*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
25	Bulbs *of Allium sativum*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
26	Leaves of *Aloe barbadensis*	Water	Squeezing	1 tumbler (approximately 50 ml) once daily
27	Barks of *Irvingia gabonensis*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
28	Leaves of *Persea Americana*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
29	Seeds /roots/leaves of *Moringa oleifera*	Water	Decoction /Maceration	1 tumbler (approximately 50 ml) twice daily
30	Leaves of *Vernonia amygdalina , Cinnamonium verum, Garcinia kola* nut, *Allium sativum* bulb, *Glycyrrhiza glabra* leaves	Water	Cold maceration	1 tumbler (approximately 50 ml) twice daily
31	*Alstonia boonei* bark	Water / Dry gin	Maceration /Decoction	1 shot (approximately 10ml) three times daily
32	*Strophanthus lispidus* root	Water	Decoction	1 shot (approximately 10ml) three times daily
33	*Xylopia aethiopica* seed	Water	Decoction	1 shot (approximately 10ml) three times daily
34	Roots of *Nauclea diderichii, Vernonia conferta* and fruit of *Citrus aurantifolium*	Water	Decoction	Half tumbler (approximately 25 ml) twice daily
35	Dried *Abelmoschus esculentus* and honey		Grinding	1 teaspoon 2 times daily
36	Leaves of *Vernonia conferta*	Water	Decoction	1 stainless cup (approximately 100ml) twice daily
37	Leaves and barks of *Chrysophyllum albiolum*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
38	Leaves *Vernonia amygdalina , Anacardium occidentale, Magnifera indica, Carica papaya, Allium sativum*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
39	Bulbs of *Allium sativum* and honey		Grind and mix	1 teaspoon once daily
40	Leaves of *Tupinanthus*		Grinding	1 teaspoon 3 times daily added

	globiferas and roots of *Acanthus montanus*			to food
41	Leaves of *Azadirachta indica*	Water	Decoction	1 tumbler (approximately 50 ml) twice daily
42	Leaves of *Psidiun guajava, Petersianthus macrocarpus, Strophanthus hispidus* stem	Water	Decoction	1 tumbler (approximately 50 ml) 3 times daily
43	Seeds of *Moringa oleifera*		Chewed raw	2 seeds 3 times daily
44	Dried leaves of *Moringa oleifera*		Grinding	Eaten with pap, beans, stew, soup, porridge or plantain
45	Fresh premature leaves of *Vernonia amygdalina,Ocimum gratissimum* and fruits of *Citrus limon*	Water	Squeezing and mix with *Citrus limon* juice	1 tumbler (approximately 50 ml) twice daily

Table 4: Results of the method of diagnosis for diabetes

Signs and Symptoms	**Yes (%)**	**No (%)**
Loss of body weight	130 (100)	0 (0)
Body weakness	130 (100)	0 (0)
Excessive urination	130 (100)	0 (0)
Excessive eating	130 (100)	0 (0)
Presence of sugar in urine	130(100)	0 (0)
Excessive thirst	109 (84)	21(16)
Swollen legs	122 (94)	8 (6)
Short tempered	0 (0)	130 (100)
Low sex drive	0 (0)	130 (100)
Fatigue	130 (100)	0 (0)
Others(slow wound healing)	20 (15)	110 (85)

Table 5: Results of the duration of treatment

Duration	**Yes (%)**
Short duration (< 1 month)	47(36)
Long duration (> 1 month)	83 (64)

Table 6: Results of the efficacy of plant treatment on patients

Description	**Yes (%)**	**No (%)**
Disappearance of sugar in urine	130 (100)	0 (0)
Reduction in body weakness	130 (100)	0 (0)
Normal body weight	130 (100)	0 (0)
Reduction in frequency of eating	130 (100)	0 (0)
Reduction in frequency of urination	130 (100)	0 (0)
Reduction in swollen legs	122 (94)	8 (6)
Improvement in temperament	0 (0)	130 (100)

Improved sex drive	0 (0)	130 (100)
Regaining of strength	130 (100)	0 (0)
Others (slow wound healing)	20 (15)	110(85)

Table 7: Results of claim of no adverse effect after treatment

Claim	Yes (%)
No adverse effect	124 (95)
Adverse effect (Fatigue, urine colouration).	6 (5)

Table 8: Results of claim of total cure after treatment

Claim	Yes (%)
Total cure	78 (60)
No total cure	52 (40)

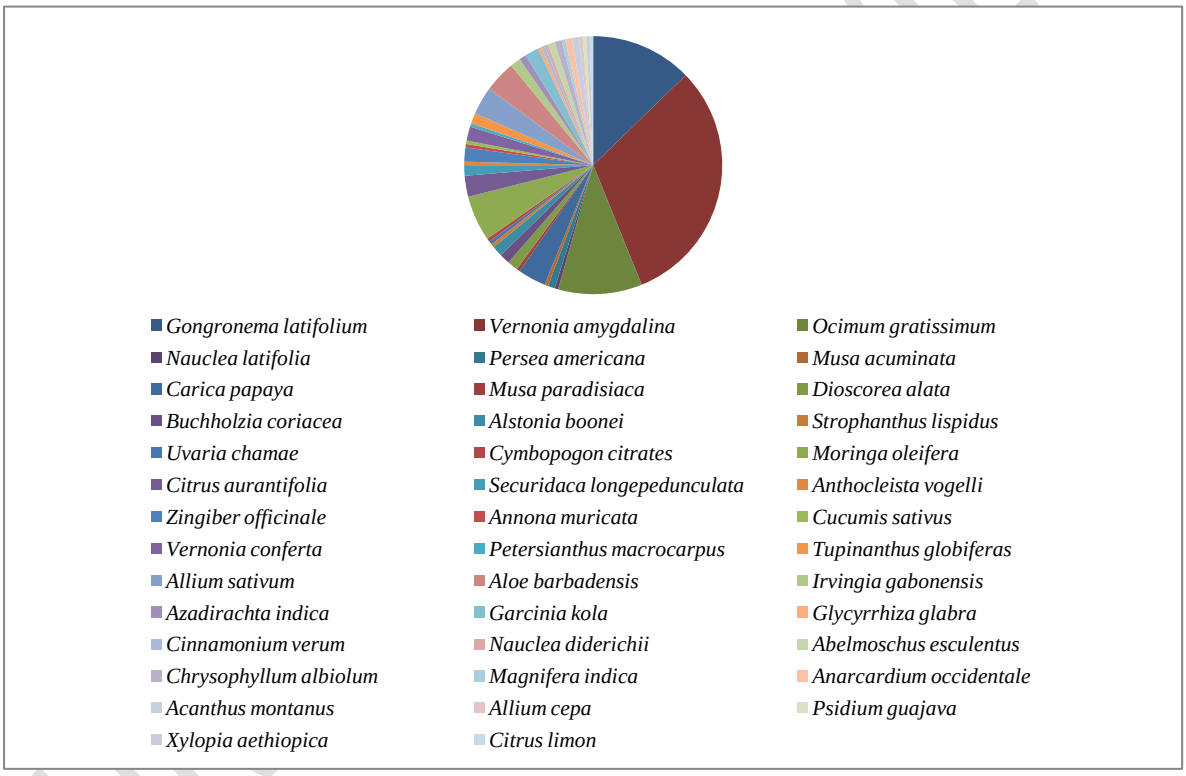

Figure 3: Pie chart showing the distribution of the plants

Table 9: Results showing the distribution of the families of the plants

S/No	Family	Frequency (%)
1	Asclepadiaceae	1 (3.5)
2	Asteraceae	2 (6.9)
3	Labiatae	1 (3.5)
4	Rubiaceae	3 (10.3)
5	Lauraceae	2 (6.9)
6	Musaceae	2 (6.9)
7	Caricaceae	1 (3.5)
8	Dioscoreacea	1 (3.5)

9	Capparidaceae	1 (3.5)
10	Apocynaceae	2 (6.9)
11	Annonaceae	3 (10.3)
12	Poaceae	1 (3.5)
13	Moringaceae	1(3.5)
14	Rutaceae	2 (6.9)
15	Polygalaceae	1 (3.5)
16	Gentianaceae	1 (3.5)
17	Zingiberaceae	1 (3.5)
18	Cucurbitaceae	1 (3.5)
19	Loranthaceae	1(3.5)
20	Liliaceae	3 (10.3)
21	Irvingiaceae	1 (3.5)
22	Meliaceae	1 (3.5)
23	Clusiaceae	1 (3.5)
24	Fabaceae	1 (3.5)
25	Malvaceae	1 (3.5)
26	Sapotaceae	1 (3.5)
27	Anarcadiaceae	2 (6.9)
28	Acanthaceae	1 (3.5)
29	Myrtaceae	1 (3.5)

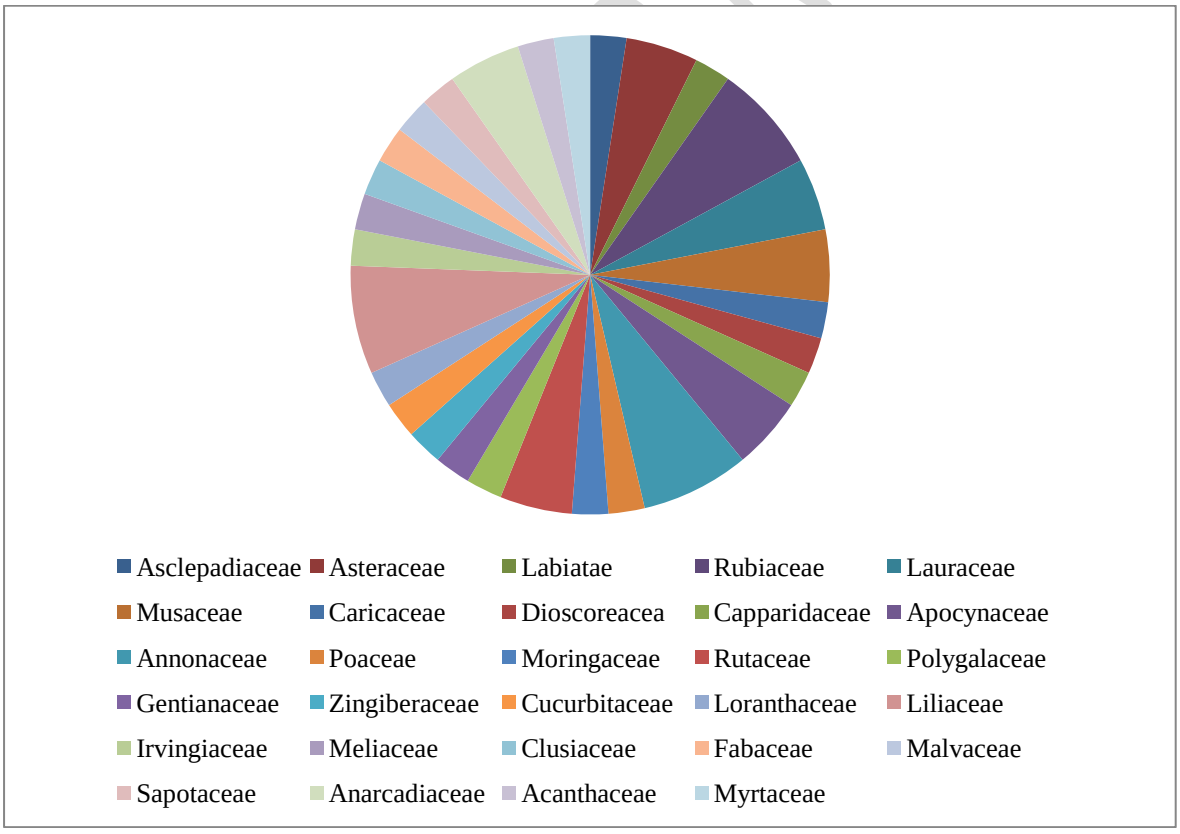

Figure 4: Pie chart showing the distribution of the plant families

DISCUSSION

The objective of this work was to study and document the diversity and traditional use of tropical plants as antidiabetic medicines and their methods of preparation by the indigenous people of Nsukka Local Government Area of Enugu state, Nigeria. This was achieved using the structured questionnaire and face to face interview method. Although some plants recorded low percentage of use, others had very significant percentage of use and previous documentation.

The biodata of the respondents showed that most of them were within the age range of 41-50, mostly females, traders , married, Christians , have no formal education, have their source of knowledge from their parents and they were all Nigerians. In comparing with ethnobotanical surveys done in other communities, it was revealed that most of the respondents in Akwa Ibom State, Nigeria were males (60 %), had farming and fishing as their major occupation, their mean age being 65 and their respondents consisted of traditional medical practitioners, elders and patients [17]. The respondents in Manisa, Turkey were mostly females (61), age range of 38- 71, comprised of more high school graduates, women used medicinal plants than men and had their source of knowledge from parents, traditional healers, television programs and books [18]. The respondents in Badagry, Lagos State, Nigeria were mostly males who are advanced in age and they consisted of traditional medical practitioners most of which had Western education in various disciplines and herb sellers [19] while in Nkonkobe Municipality in South Africa, most of the respondents were married, between the age range of 40- 60, comprised of traditional healers and herbalists and they had low education qualification [20].

The methods of diagnosis used were made using the signs and symptoms presented by the patients. 100% of the respondents reported that the patients presented with signs and symptoms such as loss of body weight, body weakness, excessive urination, excessive eating, presence of sugar in urine (manifested by the presence of sugar ants around the urine), and fatigue. 84% of the respondents reported excessive thirst, 94% of the respondents reported swollen legs, 15% of the respondents reported slow wound healing. Comparing with Nkonkobe Municipality, South Africa, the diagnosis of diabetes mellitus was made using signs and symptoms such as loss of body weight, body weakness, excessive urination, excessive thirst and presence of sugar in the urine as reported by 100% of the respondents [20] while efficacy of plant treatment was observed by the improvement of the signs and symptoms. The duration of treatment were reported as majorly long duration (64 %) in this study and (60 %) in Nkonkobe Municipality, South Africa [20]. There was a claim of no adverse effect by the majority of the respondents (95%) while a 100 % claim of no adverse effects was made in Nkonkobe Municipality, South Africa [20]. Majority of the respondents (60 %) made a claim of total cure after treatment while the remaining 40 % claimed that there was usually a relapse and also, that the plants didn't cure diabetes mellitus but helped in monitoring blood sugar level. In Nkonkobe Municipality, South Africa, there was an 80% claim of total cure [20].

The study revealed 41 plant species belonging to 29 families that are commonly used. Annonaceae, Liliaceae and Rubiaceae had the highest number with 3 species each. Asteraceae, Lauraceae, Musaceae, Rutaceae, Apocynaceae and Anarcardiaceae had 2 species each while the other families had one each. The leaves of the plant were mostly used (37.7 %), followed by the fruits (18.9 %), roots (16.9 %), barks (9.4 %), seeds (7.6 %), nuts and bulbs (3.8 %) each and whole plant (1.9 %). In Badagry, Lagos State, Nigeria, leaves were also mostly used [19], same as in Akwa Ibom [17], Manisa, Turkey [18] while roots were mostly used in Nkonkobe Municipality, South Africa [20]. It also revealed that *Vernonia amygdalina* was the most used plant (31.1 %), followed by *Gongronema latifolium* (12.7 %) and *Ocimum gratissimum* (10.5 %). The method of preparation used was commonly decoction, same in Nkonkobe Municipality, South Africa (Oyedemi et al., 2009) and Akwa

Ibom (Ajibesin et al., 2008). Infusion was commonly used in Manisa, Turkey [18] and Badagry, Lagos State, Nigeria [19].
Vernonia amygdalina has been found to contain certain phytochemicals which are responsible for its antidiabetic action. These include alkaloids, anthraquinones, saponins, flavonoids, tannins and terpenes [21]. *Gongronema latifolium* contains alkaloids, saponins, flavonoids and tannins which are involved in its hypoglycemic action [22]. Phytochemical evaluation of *Ocimum gratissimum* has shown that it contains alkaloids, tannins, phytates, flavonoids and oligosaccharides [22].

CONCLUSION

Forty- one (41) species of plants belonging to 29 families were found to be used as anti-diabetic plants in Nsukka Local Government Area of Enugu State, South eastern Nigeria and decoction identified as the common method of preparation.

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ABBREVIATIONS

LGA	Local Government Area
WHO	World Health Organization
DM	Diabetes Mellitus
GDM	Gestational Diabetes Mellitus
BMI	Body mass index
OGTT	Oral glucose tolerance test
FPG	Fasting plasma glucose