

## Ethnobotanical Survey of Medicinal Plants Used By the Natives of Umuahia, Abia State, Nigeria for the Management of Diabetes

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**Abstract:** Diabetes has been regarded as one of the major health problems wrecking havoc on the people especially the geriatrics. In Umuahia, diabetes is regarded as a serious health problems with high rate of mortality, morbidity and with serious health consequences. Currently plants are used by the natives to treat this disease. Hence the need for this study to ascertain medicinal plants with high cure rate but little side effects as synthetic antidiabetic drugs have been known to be associated with various serious and deleterious side effects. This is therefore a field trip conducted in Umuahia, Nigeria, to determine the various medicinal plants used by the natives in the management of diabetes.

Dialogue in the form of semi-structured interview was conducted with the traditional healers (TH). Some of whom were met many times depending on the amount of information available at any given time and to check the already collected information. Information regarding the plants used in the management /treatment of diabetes were collected, the socio-political data of the THs, formulation of remedies, and the symptoms and other ways the THs use to diagnose diabetes. Interviews were conducted in the local dialect (Igbo), and for the literates among them, English or Pidgin-English as they preferred. A questionnaire was designed to aid in gathering information on social status and education of the informants, general knowledge about diabetes, it's diagnosis, access to traditional medicine and ease of practice and the medicinal plants used in the treatment of diabetes. Medicinal plants being mentioned by the informants were recorded with local names and photographed where possible. Furthermore research was carried out to ascertain the plants family names and other necessary information.

The survey revealed 58 plants belonging to 39 families. The most mentioned plants were the likes of *Vernonia amygdalina*, *Azadirachta indica*, *Magnifera indica*, *Carica papaya*, *Morinda lucida*, *Plantago major*, and *Gongronema latifolium*. Some of the least mentioned plants that are believed to possess high anti diabetic activity were the *Sarcocephalus latifolius*, *Annona muricata*, *Chromolaena odorata*, *Hibiscus sabdariffa* and *Zingiber officinale*. *Vernonia amygdalina* is a well known medicinal plant useful for the treatment of diabetes. It seems to be largely available in Umuahia since it was mentioned by most informants. Although showing a promising results, the anti diabetic efficacy of *Sarcocephalus latifolius* may not be convincing due to lack of solid evidence from extensive clinical intervention studies.

The traditional medicine practitioners - TMP - understand and treat diabetes using the available plant diversities by decoction, expression and infusion with decoction being the most widely used method of preparation.

**Key words** - Traditional healers, decoction, expression, infusion

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### I. Introduction

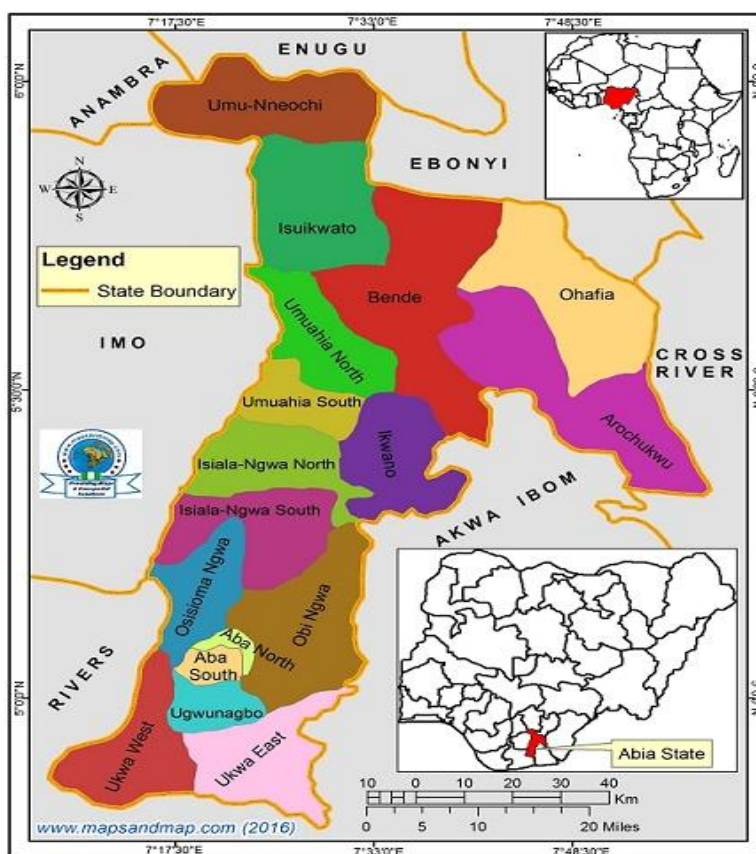
Diabetes, often, referred to as Diabetes Mellitus, is a metabolic disease in which an individual has high blood glucose, either due to inadequate insulin production or non-response of the body cells or both (American Diabetes Ass., 2009, Ahn 2017). Patients with high blood glucose level usually experience polyuria (frequent urination) which leads to increased thirst (polydipsia) and increased hunger (polyphagia) (Buchi-chukwu, 2013, Atanosov *et al* 2015). This disease also presents with symptoms such as weight loss, fatigue, unhealed bruises and cuts, male sexual dysfunction, numbness and tingling of hands and feet, blurred vision, acetone-breath, nausea and vomiting, abdominal pain, glycosuria, lethargy, and *hyperventilation* (Ramachandran, 2014, Kenedy and Whiteman 2011). Both *hyper- and hypoglycaemia* have negative effects in the body, hence it is necessary to maintain a balanced blood sugar level (Pelmuter *et al.*, 2008, Vickers *et al*, 2001, 2011). The use of herbal remedy is more prevalent in patients with chronic diseases such as cancer, diabetes, asthma and end-stage renal disease (Dieye *et al.*, 2007). Other factors that have been shown to be associated with the use of herbal medicines are gender, age, education, ethnicity, and social class. These herbs can be administered in various

forms including herbal teas, tisanes, infusions, decoction, maceration, tinctures, elixirs, extracts, which can be liquid, dry, or in nebulisers (Yetein *et al* , 2013). In Nigeria herbs are extensively use for the management of diabetes. The use of orthodox drugs possess inherent side effects and may pose serious adverse effects to the patient taking them thereby encouraging non-completion of dosage regimen and further failure of therapy. In the search of means of treatment, people recognized and used the medicinal properties of many cultivated or wild plants to manage the disease. Despite these traditional health care methods, African medicine is used by 80 % of the rural populations and appears like a sure mean of eradication of diseases (Sofowora, 1993).

## II. Materials And Methods

### 2.1 Material - Study site

The study was conducted in the geographical region of Umuahia. Umuahia is home to many traditional herbalists and is the capital city of Abia State in South-eastern Nigeria. Umuahia is located along the rail road that lies between Port Harcourt to its South and Enugu city to its North. and is well known as being an agricultural market centre since 1916. It is also a railway collecting point for crops such as yams, cassava, corn (maize), taro, citrus fruits, and palm oil and kernels. There are several breweries in Umuahia, and there is also a palm-oil-processing plant. Nigeria's National Root Crops Research Institute, at Umudike, is adjacent to the town. Umuahia's indigenous ethnic group are the Igbo. Umuahia comprises two local government areas: Umuahia North and Umuahia South. These local governments are also composed of clans such as the Umuopara, Ibeku, Olokoro, Ubakala and Ohuhu communities. Umuahia town is traditionally owned by the Ibeku after early British administrators based the town in their land (Retrieved from <http://en.m.wikipedia.org/wiki/Umuahia>).



The map above shows the geographical region of Umuahia in the Nigeria map. The map showing Umuahia south, Umuahia north, and Ikwano, where the study was carried out to investigate the type of plants used by the indigenous people of umuahia for the treatment of diabetes (Retrieved from <http://en.m.wikipedia.org/wiki/Umuahia>).

### 2.2 Methods

The aim of the study was to qualitatively identify traditional medicinal plants known, accessible and available to the people of Umuahia for the treatment of diabetes.

For this purpose, dialogues in the form of semi-structured interview were conducted with the traditional healers (THs). Some of the traditional healers were met many times depending on the amount of information available at a given time, and to check the already collected information. Information regarding the plants used in the management/treatment of diabetes was collected, the socio-political data of the THs, formulation of remedies, and of course the symptoms and other ways the THs use to diagnose diabetes.

Interviews were conducted in the local dialect (Igbo) and for the literate among them, English or Pidgin-English as they preferred.

It is noteworthy that the sample size of informants that participated in the study were limited, however, most of them were able to give us a great amount of information regarding the case study. Some of the informants, however, found it difficult to share their knowledge as they feared that they could be short changed and therefore lose their importance, clients, and funds.

A questionnaire was designed to aid in gathering information on social status and education of the informants, general knowledge about diabetes (and its diagnosis), access to traditional medicine and ease of practice, and of course the medicinal plants used in the therapy of diabetes. Medicinal plants being mentioned by the informants were recorded with local names and photographed when possible. Further research was carried out to ascertain the plants' family name and other necessary information.

### 2.3 Data Analysis

The data thus collected were subjected to frequency analysis to determine the incidence of each plant species in relation to the overall citations for all the plants. The incidence of families, plants, and parts used for preparation were adequately documented and analysed. A questionnaire was used in addition to other form of analysis to carry out analytical studies.

Other forms of analysis were carried out and are shown in the results.

#### A QUESTIONNAIRE ON THE ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED BY THE INDIGENES OF UMUAHIA FOR THE MANAGEMENT OF DIABETES

- Gender .....
- Age (Yr) .....
- Occupation .....
- Symptoms used to diagnose the disease
  1. ....
  2. ....
  3. ....
  4. ....
  5. ....
- Common name of the plant .....
- Method of collection .....
- Life form of plant
  - Herb  Leaf  Root  Rhizome
  - Fruit  Flower  Resin  Entire plant  Tender shoot
  - Milky latex  Stem  Corm
- Time of harvesting
  - Morning  Afternoon  Night
- Processing of medicinal plants for crude drug preparation in the study area
  - Infusion  Pulp  Pultice  Decoction
  - Juice  Latex  Paste
- Solvents used
  - Water  Ethanol

Others(specify).....

- Plants used in combination (if any)
  - 1.
  - 2.
  - 3.
- Dose .....
- Method of administration .....
- Duration of treatment .....
- Side effects (if any)
  - a.
  - b.
  - c.
- Percentage level of success of treatment .....

### III. Results

**Table 1** showing the socio-political data of Traditional Medicine Practitioners (TMPs) treating diabetes in Umuahia.

Education level	Illiterate	Primary school	Secondary school
Respondent	3	4	6
Origin of knowledge	Heritage	Divine revelation	Initiation by a TMP
Respondent	7	3	3
Status	Full-time TMP	Part-time	
Respondent	7	6	
Specialty	Diabetes	Diabetes and others	
Respondent	2	11	
Basis of diagnosis	Symptoms only	Laboratory results	Symptoms and lab.
Respondent	8	3	2
Season of harvest	Dry season	Rainy season	Both
Respondent	-	-	9

**Table 2** showing the number of interviewed traditional healers and age range per village visited

Villages	No of traditional Healers	Sex	Age (years)
Olokoro	4	Male	50-80
Agbama	3	Male	30-70
Umudike	2	Male	30-40
Ohuhu	2	Male	60-70
Isi gate	2	Male	36
<b>Total: 5 villages</b>	13	5	30-80

**Table 3** showing the different symptoms by which diabetes was diagnosed by the Traditional Medicine Practitioners (TMPs) in Umuahia, and the number of practitioners using it as diagnosis.

Symptoms	Respondents
Polyuria	9
Viscous urine	2
Recurrent wounds/difficult to heal	5
Oedema	5
Weight loss	4
Headache	6
Difficulty in breathing	3
Dry mouth	2
Polydipsia	8
Polyphagia	8
Blurred vision	4

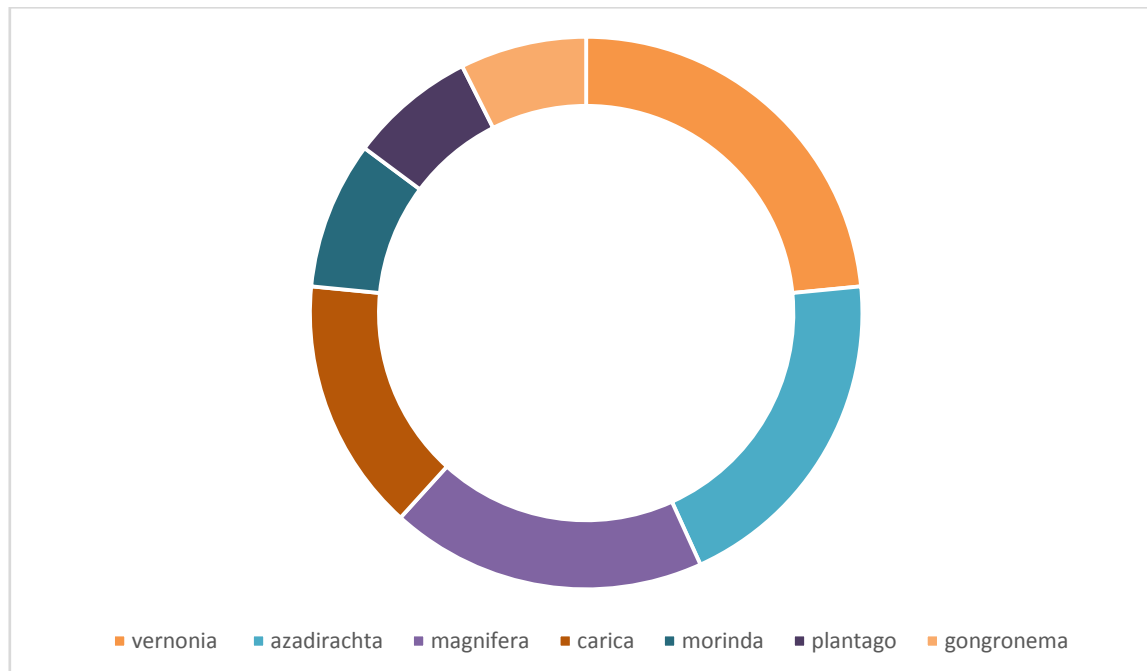
**Table 4** Medicinal plants used for the management of diabetes by the indigenes of Umuahia

	Plant specie	Family	Order	Common Name	Part used	Solvent for extraction
1	<i>Abelmoschus esculentus</i>	Malvaceae	Malvales	Okro	Fruit	(express juice)
2	<i>Allium sativum</i>	Amaryllidaceae	Asparagales	Garlic	Rhizome	Water
3	<i>Aloe vera</i>	Liliaceae	Asparagales	Aloe vera	Leaf	-
4	<i>Anacardium occidentale</i>	Anacardiaceae	Sapindales	Cashew	Fruit	-
5	<i>Annona muricata</i>	Annonaceae	Magnoliales	Soursop	Leaf	Water
6	<i>Anthocleista djalensis</i>	Laganiaceae	Gentianales	Cabbage tree	Whole plant	Water
7	<i>Antiaris toxicaria</i>	Moraceae	Rosales	Bark cloth tree	Stem bark	Water
8	<i>Azadirachta Indica</i>	Meliaceae	Sapindales	Neem plant	Flower, Leaf	Water
9	<i>Brassica oleracea</i>	Brassicaceae	Brassicales	Cabbage	Leaf	Water
10	<i>Bridelia micrantha</i>	Euphorbiaceae	Malpighiales	'Ogu ofia'	Leaf	Water
11	<i>Carica papaya</i>	Caricaceae	Brassicales	Paw-paw	Leaf, fruit, seed.	Water
12	<i>Cassia occidentalis</i>	Cesalpinnaceae	Fabales	Negro coffee	Leaf, roots, and seeds.	Water
13	<i>Ceiba pentandra</i>	Malvaceae	Malvales	Kapok	Root	Water
14	<i>Chromolaena Odorata</i>	Asteraceae	Asterales	Independent Leaf	Leaf	Water
15	<i>Cinnamomum Cassia</i>	Lauraceae	Laurales	Cinnamon	Stem bark	*
16	<i>Citrus Aurantifolia</i>	Rutaceae	Sapindales	Lime	Fruit	*
17	<i>Cucumis sativus</i>	Cucurbitaceae	Cucurbitales	Cucumber	Fruit	-
18	<i>Curcuma longa</i>	Zingiberaceae	zingiberales	Turmeric	Rhizome	Water
19	<i>Dioscorea Alata</i>	Dioscoraceae	Dioscoreales	White yam	Tuber	-
20	<i>Ficus abutilifolia</i>	Moraceae	Rosales	Ogbu	Root	Water
21	<i>Gongronema latifolium</i>	Asclepiadaceae	Gentianales	Bush buck	Leaf	Water
22	<i>Gulancha tinospora</i>	Menispermaceae	Ranunculales	Heart-leaved moonseed	Leaf	Water
23	<i>Hibiscus rosinensis</i>	Malvaceae	Malvales	Shoe-flower	Leaf	Water
24	<i>Hibiscus sabdariffa</i>	Malvaceae	Malvales	Zobo	Juice	Water
25	<i>Jatropha gossypifolia</i>	Euphorbiaceae	Euphorbiales	Black physic nut	Root, stem Bark	Water
26	<i>Jatropha curcas</i>	Euphorbiaceae	Malpighiales	Bubble bush	Leaf	Water
27	<i>Juglans major</i>	Juglandaceae	Fagales	Walnut	Fruit	-
28	<i>Lophira lanceolata</i>	Ochnaceae	Malpighiales	Okopi	Root	Water
29	<i>Magnifera indica</i>	Anacardiaceae	Sapindales	Mango	Leaf, root	Water
30	<i>Momordica charantia</i>	Cucurbitaceae	Cucurbitales	Bitter gourd	Aerial parts and seeds	Water
31	<i>Monodora myristica</i>	Annonaceae	Magnoliales	Calabash nutmeg	Leaf	Water
32	<i>Morinda lucida</i>	Rubiaceae	Gentianales	Brimestone Plant	Leaf	Water
33	<i>Moringa oleifera</i>	Moringaceae	Brassicales	Horse-raddish Tree	Leaf, stem, Flower	Water
34	<i>Musa acuminata</i>	Musaceae	Zingiberales	Dwarf Banana	Fruit	*
35	<i>Ocimum basilicum</i>	Lamiaceae	-	Sweet basil	Leaf	Water
36	<i>Ocimum Canum</i>	Lamiaceae	Lamiales	African basil	Whole Plant	Water
37	<i>Ocimum gratissimum</i>	Lamiaceae	Lamiales	Scent leaf	Leaf, Juice	Water
38	<i>Passiflora edulis</i>	Passifloraceae	Malpighiales	Passion fruit	Fruit	-
39	<i>Persea americana</i>	Lauraceae	Laurales	Avocado pear	Seed	Water
40	<i>Phaseolus Vulgaris</i>	Fabaceae	Fabales	Kidney bean	Fruit	-
41	<i>Phyllathus</i>	Euphorbiaceae	Malpighiales	Stone	Whole plant	Water

*Ethnobotanical Survey of Medicinal Plants Used By the Natives of Umuahia, Abia State, Nigeria for*

	<i>Amarus</i>			breaker		
42	<i>Picralima nitida</i>	Apocynaceae	Gentiales	Akuamma	Seed	*
43	<i>Plantago major</i>	Plantaginaceae	Lamiales	Plantain	Leaf, stem	Water
44	<i>Psidium guajava</i>	Myrtaceae	Myrtales	Guava	Leaf, Stem bark	Water
45	<i>Pycnathus angolensis</i>	Myristiceae	Magnoliales	False walnut	Seed, stem Bark	Water
46	<i>Ricinus communis</i>	Euphorbiaceae	Malpighiales	Castor-oil Plant	Flower	Water
47	<i>Saccharum officinarum</i>	Poaceae	Poales	Sugar-cane	Fruit	(juice extractor)
48	<i>Sarcocephalus latifolius</i>	Rubiaceae	Gentianales	African Peach	Leaf	Water
49	<i>Senna alata</i>	Cesalpinnaceae	Fabales	Ringworm Plant	Leaf	Water
50	<i>Solanum Tuberosum</i>	Solanaceae	Solanales	Irish potato	Tuber	-
51	<i>Solenostemon monostachyus</i>	Lamiaceae		Monkey's Potato	Aerial part	Water
52	<i>Taraxacum Officinale</i>	Asteraceae	Asterales	Dandelion	Leaf	Water
53	<i>Tecoma stans</i>	Bignoniaceae	Lamiales	Yellow elder	Leaf	Water
54	<i>Thaumatococcus Daniellii</i>	Marantaceae	Zingiberales	Miracle fruit	Fruit	-
55	<i>Vernonia amygdalina</i>	Asteraceae	Asterales	Bitter leaf	Leaf, root, stem, juice	Water
56	<i>Viscum album</i>	Santalaceae	Santalaceae	Mistletoe	Leaf	Water
57	<i>Xylopia aethiopica</i>	Annonaceae	Magnoliales	Ethiopian Pepper	Seeds	*
58	<i>Zingiber officinale</i>	Zingiberaceae	Zingiberales	Ginger	Rhizome	*

\* used in combination with other plants in the treatment of diabetes. They cannot be used solely for the management of diabetes.



**Fig 2** Pie chart showing the frequency of the most mentioned plants

#### 4.5 DESCRIPTION OF PLANTS ENCOUNTERED IN THE STUDY

##### 1. *Citrus aurantifolia*



**Fig 3** *Citrus aurantifolia*

*Citrus aurantifolia* is a citrus hybrid with a spherical fruit, 2.5-5.0 cm in diameter, that is yellow when ripe but usually green commercially. Flowers and fruit appear throughout the year, but are most abundant from May to September in the Northern Hemisphere (Traore *et al* 2013).

##### 2. *Jatropha curcas*



**Fig 4** *Jatropha curcas*

*Jatropha curcas* Is a semi-evergreen shrub or small tree, reaching a height of 6 m. It is a flowering plant in the Spurge family, Euphorbiaceae. It is known to contain phorbol esters which are considered toxic (Odugbami *et al* 2006).

3. *Jatropha gossypifolia*



**Fig 5** *Jatropha gossypifolia*

*Jatropha gossypifolia*, commonly known as bellyache bush, physicnut or cotton-leaf physicnut, is a species of flowering plant in the Spurge family, Euphorbiaceae. It grows to 2.5 – 4 m high. The three lobed leaves are purple and sticky when young and become bright green with age.

4. *Sarcocephalus latifolius* is a genus of flowering plants in the Rubiaceae family. It holds two species of shrubs or trees native to tropical Africa.



**Fig 6** *Sarcocephalus latifolius*



5. *Musa acuminata*



**Fig 7** *Sarcocephalus latifolius*

*Sarcocephalus latifolius* is an evergreen perennial, not a tree. The trunk (pseudostem) is made of tightly packed layers of leaf sheaths emerging from completely or partially buried corms. It is one of the early examples of domesticated plants.

6. *Ocimum canum*

*Ocimum canum* is also called Basil, Great Basil, or St. Joseph's-wort. It is a culinary herb of the family Lamiaceae. Basil is native to tropical regions from central Africa to Southeast Asia. It is a tender plant used in cuisines worldwide.



**Fig 8** *Ocimum canum*

8. *Pycnathus angolensis*



**Fig 9** *Pycnathus angolensis*

*Pycnathus angolensis* is a species of tree in the nutmeg family, Myristaceae. It is native to Tropical Africa. In Africa, it is widely known as *ilomba*. It grows up to 40 meters tall and usually up to a meter wide. The trunk is straight and cylindrical with fissures and flaking bark.

**9. *Thaumatococcus daniellii***



**Fig 10** *Thaumatococcus daniellii*

*Thaumatococcus daniellii* grows 3 – 4 meters in height, and has large, papery leaves up to 46 centimeters long. It bears pale purple flower and a soft fruit containing a few shiny black seeds. The fruit is covered in a fleshy red aril.

**10. *Aloe vera***



**Fig 11** *Aloe vera*

*Aloe vera* is a stemless or very short-stemmed plant growing to 60-100 cm tall spreading by off-sets. The leaves are thick and fleshy, green to grey-green. The margin of the leaf is serrated and has small white teeth.

**11 *Persea americana***



**Fig 12** *Persea americana*

*Persea americana* has a green-skinned, fleshy body and a pear-shape, egg-shape, or spherical. The fruit of the plant, also called an Avocado is botanically a large berry containing a single large seed called a pit or stone.

**12. *Ricinus communis***



**Fig 13 *Ricinus communis***

*Ricinus communis* is a fast-growing, suckering shrub that can reach the size of a small tree, around 12 m. The glossy leaves are 15 - 45 cm long, long-stalked, alternate and palmate with 5 – 12 lobes with coarsely toothed segments. In some varieties, they start off dark reddish purple or bronze when young, gradually changing to a dark green, sometimes with a reddish tinge, as they mature.

**13. *Ficus abutilifolia***



**Fig 14 *Ficus abutilifolia***

The Large-leaved rock fig is a species of African rock-splitting. It is named for the similarity of its broadly ovate leaves to that of *Abutilon*.

**14. *Senna alata***



**Fig 15 *Senna alata***

The shrub stands 3–4 metres (9.8–13.1 ft) tall, with leaves 50–80 centimetres (20–31 in) long. The leaves close in the dark. The seed pods are nearly straight, dark brown or nearly black, about 15 centimetres (5.9 in) long, and 15 millimetres (0.59 in) wide.

**14. *Cassia occidentalis***



**Fig 16** *Cassia occidentalis*

Alternate, compound, paripinnate; rachis channelled, presence of a gland at the base of the rachis; stipulate, stipules obliquely cordate, acuminate; leaflets 4–5 pairs, size (3.7 cm X 2 cm- 7 cm X 3.5 cm), obovate to oblong-lanceolate; acuminate, margin ciliate, glabrous or pubescence.

**16. *Lophira lanceolata***



**Fig 17** *Lophira lanceolata*

*Lophira lanceolata* is a dwarf-red ironwood deciduous tree growing up to 16m tall with exceptional specimens up to 24 metres tall. The tree has a narrow crown with ascending branches and a straight or twisted bole that can be branchless for up to 7.5 metres and up to 70cm in diameter. It is regarded as a multipurpose tree.

**17. *Antiaris toxicaria***



**Fig 18 *Antiaris toxicaria***

*Antiaris toxicaria* is monoecious. It is a large tree, growing to 25–40 m tall, with a trunk up to 40 cm diameter, often buttressed at the base, with pale grey bark. The leaves are elliptic to obovate, 7–19 cm long and 3–6 cm broad.

**18. *Anthocleista djalonensis***



**Fig 19 *Anthocleista djalonensis***

Small tree up to 15 m tall; bole up to 40 cm in diameter; twigs sometimes with 2 erect spines or small cushions above the leaf axils. Leaves opposite, simple and entire; petiole 1–9 cm long, auricled; blade oblong-elliptical to obovate-elliptical, 9–35 cm × 5–17 cm, in young plants up to 115 cm × 50 cm, base cordate, rounded or cuneate, apex rounded.

**19. *Solenostemon monostachyus***



**Fig 20 *Solenostemon monostachyus***

Annual or perennial, slightly succulent, aromatic herb up to 100 cm tall, branched; stem erect or decumbent, 4-angled, shortly pubescent. Leaves opposite, simple; stipules absent; petiole 1.5–4 cm long; blade ovate, 5–9 cm × 3–6 cm, cuneate at base, obtuse to acute at apex, margin crenate, puberulous and gland-dotted below, distinctly veined.

20. *Solanum tuberosum*



**Fig 21** *Solanum tuberosum*

An erect, perennial, aromatic herb up to 1 m tall. Sparsely hairy, with tuber-bearing underground stolons (vegetative shoots). Stems erect, succulent, winged, branching. Flowers are white to pink, purple or blue, about 2.5 cm in diameter with yellow anthers. Each flower is borne on a flower stalk (pedicel) 2–3 cm long. Fruits are succulent (but inedible), spherical, yellow-green to purple berry, up to 4 cm in diameter

22. *Phyllanthus amarus*



**Fig 22** *Phyllanthus amarus*

Monoecious, annual, erect, glabrous herb up to 60 cm tall, reddish; branchlets flattened, often slightly winged and sparsely hairy. Leaves alternate, distichous and crowded along lateral branchlets, simple and entire, sessile; stipules ovate-lanceolate to lanceolate; blade oblong to elliptical-oblong, 7–12(–20) mm × 3–6(–9) mm, base obtuse to rounded and slightly unequal, apex rounded, often pointed.

22. *Bridelia micrantha*



**Fig 23** *Phyllanthus amarus*

A medium to tall tree (up to 20 m), with a dense widely spreading crown. The leaves are large, alternate and simple. The tree may be deciduous or evergreen.

**23. *Azadirachta indica***



**Fig 24** *Azadirachta indica*

Neem is a fast-growing tree that can reach a height of 15 – 20 m and rarely 35 – 40 m. The fairly denser crown is roundish and may reach a diameter of 20 – 25 m.

**24. *Chromolaena odorata***



**Fig 25** *Chromolaena odorata*

*Chromolaena odorata* is a rapidly growing perennial herb. It is a multi-stemmed shrub to 2.5 m tall in open areas. The plant is hairy and glandular and the leaves give off a pungent, aromatic odour when crushed. Leaves are 4 – 10 cm long by 1 – 5 cm wide. The seeds are achenes and are somewhat hairy.

**25. *Solanum melogona***



**Fig 26** . *Solanum melogona*

Eggplant grows 40 - 150 cm tall with large, coarsely lobed leaves that are 10 – 20 cm long after 5 – 10 cm broad. Semiwild types can grow much larger, to 225 cm with large leaves over 30 cm long with 15 cm broad.

**26. *Dioscorea alata***



**Fig 27** *Dioscorea alata*

The tubers are usually vivid violet to bright lavender in color, but they may sometime be plain white. They are also known as purple yam, ube or many other names.

**27. *Momordica charantia***



**Fig 28** *Momordica charantia*

The herbaceous, tendril-bearing vine grows up to 5 m in length. It bears simple, alternate leaves 4 – 12 cm across, with 3 – 7 deeply separated lobes.

**28. *Tecoma stans***



**Fig 29** *Tecoma stans*



Yellow trumpetbush is an attractive plant that has sharply toothed, lance-shaped green leaves and bears large, showy, bright golden yellow trumpet-shaped flowers.

**29. *Solanum tuberosum***

Are herbaceous perennials that grow about 60 cm high depending on the variety, with the leaves dying back flowering, fruiting and tuber formation. They bear white, pink, red, blue, or purple flowers with yellow stamens (Traore *et al* 2013).



**Fig 30 *Solanum tuberosum***

**30.. *Zingiber officinale***



**Fig 31 *Zingiber officinale***

Are herbaceous perennials which grows annual pseudostems (false stems made of the rolled bases of leaves) about a meter-tall bearing narrow leaf blades. The inflorescence bear pale yellow with purple flowers and arise directly from the rhizome on separate shoots.

**31. *Picralima nitida***

Is a plant in the family, Apocynaceae. Used in its seed form.



**Fig 32 *Picralima nitida***

**32. *Juglans major***



**Fig 33** *Juglans major*

In moister areas, the tree features a single, stout trunk; they are usually several slender trunks in drier situations. The 8 – 14 in long pinnately compound leaves bear 9 – 15 lanceolate leaflets, 19 – 32 mm wide by 51 – 102mm long ( Odugbami *et al* 2006).

**33. *Phaseolus vulgaris***



**Fig 34** *Phaseolus vulgaris*

All varieties bear alternate, green or purple leaves, which are divided into three oval smooth-edged leaflets, each 6 – 15 cm long and 3 – 11 cm wide. The beans are smooth, plump, kidney-shaped, up to 1.5 cm long, range widely in color, and are often mottled in two or more colors (Odugbami *et al* 2006).

**34. *Annona muricata***



**Fig 35** *Annona muricata*

*Annona muricata* is a small, upright, evergreen tree that can grow to about 30 feet tall. Its young branches are hairy. Leaves are oblong to oval, 8 centimeters to 16 centimeters wide. The leaf stalks are 4 millimeters to 14 millimeters long and without hairs.

**35. *Allium sativum***



**Fig 36** *Allium sativum*

*Allium sativum* is a bulbous plant. It grows up to 1.2 m in height. It produces hermaphrodite flowers.

**36. *Ceiba pentandra***



**Fig 37** *Ceiba pentandra*

The tree grows 73 m as confirmed by climbing and tape drop with reports of Kapoks up to 77 m. Trunks can often be up to 3 m in diameter above the extensive buttresses.

**36. *Moringa oleifera***



**Fig 38** *Moringa oleifera*

*Moringa oleifera* is a fast-growing deciduous tree that can reach a height of 10 – 12m and trunk diameter of 45 cm. the flowers are fragrant and asexual, surrounded by five unequal, thinly veined, yellowish-white petals. They grow on slender, hairy stalks in spreading or drooping flower clusters which have a length of 10 – 25 cm.

**37. *Hibiscus sabdariffa***



**Fig 39** *Hibiscus sabdariffa*

It is an annual or perennial herb or woody-based subshrub, growing to 2 – 2.5 m. the leaves are deeply three to five lobed, 8 – 15 cm long, arranged alternatively on the stems.

**38. *Abelmoschus esculentus***



**Fig 40** *Abelmoschus esculentus*

The plant is cultivated in tropical, subtropical and warm temperate regions around the world. It is valued for its edible green seed pods.

**39. *Curcuma longa***



**Fig 40** *Curcuma longa*

Turmeric is a perennial herbaceous plant that reaches up to 1 m tall. The leaves are alternate and arranged in two rows. The petiole is 50-110 cm long. The simple leaf blades are usually 76-115cm long. Highly branched, yellow to orange, cylindrical, aromatic rhizomes are found.

**40. *Taraxacum officinale***



**Fig 41** *Taraxacum officinale*

It grows from generally unbranched taproots and produces one to more than ten stems that are typically 5-40 cm tall but sometimes up to 70 cm tall. The stems can be tinted purplish, glabrous, and sparsely covered with short hairs.

**41. *Cinnamomum cassia***



**Fig 42** *Cinnamomum cassia*

The tree grows to 10 – 15 m tall with greyish bark and hard, elongated leaves that are 10-15 cm long and have a decidedly reddish colour when young.

**42. *Psidium guajava***

Are notable for an extremely slow growth rate for several months, before a rapid acceleration in growth rate takes over. From seed, common guavas may bloom and set fruit in as few as two years or as many as eight. Guava fruits can range in size from as small as an apricot to as large as a grapefruit.



**Fig 43** *Psidium guajava*

**42. *Xylopia aethiopica***



**Fig 44** *Xylopia aethiopica*

*Xylopia aethiopica* is an evergreen aromatic tree that can grow up to 20 m high. It is native to the lowland rainforest and most fringe forests in the savannah zones of Africa.

**44. *Monodora myristica***



**Fig 45.** *Monodora myristica*

The *Monodora myristica* tree can reach a height of 35 m and 2 m in diameter at breast height. The leaves are alternatively arranged and drooping with the leaf blade being elliptical, oblong or broadest towards the apex and tapering to the stalk.

**46. *Passiflora edulis***



**Fig 47** *Passiflora edulis*

It is a perennial vine. Usually the vine produces a single flower at each node (Sofowora 1993).

**46. *Vernonia amygdalina***



**Fig 48** *Vernonia amygdalina*

Is a small shrub that grows to a height of 2-5 m. The leaves are elliptical and up to 20 cm long. Its bark is rough.

**49. *Ocimum basilicum***

Basil grows between 30-130 cm tall, with opposite, light green, silky leaves 3-11 cm long and 1-6 cm wide. The flowers are small, white in colour and arranged in terminal spikes. It is sensitive to cold, with best growth in hot, dry conditions.



**Fig 50** *Ocimum basilicum*

**48. *Ocimum gratissimum*** (is also known as clove basil, African basil and wild basil.)



**Fig 51** *Ocimum gratissimum*

**48. *Cucumis sativus***

Is a creeping vine that roots in the ground and grows up, wrapping around support with thin spiralling tendrils. The vine has large leaves that form a canopy over the fruits. The fruit is roughly cylindrical but elongated with tapered ends, and may be as large as 60 cm long and 10 cm in diameter (Sofowora 1993).



**Fig 52** *Cucumis sativus*

**49. *Carica papaya***



**Fig 53** *Carica papaya*

The papaya is a small, sparsely branched tree, usually with a single stem growing from 5 – 10 cm tall with spirally arranged laves confined to the top of the trunk. The leaves are large, 50-70 cm in diameter, deeply palmately lobed, with seven lobes.

**50. *Hibiscus rosa-sinensis***

Is a bushy evergreen shrub or small tree growing 2.5-5 m tall and 1.5-3 m wide, with glossy leaves and solitary, brilliant flowers. The 5-petaled flowers are 10 cm in diameter with prominent orange-tipped red anthers.





**Fig 54** *Hibiscus rosa-sinensis*

**51. *Morinda lucida***



**Fig 55** *Morinda lucida*

Is an evergreen shrub or small to medium-sized tree up to 18 m tall, with bole and branches often crooked or gnarled. Leaves are simple, and entire with flowers bisexual and regular and with fragrant.

**52. *Magnifera indica***

Commonly known as mango, is a large fruit tree capable of growing to a height and crown width of about 100 feet and trunk circumference of more than 12 feet (Sofowora 1993).



**Fig 56** *Magnifera indica*

**53. *Brassica oleracea***



**Fig 57 *Brassica oleracea***

Wild *B. oleracea* is a tall biennial plant that forms a stout rosette of large leaves in the first year. In its second year, it uses stored nutrients to produce a flower spike 1 – 2 m tall (Odugbami *et al* 2006).

**54. *Gongronema latifolium***

Is a climbing shrub up to 5 m long. Leaves are simple and entire. All parts soft-hairy to glabrous, with woody base and fleshy roots, containing latex. Flowers are bisexual, small, regular, yellow-green and fragrant (Traore *et al* 2013).



**Fig 58 *Gongronema latifolium***

**55. *Viscum album***



**Fig 59 *Viscum album***

It is a hemi-parasitic shrub, which grows on the stems of other trees. The leaves are in opposite pairs, strap-shaped, entire, leathery textured, 2-8 cm long and 0.8-2.5 cm broad and are a yellowish-green colour (Orwa *et al* 2009).

**56. *Plantago major***

Each leaf is oval-shaped, 5-20 cm long and 4-9 cm broad, with an acute apex and a smooth margin; there are 5-9 conspicuous veins. Each plant can produce up to 20,000 seeds which are very small and oval-shaped.



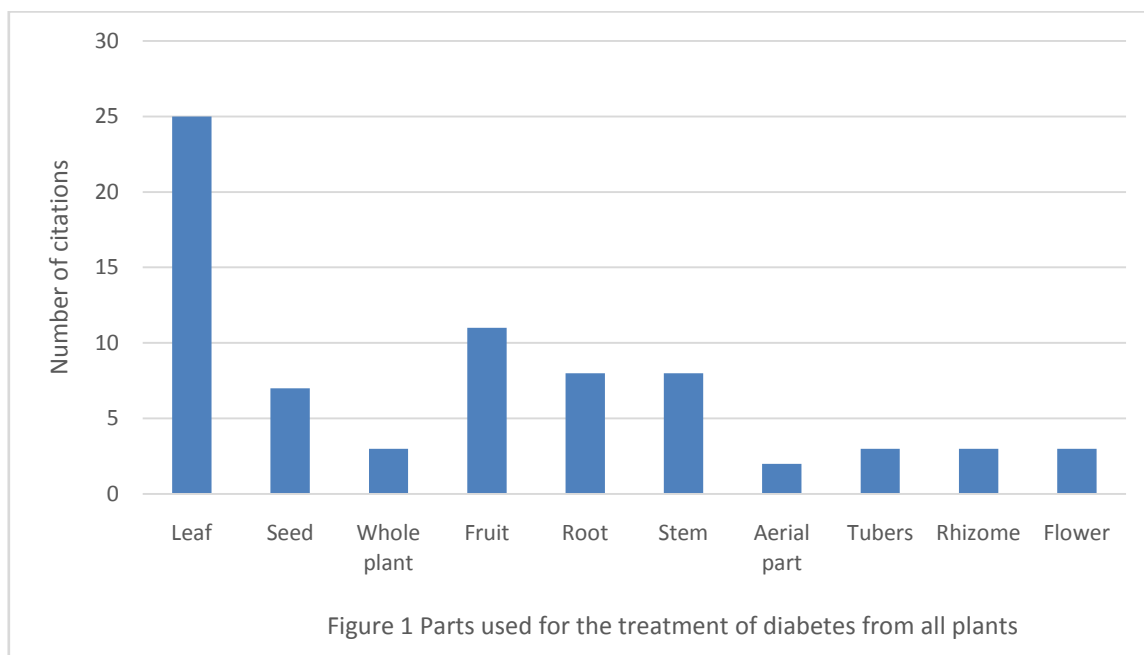
**Fig 60** *Plantago major*

**57. *Anacardium occidentale***

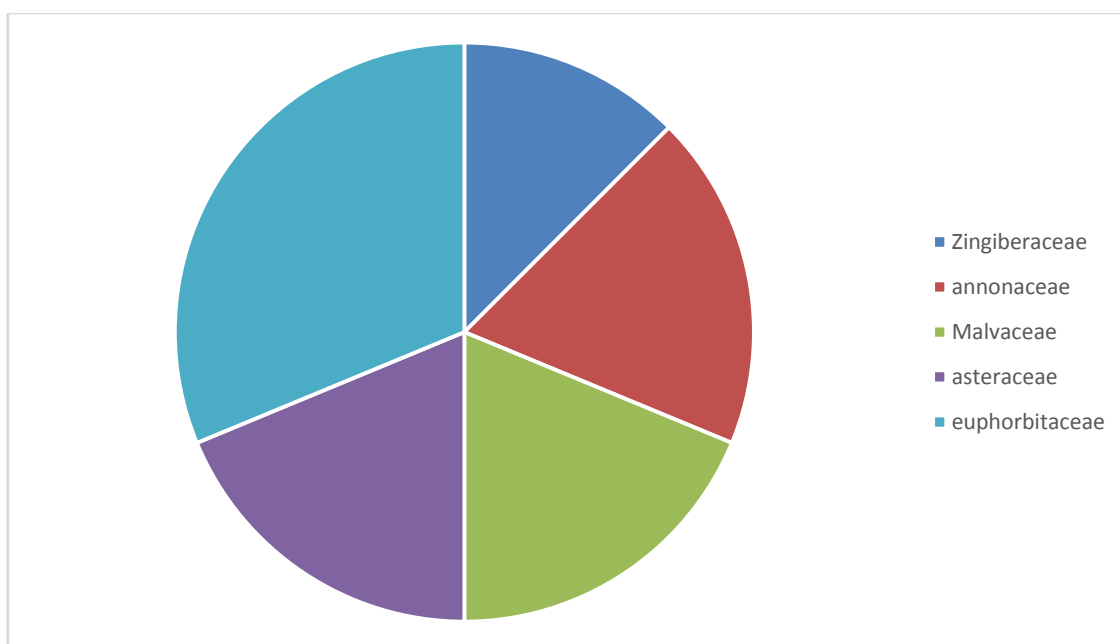


**FIG 61** *Anacardium occidentale*

The cashew tree grows as high as 14 m but the dwarf cashew growing up to 6 m has proved more profitable, with earlier maturity and higher yields.



**Fig 58** Bar chart showing the different parts used for the treatment of diabetes from all plants investigated



**Fig 59** Pie chart showing the frequency of the most frequently mentioned plant families

**Table 9:** Indications on the methods of preparation and administration of medicines

Plant specie	Part used	Mode of preparation	Medication form	Mode of administration	Dose
<i>Abelmoschus Esculentus</i>	Fruit	Expression	Juice	Drink	25ml 2* daily
<i>Allium sativum</i>	Rhizome	Decoction *	Decocte	Drink	-
<i>Aloe vera</i>	Leaves	Decoction	Decocte	Drink	-
<i>Anacardium occidentale</i>	Bark, leaf, stem	Decoction	Decocte	Drink	150ml 2* daily
<i>Ammonia Muricata</i>	Leaf	Decoction	Decocte	Drink	25ml 2* daily
<i>Anthocleista Djalonensis</i>	Whole plant	Infusion	Infused	Drink	-
<i>Antiaris Toxicaria</i>	Stem bark and bark	Infusion	Infused	Drink	-
<i>Azadirachta</i>	Leaf	Decoction	Decocte	Drink	30ml

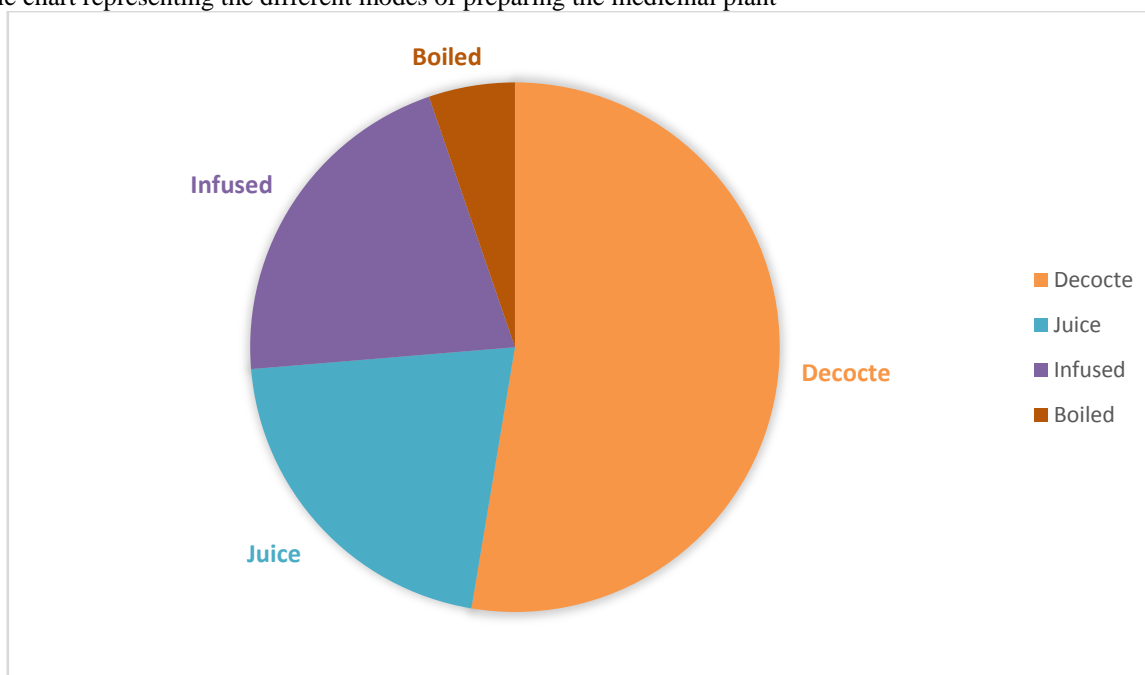
*Ethnobotanical Survey of Medicinal Plants Used By the Natives of Umuahia, Abia State, Nigeria for*

<i>Indica</i>					2* daily
<i>Brassica Oleracea</i>	Leaf	Decoction	Decocte	Drink	150ml 3* daily
<i>Bridelia Micrantha</i>	Leaf	Infusion	Infused	Drink	-
<i>Carica papaya</i>	Leaf, fruit, seed.	Infusion	Infused	Drink	25ml 2* daily
<i>Cassia occidentalis</i>	Leaf, roots, and seeds.	Decoction	Decocte	Drink	25ml 3* daily
<i>Ceiba Pentandra</i>	Root	Decoction	Decocte	Drink	25ml 2* daily
<i>Chromolaena Odorata</i>	Leaf	Decoction	Decocte	Drink	30ml 3* daily
<i>Cinnamomum Cassia</i>	Bark	Decoction	Decocte	Drink	5ml 2* daily
<i>Citrus Aurantifolia</i>	Fruit	Expression	Juice	Drink	50ml 2* daily
<i>Cucumis sativus</i>	Fruit	Expression	Juice	Drink	-
<i>Curcuma longa</i>	Rhizome	Decoction	Decocte	Drink	25ml 3* daily
<i>Dioscorea Alata</i>	Tubers	Boil	Boiled	Eat	-
<i>Ficus abutifolia</i>	Roots	Decoction	Decocte	Drink	-
<i>Gongronema latifolium</i>	Leaf	Infusion	Infused	Drink	50mls 2* daily
<i>Hibiscus rosasinensis</i>	Leaf	Infusion	Infused	Drink	150ml 3* daily
<i>Hibiscus Sabdariffa</i>	Leaf	Decoction	Decocte	Drink	50ml 3* daily
<i>Jatropha gossypifolia</i>	Root bark	Decoction	Decocte	Drink	-
<i>Jatropha curcas</i>	Leaf	Decoction	Decocte	Drink	-
<i>Juglans major</i>	Fruit	Expression	Juice	Drink	-
<i>Lophira Lanceolate</i>	Roots	Decoction	Decocte	Drink	-
<i>Magnifera indica</i>	Leaf, root	Decoction	Decocte	Drink	25ml after each meal
<i>Momordica Charantia</i>	Aerial parts and seeds	Infusion	Infused	Drink	-
<i>Monodora Myristica</i>	Leaves	Decoction	Decocte	Drink	-
<i>Morinda lucida</i>	Leaf	Decoction	Decocte	Drink	35ml 2* daily
<i>Moringa Oleifera</i>	Leaf, stem, flower	Decoction	Decocte	Drink	150ml 3* daily
<i>Musa Acuminata</i>	Fruit	Expression	Juice	Drink	-
<i>Ocimum Canum</i>	Whole plant	Expression	Juice	Drink	-
<i>Ocimum Basilicum</i>	Leaf	Decoction	Decocte	Drink	150ml 3* daily
<i>Ocimum gratissimum</i>	Leaf, juice	Decoction	Decocte	Drink	25ml 2* daily
<i>Passiflora Edulis</i>	Fruits	Expression	Juice	Drink	-
<i>Passiflora Edulis</i>	Fruits	Expression	Juice	Drink	-
<i>Persea Americana</i>	Seed	Decoction	Decocte	Drink	-
<i>Phaseolus Vulgaris</i>	Fruit	Expression	Juice	Drink	-
<i>Phyllanthus Amarus</i>	Whole plant	Decoction	Decocte	Drink	30ml 2* daily
<i>Picralima nitida</i>	Seeds	Decoction *	Decocte	Drink	
<i>Plantago major</i>	Leaf, stem	Expression	Juice	Drink	30ml 3* daily
<i>Psidium Guajava</i>	Leaf, bark, stem	Decoction	Decocte	Drink	150ml 3* daily
<i>Pycnathus Angolensis</i>	Seed, bark	Decoction	Decocte	Drink	-

<i>Ricinus Communis</i>	Flower	Infused	Infused	Drink	30ml 2* daily
<i>Saccharum Officinarum</i>	Fruit, stem	Expression	Juice	Drink	150ml 2* daily
<i>Sarcocephalus Latifolius</i>	Leaves	Decoction	Decocte	Drink	25ml 3* daily
<i>Senna alata</i>	Barks and leaf	Infusion	Infused	Drink	-
<i>Solanum Melongna</i>	Fruit	Expression	Juice	Eat	-
<i>Solanum Tuberosum</i>	Tuber	Boil	Boiled	Eat	-
<i>Solenostemon monostachyus</i>	Aerial part	Decoction	Decocte	Drink	-
<i>Taraxacum Officinale</i>	Leaf	Infusion	Infused	Drink	150ml 3* daily
<i>Tecoma stans</i>	Leaves	Infusion	Infused	Drink	-
<i>Thaumatococcus Daniellii</i>	Fruit	Expression	Juice	Drink	-
<i>Vernonia Amygdalina</i>	Leaf, root, stem	Decoction	Decocte	Drink	25ml 3* daily
<i>Viscum album</i>	Leaf	Decoction	Decocte	Drink	4ml 3* daily
<i>Xylopia Aethiopica</i>	Seeds	Decoction *	Decocte	Drink	-
<i>Zingiber Officinale</i>	Rhizome	Decoction *	Decocte	Drink	-

\* prepared with other plants in combination to produce desired effect.

Pie chart representing the different modes of preparing the medicinal plant



**Fig 60** Pie chart representing the different modes of preparation

**Table 6:** Duration of treatment, side effects, and perceived percentage level of success

SN	Plant species	Duration of treatment	Side effects	% level of success (%)
1	<i>Abelmoschus esculentus</i>	5 days	None	60
2	<i>Allium sativum</i>	3 days	None	50
3	<i>Aloe vera</i>	4 days	None	40
4	<i>Anacardium occidentale</i>	6 weeks	None	85-90
5	<i>Ammonia muricata</i>	7 days	None	60-80
6	<i>Anthocleista djalensis</i>	7 days	None	50

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7	<i>Antiaris toxicaria</i>	4 days	None	55
8	<i>Azadirachta indica</i>	7 days	None	75-85
9	<i>Brassica oleracea</i>	14 days	Goitre	55
10	<i>Bridelia micrantha</i>	6 days	None	45
11	<i>Carica papaya</i>	10 days	None	70-90
12	<i>Cassia occidentalis</i>	8 days	None	70
13	<i>Ceiba pentandra</i>	8 days	None	65
14	<i>Chromolaena odorata</i>	14 days	None	70-80
15	<i>Cinnamomum cassia</i>	6 weeks	None	70-75
16	<i>Citrus Aurantifolia</i>	12 days	None	60-80
17	<i>Cucumis sativus</i>	7 days	None	60
18	<i>Curcuma longa</i>	2 days	None	85
19	<i>Dioscorea Alata</i>	Diet	None	65
20	<i>Ficus abutilifolia</i>	7 days	None	55
21	<i>Gongronema latifolium</i>	10 days	Hypoglycaemia	65-80
22	<i>Gulantha Tinospora</i>	5 days	None	50
23	<i>Hibiscus rosasinensis</i>	5 days	None	60
24	<i>Hibiscus sabdariffa</i>	Diet	None	75
25	<i>Jatropha Gossypifolia</i>	7 days	None	75
26	<i>Jatropha curcas</i>	3 days	None	80
27	<i>Juglans major</i>	10 days	None	50
28	<i>Lophira lanceolata</i>	14 days	None	45
29	<i>Magnifera indica</i>	3 months	None	70
30	<i>Momordica charantia</i>	8 days	None	50
31	<i>Monodora myristica</i>	11 days	None	55
32	<i>Morinda lucida</i>	9 days	None	65
33	<i>Moringa oleifera</i>	6 weeks	None	95
34	<i>Musa acuminata</i>	Diet	None	70
35	<i>Ocimum basilicum</i>	6 weeks	None	95
36	<i>Ocimum Canum</i>	6 weeks	None	75
37	<i>Ocimum gratissimum</i>	8 days	None	60
38	<i>Passiflora edulis</i>	7 days	None	55
39	<i>Persea Americana</i>	12 days	None	75
40	<i>Phaseolus vulgaris</i>	14 days	None	50
41	<i>Phyllanthus amarus</i>	3 days	None	50
42	<i>Picralima nitida</i>	7 days	None	55
43	<i>Plantago major</i>	7 days	None	75
44	<i>Psidium guajava</i>	6 weeks	None	80-85
45	<i>Pycnathus Angolensis</i>	8 days	None	55
46	<i>Ricinus communis</i>	7 days	None	75
47	<i>Saccharum officinarum</i>	Diet	None	75
48	<i>Sarcocephalus Latifolius</i>	5 days	None	80
49	<i>Senna alata</i>	13 days	None	60
50	<i>Solanum tuberosum</i>	Diet	None	70
51	<i>Solenostemon monostachyus</i>	5 days	None	65

52	<i>Taraxacum officinale</i>	5 days	None	60
53	<i>Tecoma stans</i>	7 days	None	55
54	<i>Thaumatococcus Daniellii</i>	10 days	None	50
55	<i>Vernonia Amygdalina</i>	14 days	None	80
56	<i>Viscum album</i>	31 days	None	70
57	<i>Xylopia aethiopica</i>	7 days	None	45
58	<i>Zingiber officinale</i>	14 days	None	70

#### IV. Discussion

Overall, the survey revealed 58 plants belonging to 39 families that are used to treat diabetes in Umuahia. Due to limited sample size, we focused this discussion on the most frequently mentioned plants. Regarding all identified plants, leaves and fruits were the major plant parts used.

Most of the traditional medicinal practitioners (TMPs) met were not literate - about 6 stopped at secondary school and about 4 at primary school. The origin of their knowledge of herbal medicine were mainly a form of heritage and divine revelation as some claimed to receive “spiritual” instructions as they slept or communed with their inner man. A greater percentage of the TMPs were full-time practitioners while others regarded the practice as part-time. They diagnosed diabetes using two broad means –symptoms or laboratory analysis. However, some of them used a combination of the two. These symptoms and laboratory techniques have been explained prior to this chapter.

Regarding the regional distribution of plants, the most mentioned plants seem to be similarly available in urban and rural regions. The most mentioned plants were *Vernonia amygdalina*(19%), *Azadirachta indica*(16%), *Magnifera indica*(15%), *Carica papaya*(12%), and *Morinda lucida*(7%). *Plantago major*(6%), and *Gongronema latifolium* (6%), with the plant part used exclusively stated in the previous chapter. Some of the least mentioned plants but with a great deal of belief to possess high antidiabetic activity were the *Sarcocephalus latifolius*(1%), *Annona muricata*(2%), *Chromolaena odorata*(2%), *Hibiscus sabdariffa*(3%), and *Zingiber officinale* (4%). *Vernonia amygdalina* is a well-known medicinal plant and is used for the treatment of diabetes. Both old and young leaves of *Vernonia amygdalina* possess antidiabetic activities which may explain the traditional use of this plant for management of diabetes (2016, Tabuti *et al* 2003). Present study has shown aqueous extract of *Azadirachta indica* rebuilt the destroyed islet and acini cells enabling them to perform their actions again (Szkudelski, 2001, Traore *et al* 2013). From researches concerning *Magnifera indica*, it has been shown that long-term administration of the aqueous and methanol extract decreases blood glucose level in diabetic rats (Rajesh and Rajeskhar, 2014, Tardio and Pardo de Santayana 2008).It seems to be largely available in the area of Umuahia since it was mentioned by most informants.

As mentioned earlier in this chapter, 58 plants were identified, and these plants were used in different forms – leaf (34%), stem (11%), whole plant (4%), fruit (15%), root (11%), aerial parts (3%), tubers (4%), rhizome (4%), flower (4%), and seed (10%).

The decoction (52%) appeared to be the most widespread method of preparation used by the healers, followed by infusion (20%), juice (20%), and cooking (3%).

The most mentioned plant families included the families of Malvaceae, Asteraceae, and Annonaceae (19%), Zingiberaceae (13%), and Euphorbiaceae (31%).

Plants such as *Allium cepa*, and *Momordica charantia*, have been shown to possess high antidiabetic activity and have been subjected to clinical trials (Traore, *et al.*, 2013)

In the course of interacting with the TMPs, it was gathered of the duration of treatment an individual has to undergo using a particular plant. They also revealed their perceived level of success while using each plant. The doses of each preparation of plants varied and in some cases, there was no certain dose which gave cause for concern and pose a problem for standardization of herbal medicinal plants. They all attested to the plants having very minimal or no side effects. However, these plants may contain toxic constituents which may pose harm or health hazard to the patient on a long-term use.

#### V. Conclusion

The ethnomedicinal investigations conducted in Umuahia show that 58 species of plants are used by its people for the treatment of diabetes. The drugs (leaf, stem, whole plant, fruit, root, stem, aerial parts, tubers, rhizome, flower) are used to develop many medicinal preparations by decoction, expressed, infusion, and cooking. The oral route is the only route of administration for these plants.

The ethnomedicinal plants used as antidiabetics relating to a particular region (Umuahia) were determined and further documented.



The people of Umuahia thus visited in the course of this study are partly dependent on medicinal plants to fulfil their day-to-day healthcare needs. A loss of medicinal plants and associated knowledge will, to a certain extent, hamper the existing healthcare system in the area. The knowledge of medicinal plants is declining in its depth and breadth, and less and less medicinal plants are being utilized as generations go by. Hence, the need to encourage younger generation to appreciate traditional medicinal knowledge as their need in the overall current health problems cannot be over-emphasized. There is need to preserve traditional medicinal information as they remain a vital source of ammunition against emerging diseases.

Diabetes has become a major concern especially in developing countries. To cope concerns, research utilizing natural medicinal plants is gaining pace. These being cheaper, easily available, without side effects, have great promise for diabetes cure. However, further research is needed for evaluation at molecular, physiological, prophylactic, and therapeutic levels for better management of this chronic disease (Mohd *et al.*, 2017).

The first and most urgent demand of man, as of every creature is for food. Besides food, man requires shelter and clothing against the inclemency of the weather. He needs also a considerable variety of materials for the manufacture of various equipment. And for illness, he looks at the plant kingdom, diverse and broad, to manage various illnesses today.

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