

Ethnobotanical Uses of Medicinal Plants for the Control of Diabetes and Hypertension

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ABSTRACT

Diabetes and hypertension are among the prevalent diseases in the world; while they can be controlled and prevented, they create many problems and complications for affected patients. Ethnomedicine which is the study of traditional medicines used for curative purposes in a given locality revealed the medicinal plants used for the treatment of diabetes and hypertension. Plants such as *Allium sativum*, *Aloe vera*, *Mordica charantha*, *Mangifera indica*, *Opuntia dillenii*, *Cocos nucifera*, *Carica papaya*, *Persea americana*, *Psidium guajava*, *Vernonia amygdalina*, *Datura stramonium*, *Zingiber officinale*, *Gongronema latifolium*, and *Hibiscus sabdariffa* have commonly been used for the treatment of diabetes and hypertension. Ethnobotanical data were collected by means of interview using structured questionnaire. The questions were focused on the local names of plants commonly used for the treatment of diabetes and hypertension, its efficacy, plant parts used, mode of preparation and administration, toxicity, state of the plant (fresh or dry), and dosage. The result revealed that *C. papaya*, *G. latifolium*, *M. indica*, *V. amygdalina*, and *M. charantha* were rated highest in their use for treatment of diabetes while *Bryophyllum pinnatum*, *H. sabdariffa*, and *Jatropha curcas* were rated highest in their use for the treatment of hypertension. The plant parts commonly used for the treatment of these ailments revealed that leaf had highest percentage score than other parts for the entire sample plants. The toxicity rating of sample plants revealed that *Jatropha gossypifolia*, *M. charantha*, and *O. dillenii* had the highest toxicity rating. Phytochemical characterization and pharmacological validation of these plants would prove their possibility for production of drugs which are useful in curing and controlling diabetes and hypertension.

Key words: Control, diabetes, ethnobotanical, hypertension, medicinal plant

INTRODUCTION

Diabetes is the most common human carbohydrate metabolism disorder in which blood sugar (glucose) level rises due to a deficiency of insulin secretion or its abnormal activity.^[1] Diabetes mellitus is caused by the destruction of insulin-producing β -cells in the pancreas-type I diabetes and the reduction in the sensitivity of the body muscles and the liver cells to insulin action leads to type II diabetes.^[2] According to Greenberg and Glick,^[3] diabetes mellitus is a complex disorder with metabolic and vascular complications. This chronic disease causes hyperglycemia then it affects different body systems, including the kidneys, eyes, and mucous membrane. Long-term complications of diabetes

include heart disease, stroke, kidney failure, blindness, nerve damage and neuropathy, atherosclerosis, chronic infections, immune deficiency, and peripheral vascular disease that may lead to ulcers, gangrene, and amputation.^[1,4] It has been noted by Tedong *et al.*^[5] that patients with high blood sugar level usually experienced frequent urination. They are also prone to thirst and hunger. Other symptoms of diabetes mellitus include numbness, loss of sensation and coordination, imbalance, blurred vision, and feet pains.

Diabetes insipidus is another disorder that is associated with a lack of vasopressin and is also characterized by the symptoms of diabetes mellitus.^[6] Vasopressin is an antidiuretic hormone formed in the hypothalamus and secreted in the pituitary

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gland. The hormone is used primarily to control water retention through the reduction in urine output. Although both diseases share some common symptoms such as frequent urination and excessive thirst, the diagnosis and treatments are not the same.^[6] Therefore, diabetes insipidus should not be confused with diabetes mellitus which result from insulin deficiency or resistance leading to high blood sugar level.

Lifton^[7] said that according to the WHO criteria hypertension means elevated blood pressure levels above 140/90 mmHg. It has been named the “silent killer” as it is asymptomatic and the major contributor or risk factor to cardiovascular morbidity and mortality.^[8] In 2000, 26.4% of the world population suffered hypertension, and it is predicted this rate would increase by 60% in 2025. Carretero and Oparil^[9] reported that hypertension is mainly of two types; primary or essential hypertension (90–95%) has no specific cause and may contribute to increase in blood pressure. Secondary hypertension (5–10%) is caused by underlying diseases such as renal damage, pheochromocytoma, muscular disorder, and renal failure that affect the kidney, arteries, heart, or endocrine system.^[10]

Ethnomedicine which is the study of traditional medicine practiced by various ethnic groups, especially by indigenous people, has helped in the identification of medicinal plants used in the treatments of diabetes and hypertension.^[11] However, these components of ethno medicine have long been ignored by many biomedical practitioners for many reasons. For example, the chemical composition, dosages and toxicity of plants used in ethnomedicine are not clearly defined.^[12] However, ethnomedicinal uses of plants are one of the most successful criteria used by the pharmaceutical industry in finding new therapeutic agents for various fields of biomedicine.^[13] Some outstanding medicinal drugs which have been developed from ethnomedicinal uses of the plant include reserpine from *Rauwolfia serpentina* (Indian snakeroot), used for treating hypertension and quinine from *Cinchona pubescens* (Cinchona) used for treating malaria.^[14]

The main aim of this present ethnobotanical survey is to establish an inventory of medicinal plants and plant parts which are used traditionally to control diabetes and hypertension and to compare the plants used for treating diabetes and hypertension.

MATERIALS AND METHODS

Location

The study was carried out in Oba town in Idemili South Local Government Area, Anambra State. Oba town lies between latitudes 4°4'N and longitudes 6° and 8° 20' E of the equator.

Survey design

The survey was conducted in two stages which are (a) fieldwork which included (i) oral interview and (ii) questionnaire and (b) inventory documentation.

The field trip was carried out in five villages out of the nine villages in the study area during 2 weeks of the trip. The trip involved using the motorcycle to arrive at the study area which includes Umuokokpa, Aborji, Umumpama, Isu, and Ezelle. These areas were selected because they are mostly covered by the different medicinal plants which are used to treat different ailments including diabetes and hypertension.

Ethnobotanical data collection

Data were collected using both qualitative method and oral interview. Qualitative method is by the use of questionnaire known as the closet format question that includes multiple choice questions and answers to help in the easy calculation of statistical data and for preliminary analysis to be prepared with ease. Appendix 1 shows the details on questionnaire.

The questionnaire was developed and modeled according to various survey methodologies.^[15,16] The questions were focused on the local names of plants commonly used for the treatment of diabetes and hypertension, its efficacy, plant parts used, mode of preparation, and administration, toxicity, state of the plant (fresh or dry), dosage, and others if any to specify.

Table 1: Mean ratings on the plant used for treating diabetes

Name of plant	Means	Standard deviation	Mean rank
<i>Carica papaya</i>	4.25	0.79	1 st
<i>Gongronema latifolium</i>	3.93	1.07	2 nd
<i>Mangifera indica</i>	3.88	1.15	3 rd
<i>Mordica charantha</i>	3.62	1.14	4 th
<i>Vernonia amygdalina</i>	3.62	1.24	4 th
<i>Moringa oleifera</i>	3.45	1.32	6 th
<i>Acanthus monatus</i>	3.40	1.32	7 th
<i>Opuntia dillenii</i>	3.37	1.37	8 th
<i>Anacardium occidentale</i>	3.33	1.46	9 th
<i>Rauwolfia vomitoria</i>	3.25	1.3	10 th
<i>Annona muricata</i>	3.18	1.32	11 th
<i>Dioscorea cayenensis</i>	3.00	1.46	12 th
<i>Chromolaena odorata</i>	2.98	1.19	13 th
<i>Hibiscus sabdariffa</i>	2.98	1.35	13 th
<i>Ocimum gratissimum</i>	2.98	1.44	13 th
<i>Allium cepa</i>	2.83	1.2	16 th
<i>Bridelia micrantha</i>	2.52	1.53	17 th
<i>Costus afer</i>	2.47	1.36	18 th
<i>Phyllanthus amarus</i>	2.42	1.2	19 th
<i>Anthocleista djalonensis</i>	2.42	1.2	19 th

About 60 respondents were interviewed. These respondents were between the ages of 30–78 and were selected based on their socioeconomic level, knowledge, attitude, and pathology.^[17] Among them, 40 were farmers, five patients suffering from diabetes and hypertension, and 15 herbalists. The interviews were done in the field to avoid the probable confusions with regard to identification of the medicinal plants.^[18] The morphological characteristics, habitats and habits of medicinal plants were observed. The ethnobotanical inventory consists of local names of plants used, plant parts, mode of preparation, route of administration, toxicity, and dosage.

Botanical identification

Some plants were identified in the field by the herbalists using their local names while the unknown ones were identified by a taxonomist at the Herbarium of Nnamdi Azikiwe University, Botany Department, Awka.

Statistical analysis of ethnobotanical data

The documented ethnobotanical data were elucidated to define the plant parts and the preparation methods used in different villages. The various statistical analysis used include that of percentage and frequency distribution employed in analyzing the distribution of medicinal plants collected in different villages. *T*-test and ANOVA were employed in comparing the various answers. Fidelity level (FL) points out

the preference shown for one species over others; treating particular ailments as described by Alexiades.^[19] High FL confirms high usage of the plant species for a particular ailment whereas low FL confirms wide range of medicinal uses but with a low frequency for each ailment. It was calculated using the formula $FL = NP/N \times 100$ where NP is the number of respondents that provided information about the use of the species for a particular ailment category whereas N is the number of respondents stating the use of that plant for any ailment category. High FL value (near 100%) is obtained from plants for which almost all use reports mention using it in nearly the same way, whereas low FL value is obtained from plants that are used for many different purposes.

RESULTS

Ethnobotanical studies on plants used for treating diabetes

The result of the mean ratings of plant commonly used for treating diabetes in the study area revealed that *Carica papaya* (4.25 ± 0.79) has the highest rating followed by *Gongronema latifolium* (3.93 ± 1.07), *Mangifera indica* (3.88 ± 1.15), *Vernonia amygdalina* (3.62 ± 1.34), and *Mordica charantha* (3.62 ± 1.14). However, the least rated plants were *Phyllanthus amarus* (2.42 ± 1.20), *Anthocleista djalensis* (2.42 ± 1.15), and *Costus afer* (2.47 ± 1.36) [Table 1]. There

Table 2: Percentage responses on the part of plant mostly used for treating diabetes

Name of plant	Part of plant used (%)							Decision (mostly used)
	Leaf	Bark	Root	Seed	Fruit	Flower	Stem	
<i>Mangifera indica</i>	51.7	38.3	1.7	3.3	0.0	3.3	1.7	Leaf
<i>Moringa oleifera</i>	65.0	16.7	0.0	8.3	6.7	1.7	1.7	Leaf
<i>Costus afer</i>	58.3	5.0	20.0	0.0	0.0	0.0	16.7	Leaf
<i>Anacardium occidentale</i>	38.3	31.7	5.0	1.7	3.3	6.7	13.3	Leaf
<i>Vernonia amygdalina</i>	76.7	0.0	1.7	0.0	0.0	1.7	20.0	Leaf
<i>Annona muricata</i>	56.7	16.7	6.7	0.0	5.0	3.3	11.7	Leaf
<i>Ocimum gratissimum</i>	81.7	0.0	1.7	1.7	0.0	0.0	15.0	Leaf
<i>Rauwolfia vomitoria</i>	70.0	0.0	25.0	0.0	0.0	0.0	5.0	Leaf
<i>Gongronema latifolium</i>	83.3	0.0	5.0	3.3	0.0	1.7	6.7	Leaf
<i>Chromolaena odorata</i>	50.0	0.0	15.0	0.0	0.0	1.7	33.3	Leaf
<i>Acanthus montanus</i>	55.0	1.7	16.7	0.0	0.0	0.0	26.7	Leaf
<i>Carica papaya</i>	46.7	0.0	1.7	26.7	8.3	1.7	15.0	Leaf
<i>Mordica charantha</i>	71.7	0.0	10.0	1.7	1.7	1.7	13.3	Leaf
<i>Opuntia dillenii</i>	53.3	0.0	30.0	1.7	1.7	1.7	11.7	Leaf
<i>Dioscorea cayenensis</i>	36.7	0.0	0.0	61.7	0.0	0.0	1.7	Seed
<i>Phyllanthus amarus</i>	43.3	0.0	20.0	1.7	1.7	1.7	31.7	Leaf
<i>Allium cepa</i>	23.3	0.0	8.3	58.3	0.0	0.0	10.0	Bulb
<i>Anthocleista djalensis</i>	65.0	1.7	18.3	3.3	1.7	1.7	8.3	Leaf
<i>Hibiscus sabdariffa</i>	21.7	0.0	1.7	8.3	8.3	60.0	0.0	Flower
<i>Bridelia micrantha</i>	41.7	0.0	10.0	1.7	1.7	0.0	45.0	Stem

Table 3: Responses on toxicity of the plant used for treating diabetes

Name of plant	Yes (%)	No (%)	Rank
<i>Mordica charantha</i>	61.7	38.3	1 st
<i>Opuntia dillenii</i>	51.7	48.3	2 nd
<i>Carica papaya</i>	45	55	3 rd
<i>Bridelia micrantha</i>	40	60	4 th
<i>Acanthus montanus</i>	38.3	61.7	5 th
<i>Rauwolfia vomitoria</i>	30	70	6 th
<i>Mangifera indica</i>	28.3	71.7	7 th
<i>Chromolaena odorata</i>	25	75	8 th
<i>Costus afer</i>	16.7	83.3	11 th
<i>Anthocleista djalonenis</i>	15	85	12 th
<i>Anacardium occidentale</i>	13.3	86.7	13 th
<i>Moringa oleifera</i>	6.7	93.3	14 th
<i>Allium cepa</i>	3.3	96.7	15 th
<i>Dioscorea cayenensis</i>	1.7	98.3	16 th
<i>Vernonia amygdalina</i>	1.7	98.3	16 th
<i>Hibiscus sabdariffa</i>	1.7	98.3	16 th
<i>Ocimum gratissimum</i>	0	100	19 th
<i>Phyllanthus amarus</i>	0	100	19 th

was a significant difference in the mean ratings of the plant used for treating diabetes in the study area ($P < 0.05$). The result on the part of the plant used revealed that leaf has the highest percentage score than the bark, root, seed, fruit, flower, and stem. Except for *Dioscorea cayenensis* (seed), *Allium cepa* (bulb), *Hibiscus sabdariffa* (flower), and *Bridelia micrantha* (stem), the leaf has highest percentage scores for all the sample plants [Table 2]. The result on the toxicity of the plants revealed that *M. charantha*, *Opuntia dillenii*, and *C. papaya* have the highest toxicity rating while *Phyllanthus amarus* and *Ocimum gratissimum* have the lowest toxicity ratings [Table 3]. Responses on the method of preparation/use of the plant in treating diabetes vary between infusions, decoction, poultice, tea, and maceration. The most used method was decoction, followed by maceration, infusion, tea, and finally poultice [Table 4]. The response on the state of use of the plant for treating diabetes revealed that except for *Moringa oleifera*, *C. afer*, *G. latifolium*, *C. papaya*, *M. charantha*, and *Phyllanthus amarus*, all other plants are used mostly when fresh [Table 5].

Ethnobotanical studies of plants used for treating hypertension

The result of the mean rating of plants commonly used for treating hypertension in the study area revealed that

Table 4: Responses on methods of plant preparation for the treatment of diabetes

Name of plant	Method of preparation/use (%)					Decision (mostly used)
	Infusion	Decoction	Poultice	Tea	Maceration	
<i>Mangifera indica</i>	11.7	88.3	0.0	0.0	0.0	Decoction
<i>Moringa oleifera</i>	0.0	0.0	0.0	100.0	0.0	Tea
<i>Costus afer</i>	20.0	0.0	0.0	80.0	0.0	Tea
<i>Anacardium occidentale</i>	0.0	50.0	0.0	0.0	50.0	Decoction/maceration
<i>Vernonia amygdalina</i>	40.0	40.0	13.3	6.7	0.0	Infusion/decoction
<i>Annona muricata</i>	40.0	43.3	0.0	0.0	16.7	Decoction
<i>Ocimum gratissimum</i>	0.0	50.0	0.0	0.0	50.0	Decoction/maceration
<i>Rauwolfia vomitoria</i>	65.0	21.7	13.3	0.0	0.0	Infusion
<i>Gongronema latifolium</i>	38.3	33.3	0.0	0.0	28.3	Infusion
<i>Chromolaena odorata</i>	0.0	0.0	0.0	0.0	100.0	Maceration
<i>Acanthus montanus</i>	35.0	61.7	0.0	0.0	3.3	Decoction
<i>Carica papaya</i>	0.0	46.7	15.0	13.3	25.0	Decoction
<i>Mordica charantha</i>	28.3	71.7	0.0	0.0	0.0	Decoction
<i>Opuntia dillenii</i>	0.0	31.7	28.3	0.0	40.0	Maceration
<i>Dioscorea cayenensis</i>	0.0	45.0	0.0	18.3	36.7	Decoction
<i>Phyllanthus amarus</i>	0.0	51.7	0.0	13.3	35.0	Decoction
<i>Allium cepa</i>	30.0	0.0	8.3	0.0	61.7	Maceration
<i>Anthocleista djalonenis</i>	38.3	0.0	0.0	0.0	61.7	Maceration
<i>Hibiscus sabdariffa</i>	20.0	28.3	11.7	25.0	15.0	Decoction
<i>Bridelia micrantha</i>	65.0	21.7	13.3	0.0	0.0	Infusion

Table 5: State of plant used for treating diabetes

Name of plant	State of Plant (%)		Mostly indicated
	Fresh	Dry	
<i>Mangifera indica</i>	66.7	33.3	Fresh
<i>Moringa oleifera</i>	33.3	66.7	Dry
<i>Costus afer</i>	33.3	66.7	Dry
<i>Anacardium occidentale</i>	58.3	41.7	Fresh
<i>Vernonia amygdalina</i>	61.7	38.3	Fresh
<i>Annona muricata</i>	68.3	31.7	Fresh
<i>Ocimum gratissimum</i>	61.7	38.3	Fresh
<i>Rauwolfia vomitoria</i>	53.3	46.7	Fresh
<i>Gongronema latifolium</i>	23.3	76.7	Dry
<i>Chromolaena odorata</i>	63.3	36.7	Fresh
<i>Acanthus montanus</i>	70.0	30.0	Fresh
<i>Carica papaya</i>	25.0	75.0	Dry
<i>Mordica charantha</i>	28.3	71.7	Dry
<i>Opuntia dillenii</i>	60.0	40.0	Fresh
<i>Dioscorea cayenensis</i>	58.3	41.7	Fresh
<i>Phyllanthus amarus</i>	35.0	65.0	Dry
<i>Allium cepa</i>	63.3	36.7	Fresh
<i>Anthocleista djalonensis</i>	66.7	33.3	Fresh
<i>Hibiscus sabdariffa</i>	68.3	31.7	Fresh
<i>Bridelia micrantha</i>	58.3	41.7	Fresh

Table 6: Mean ratings on the plant used for treating hypertension

Name of plant	Means±SD	Rank
<i>Bryophyllum pinnatum</i>	3.50±1.47	1 st
<i>Hibiscus sabdariffa</i>	3.30±1.47	2 nd
<i>Jatropha curcas</i>	3.27±1.40	3 rd
<i>Catharanthus roseus</i>	3.27±1.27	3 rd
<i>Zingiber officinale</i>	3.25±1.59	5 th
<i>Psidium guajava</i>	2.17±1.32	6 th
<i>Cocos nucifera</i>	3.00±1.59	7 th
<i>Jatropha gossipifolia</i>	2.98±1.32	8 th
<i>Costus afer</i>	2.95±1.32	9 th
<i>Persea americana</i>	2.88±1.38	10 th
<i>Mordica charantha</i>	2.87±1.70	11 th
<i>Opuntia dillenii</i>	3.73±1.44	12 th
<i>Carica papaya</i>	2.65±1.45	13 rd
<i>Tapinanthus globiferus</i>	2.58±1.36	14 th
<i>Datura stramonium</i>	2.57±1.44	15 th
<i>Allium cepa</i>	2.55±1.31	16 th

Bryophyllum pinnatum (3.50 ±1.47) has the highest rating followed by *H. sabdariffa* (3.30 ± 1.47) and *Jatropha curcas* (3.27 ± 1.40). However, the least rated plants were *Allium cepa* (2.55 ± 1.31), *Datura stramonium* (2.57 ± 1.44), and *Tapinanthus globiferus* (2.58 ± 1.36) [Table 6]. There was a significant difference in the mean ratings of the plant used for treating hypertension in the study area ($P < 0.05$).

The result on the part of the plant used revealed that leaf has the highest percentage score than the bark, root, seed, fruit, flower, and stem. Except for *Cocos nucifera* (seed), *Zingiber officinale* (root), *A. cepa* (bulb), and *H. sabdariffa* (flower), the leaf has highest percentage scores for all the sample plants [Table 7].

The result on the toxicity of the plants revealed that *Jatropha gossipifolia*, *M. charantha*, and *O. dillenii* have the highest toxicity rating while *A. cepa*, *H. sabdariffa*, and *C. nucifera* have the lowest toxicity ratings [Table 8].

Responses on the method of preparation/use of the plant in treating hypertension vary between infusions, decoction, poultice, tea, and maceration. The most used method was tea, followed by decoction infusion, maceration, and finally poultice [Table 9].

The response on the state of use of the plant for treating hypertension revealed that except for *O. dillenii*, *A. cepa*, *C. nucifera*, and *Persea Americana*, all other plants are used mostly when dry [Table 10].

DISCUSSION

This study investigated the ethnobotanical uses of some plants used in the treatment of diabetes and hypertension. The result revealed that *C. papaya*, *G. latifolium*, *M. indica*, *V. amygdalina*, and *M. charantha* were rated highest in their use for treatment of diabetes while *B. pinnatum*, *H. sabdariffa*, and *J. curcas* were rated highest in their use for the treatment of hypertension. This result is in conformity with the study of Yeh *et al.*,^[20] who showed the ethnobotanical application of *C. papaya* and *B. pinnatum* among others for the treatment of diabetes and cardiovascular diseases.

The result on the part of plants commonly used for the treatment of diabetes and hypertension revealed that the leaf has the highest percentage scores for all the sample plants. This could be because leaves contain a reasonable amount of secondary metabolites that have the potential of targeting the disease-causing organisms or regulating defects in body cells or tissues.^[21]

The result on the toxicity of the sample plants revealed that *M. charantha*, *O. dillenii*, *C. papaya*, and *J. gossipifolia* have the highest toxicity ratings. This confirms the study of

Table 7: Percentage responses on the part of plant mostly used for treating hypertension

Name of plant	Leaf	Bark	Root	Seed	Fruit	Flower	Stem	Mostly used
<i>Bryophyllum pinnatum</i>	71.7	0.0	6.7	0.0	0.0	0.0	21.7	Leaf
<i>Tapinanthus globiferus</i>	50.0	0.0	20.0	1.7	1.7	1.7	25.0	Leaf
<i>Costus afer</i>	51.7	0.0	10.0	0.0	0.0	0.0	38.3	Leaf
<i>Cocos nucifera</i>	21.7	3.3	5.0	61.7	5.0	1.7	1.7	Seed
<i>Jatropha curcas</i>	70.0	0.0	8.3	6.7	3.3	1.7	10.0	Leaf
<i>Jatropha gossypifolia</i>	66.7	0.0	15.0	10.0	6.7	0.0	1.7	Leaf
<i>Catharanthus roseus</i>	53.3	0.0	6.7	21.7	5.0	5.0	8.3	Leaf
<i>Persea Americana</i>	45.0	5.0	3.3	16.7	30.0	0.0	0.0	Leaf
<i>Psidium guajava</i>	56.7	25.0	3.3	5.0	3.3	1.7	5.0	Leaf
<i>Zingiber officinale</i>	10.0	0.0	88.3	0.0	0.0	0.0	1.7	Rhizome
<i>Datura stramonium</i>	55.0	23.3	5.0	0.0	0.0	0.0	16.7	Leaf
<i>Carica papaya</i>	43.3	0.0	1.7	35.0	10.0	0.0	10.0	Leaf
<i>Mordica charantha</i>	56.7	1.7	35.0	0.0	0.0	0.0	6.7	Leaf
<i>Opuntia dillenii</i>	50.0	0.0	21.7	1.7	1.7	0.0	25.0	Leaf
<i>Allium cepa</i>	20.0	0.0	80.0	0.0	0.0	0.0	0.0	Bulb
<i>Hibiscus sabdariffa</i>	26.7	0.0	0.0	16.7	0.0	56.7	0.0	Flower

Table 8: Responses on toxicity of the plant used for treating hypertension

Name of plant	Yes	No	Rank
<i>Jatropha gossypifolia</i>	56.7	43.3	1 st
<i>Mordica charantha</i>	48.3	51.7	2 nd
<i>Opuntia dillenii</i>	43.3	56.7	3 rd
<i>Datura stramonium</i>	43.3	56.7	3 rd
<i>Zingiber officinale</i>	26.7	73.3	5 th
<i>Tapinanthus globiferus</i>	25	75.0	6 th
<i>Catharanthus roseus</i>	17	80.0	7 th
<i>Carica papaya</i>	15	85.0	8 th
<i>Bryophyllum pinnatum</i>	11.7	88.3	9 th
<i>Persea Americana</i>	5	95.0	10 th
<i>Jatropha curcas</i>	3.3	96.7	11 th
<i>Psidium guajava</i>	20	98.3	12 th
<i>Costus afer</i>	1.7	98.3	12 th
<i>Allium cepa</i>	0	100	14 th
<i>Cocos nucifera</i>	0	100	14 th
<i>Hibiscus sabdariffa</i>	0	100	14 th

Caraballo and Caraballo^[22] that some herbal plants are toxic to human body and must be used with utmost care.

More so, the study revealed that the mostly indicated plant preparation methods for diabetes were decoction and maceration while tea and decoction were the mostly indicated methods for hypertension. This result confirms the study of Arowosegbe *et al.*^[21] who showed that decoction was

the mostly used plant preparation method for the treatment of diabetes. This result also agrees with the study of Yeh *et al.*^[20] who reported an increased uptake of herbal tea for the treatment of hypertension.

The response on the state of use of the plant revealed that for treating diabetes, most of the plants are used when fresh while for hypertension the plants are used when mostly dry. This finding agrees with the study of Etuk *et al.*^[23] who observed that most medicinal plants used for the treatment of diabetes are usually fresh and prepared by decoctions while most medicinal plant used for the treatment of hypertension is usually dry and prepared as tea. This study finally showed that the plant list, method of preparation and state of the plant for treatment of diabetes and hypertension vary. This finding confirms the study of Yeh *et al.*^[20] that method of preparation of medicinal plant species may vary with respect to the type of ailment.

CONCLUSION AND RECOMMENDATIONS

This study has been able to document indigenous knowledge on the use of plants in treating diabetes and hypertension. It was revealed that the inhabitants of the study area still relied on the use of plants as primary health care. However, the phytochemical characterization and pharmacological validation of these plants are to be carried out. More so, awareness regarding the conservation status of medicinal plants, domestication strategies as well as appropriate methods of exploitation is crucial for further studies to ensure

Table 9: Responses on methods of plant preparation for treatment of hypertension

Name of plant	Method of preparation/use (%)					Decision (mostly used)
	Infusion	Decoction	Poultice	Tea	Maceration	
<i>Bryophyllum pinnatum</i>	20.0	15.0	10.0	35.0	20.0	Tea
<i>Costus afer</i>	20.0	0.0	0.0	80.0	0.0	Tea
<i>Carica papaya</i>	0.0	46.7	15.0	25.0	13.3	Decoction
<i>Datura stramonium</i>	35.0	59.7	2.0	3.3	0.0	Decoction
<i>Zingiber officinale</i>	28.3	33.3	0.0	38.3	0.0	Tea
<i>Opuntia dillenii</i>	0.0	31.7	28.3	40.0	0.0	Tea
<i>Psidium guajava</i>	0.0	31.7	28.3	40.0	0.0	Tea
<i>Allium cepa</i>	30.0	0.0	18.4	51.6	0.0	Tea
<i>Tapinanthus globiferus</i>	35.0	51.7	13.3	0.0	0.0	Decoction
<i>Cocos nucifera</i>	65.0	21.7	13.3	0.0	0.0	Infusion
<i>Persea americana</i>	20.0	20.0	0.0	60.0	0.0	Tea
<i>Jatropha gossypifolia</i>	30.0	0.0	8.3	61.7	0.0	Tea
<i>Jatropha curcas</i>	35.0	61.7	0.0	3.3	0.0	Decoction
<i>Catharanthus roseus</i>	0.0	0.0	30.0	70.0	0.0	Tea
<i>Mordica charantha</i>	0.0	46.7	15.0	25.0	13.3	Decoction
<i>Hibiscus sabdariffa</i>	20.0	28.3	11.7	15.0	25.0	Decoction

Table 10: State of the plant for treating hypertension

Name of plant	State of plant (%)		Mostly indicated
	Fresh	Dry	
<i>Bryophyllum pinnatum</i>	35.0	65.0	Dry
<i>Costus afer</i>	33.3	66.7	Dry
<i>Carica papaya</i>	25.0	75.0	Dry
<i>Datura stramonium</i>	41.7	58.3	Dry
<i>Zingiber officinale</i>	68.3	31.7	Dry
<i>Opuntia dillenii</i>	60.0	40.0	Fresh
<i>Psidium guajava</i>	30.0	70.0	Dry
<i>Allium cepa</i>	63.3	36.7	Fresh
<i>Tapinanthus globiferus</i>	30.0	70.0	Dry
<i>Cocos nucifera</i>	66.7	33.3	Fresh
<i>Persea americana</i>	80.0	20.0	Fresh
<i>Jatropha gossypifolia</i>	48.3	51.7	Dry
<i>Jatropha curcas</i>	45.0	55.0	Dry
<i>Catharanthus roseus</i>	30.0	70.2	Dry
<i>Mordica charantha</i>	28.3	71.7	Dry
<i>Hibiscus sabdariffa</i>	35.0	65.0	Dry

a sustainable utilization and availability of these plants. It is, therefore, recommended that people should utilize plants for their general health-care knowing that they have little or no adverse effects on humans.

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APPENDIX 1

QUESTIONNAIRE

This questionnaire is to find out how people use plants for the treatment of disease. The answer will be treated with utmost confident.

Please kindly tick (✓) the answers to the questions below.

Gender: Male Female

Age: 20-39 40-59 60-79 above

Occupation: Farmers Herbalists Traders

Others please specify -----

Tick (✓) on the answers of your choice

Note: (SA) – Strongly Agree (L) – Leaves (FL) - Flower

(A) – Agree (B) – Bark (ST) - Stem

(D) – Disagree (R) - Root

(SD) – Strongly Disagree (S) - Seed

(NID) – No Idea (F) - Fruit

Q1: Are the under listed plants used for treating diabetes.

S/N	Name of plants	SA	A	SD	D	NID	Toxicity		Plant parts used									
							Yes	No	L	B	R	S	F	FL	S			
a	<i>Mangifera indica</i> (mango)																	
b	<i>Moringa oleifera</i> (odudu oyibo)																	
c	<i>Costus afer</i> (okpete)																	
d	<i>Anacardium occidentale</i> (cashew)																	
e	<i>Vernonia amygdalina</i> (onugbu)																	
f	<i>Annona muricata</i> (sour sop)																	
g	<i>Occium gratissimum</i> (nchuanwu)																	
h	<i>Rauvolfia vomitoria</i> (akata)																	
i	<i>Gongronema latifolium</i> (utazi)																	
j	<i>Chromolena odorata</i> (nsi-igwulube)																	
k	<i>Acanthus montanus</i> (agameebu)																	
l	<i>Carica papaya</i> (pawpaw)																	
m	<i>Mordica charantha</i> (ahu mmuo)																	
n	<i>Opuntia dilleni</i> (ogwu ogwu)																	
o	<i>Dioscorea cayenensis</i> (oku-ji-ocha)																	
p	<i>Phyllanthus amarus</i> (ngwu ana)																	
q	<i>Allium cepa</i> (onions)																	
r	<i>Anthoscleista djalonensis</i> (okpokolo)																	
s	<i>Hibiscus sabdariffa</i> (zobo)																	
t	<i>Bridelia micrantha</i> (aga ogwu)																	

Q2: Are the under listed plants used for treating hypertension.

S/N	Name of plants	SA	A	SD	D	NID	Toxicity		Plant parts used									
							Yes	No	L	B	R	S	F	FL	S			
a	<i>Bryophyllum pinnatum</i> (oda opue)																	
b	<i>Tapinanthus globiferus</i> (owube)																	
c	<i>Costus afer</i> (okpete)																	
d	<i>Cocos nucifera</i> (coconut palm)																	
e	<i>Jatropha curcas</i> (physic nut)																	
f	<i>Jatropha gossypifolia</i> (red physic nut)																	
g	<i>Catharanthus roseus</i> (periwinkle)																	
h	<i>Persea Americana</i> (avocado pear)																	
i	<i>Psidium guajava</i> (guava)																	
j	<i>Zingiber officinale</i> (ginger)																	
k	<i>Datura stramonium</i>																	
l	<i>Carica papaya</i> (pawpaw)																	
m	<i>Mordica charantha</i> (ahu mmuo)																	
n	<i>Opuntia dilleni</i> (ogwu ogwu)																	
o	<i>Allium sativum</i> (garlic)																	
p	<i>Hibiscus sabdariffa</i> (zobo)																	

Q3: Tick (✓) the correct answer.

- Habitat: Wild Cultivated Both
- Mode of preparation: Infusion Decoction Poultice Tea Tincture
Maceration Tablet Capsule Injection
- Mode of administration: Inhaling Smoking Chewing Injecting
- Others: Please specify
- State of the plant: Fresh Dry