An ethnobotanical study of medicinal plants used to treat and manage diabetes mellitus in Ede, Osun State Nigeria

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Research

Abstract

Background: The severity and relatively high incidence of diabetes mellitus (DM) in Nigeria call for research into discovering more potent antidiabetic agents. People of Ede have a long history of relying on medicinal plants to treat and manage various ailments, including DM. Therefore, it provides an alternative means of managing and treating the condition. This study was carried out to identify and document medicinal plants used in treating DM among the inhabitants of Ede, southwestern Nigeria.

Methods: A preliminary survey of the study area was conducted between August 2022 and February 2023. One hundred thirty-five people were selected for semi-structured interviews and questionnaires to collect ethnobotanical data, including the local names of the plants, the plant parts used, and methods of preparation. A literature survey was also conducted to determine which recorded plants have been validated scientifically for their traditional use in treating DM.

Results: Thirty-nine plants from 24 families were identified from the survey. *Crinum jagus* from the family Amaryllidaceae has the highest citation and fidelity level frequency. Trees (46%) and shrubs(23%) were the most abundant life forms of the recorded plants. Similarly, leaf (43%) and stem bark (19%) were the most used plant part, while decoction (54%) was the favoured method of preparation. Over 87% of the plants have been assessed for antidiabetic activities, thus lending credence to the usage of the implicated plants for DM.

Conclusion: This study indicates that the area has a rich diversity of medicinal plants for treating and managing DM. Therefore, phytochemical, pharmacological, and toxicological screening of plants that have not been tested is recommended to aid the ongoing search for effective and safe antidiabetic agents.

Keywords: Antidiabetic activities, Diabetes mellitus, Ede, Ethnobotany, Indigenous knowledge, Medicinal plants

Background

Diabetes mellitus (DM) is a common and severe metabolic ailment responsible for substantial global mortality (Sabiu *et al.* 2019a). According to WHO (2022), approximately 24 million adults live with the disease in Africa, and it is projected to reach about 55 million by 2045. In Nigeria, about 11.2 million people live with DM, many undiagnosed due to poverty and inadequate access to health care (Uloko et. 2018). Due to the inability of local people to seek medical intervention through conventional therapy because of the cost, researchers have been looking for alternative, complementary medicine through plants to treat and manage DM (Sabiu *et al.* 2016; Sabiu *et al.* 2019a). One of the ways to discover alternative, complementary medicine is through documentation of indigenous use of plants among the local people or herbal practitioners for different ailments. The ethnobotanical survey provides a relationship between local dwellers and plants, including how they are used and prepared for various uses (Amjad *et al.* 2020). Apart from the significance of the study in preserving indigenous knowledge about the use of plants, it is also essential for discovering novel antidiabetic drugs. Previously, medicinal plants have been documented from the region where the current study falls, especially in Ibadan (Ajayi *et al.* 2020; Sidiq *et al.* 2020; Abo et al. 2008). The importance of indigenous knowledge about plants in treating different ailments among local communities has been affirmed in several studies (Lawal *et al.* 2020; Mukaila *et al.* 2021, 2022; Ajayi *et al.* 2019; Gbolade 2009). Therefore, we hypothesised that Ede town would contain valuable ethnomedicinal knowledge of the treatment of diabetes mellitus due to its uniqueness in terms of cultural heritage, indigenous knowledge, and the reliance of people residing in the town on medicinal plants for treating several ailments, including diabetes mellitus. Hence, this study was conducted to document the medicinal plants used to treat DM within Ede communities in Osun State, Nigeria, using quantitative indices, namely Frequency of Citation (FC), Relative Frequency of Citation (FRC), and Fidelity level (FL). Information on the recorded plants that have been validated scientifically for their traditional use in treating DM is also provided.

Materials and Methods

Study area

The research was conducted in Ede, an ancient town in southwestern Nigeria predominantly occupied by the Yoruba people. Politically, the study area comprises two local governments - Ede North and South (Figure 1). Ede is geographically located around longitude 4°25'N and latitude 7°43'N with an approximate population of 156,866, according to the last official census (NPC, 2006). The town falls within Nigeria's rainforest region, with an average rainfall between 1000 and 1250mm making farming a major occupation (Gasu, 2018). The mean relative humidity is 75-100%; the average temperature is 26.8°C. The terrain is undulating, with clay soil on the upper slopes and sandy soil on the lower slopes (Adetunji *et al.* 2018).

Field survey and data collection

A preliminary survey of the study area was conducted between August 2022 and February 2023, and 135 people were selected by snowball sampling technique for semi-structured interviews and questionnaires. The informants consist mainly of traditional healers, herb sellers, farmers and older men and women who are reported to be custodians of medicinal plant knowledge (Mukaila *et al.* 2021). Public bus and car drivers were also included in the survey because it has been affirmed that diabetes is a common ailment among them (Ajayi *et al.* 2020). Some interviews were conducted in groups, while others were conducted individually. Demographic information of the informants was collected and recorded.

The language used during the interview is the local language of the area (Yoruba). Information about plants used for diabetes, their local names, the plant parts used, and their modes of use was collected and recorded. Consent was sought from each informant to publish the information provided. The plants were collected with the aid of some community members, and herbarium specimens were prepared and deposited in the Obafemi Awolowo University (IFE) herbarium. Scientific names of the implicated plants in this study were verified using online databases such as the International Plant Names Index (https://www.ipni.org/), WFO Plant List Database (www.wfoplantlist.org), and the Tropicos (www.tropicos.org).

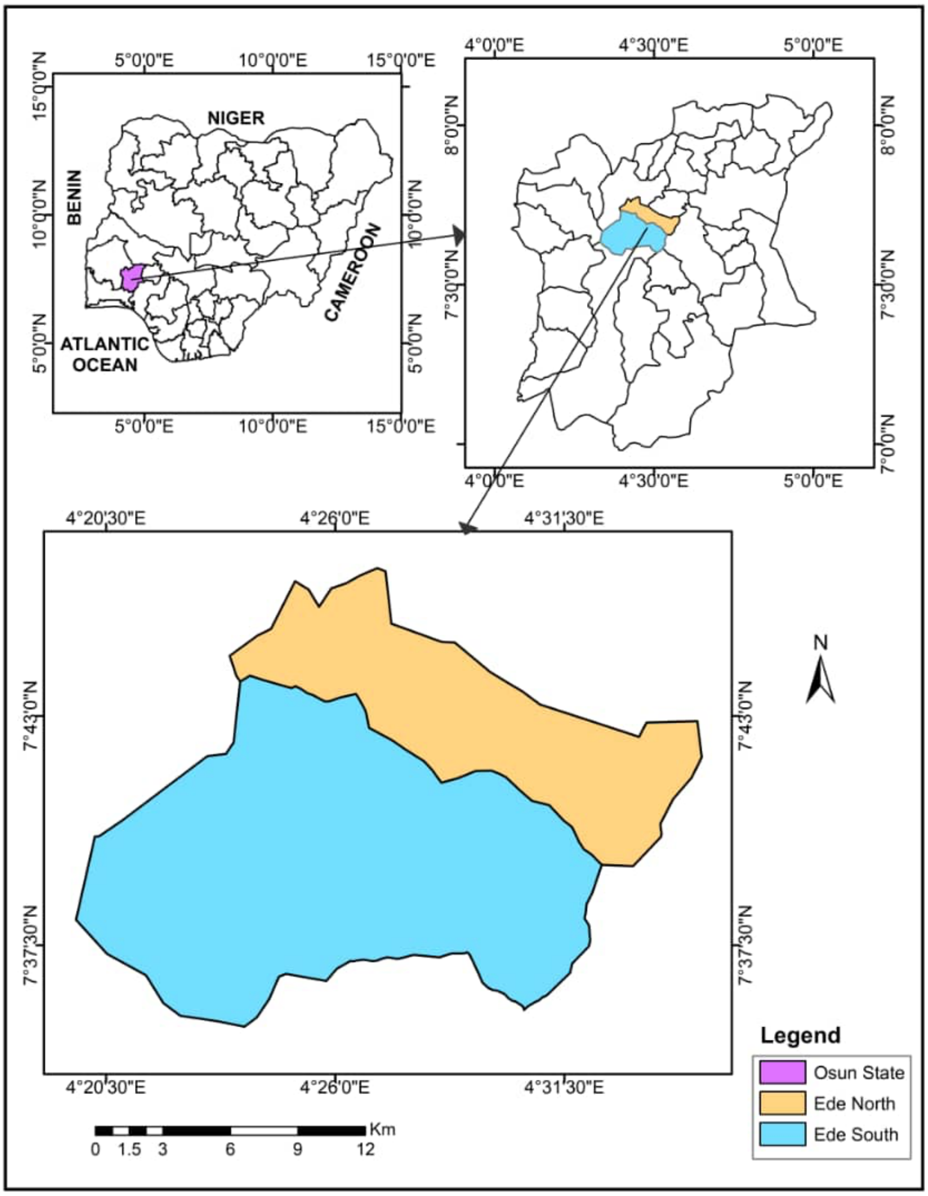

Figure 1. Map of the study area

Quantitative analysis

The ethnobotanical data collected were analyzed using the following quantitative methods.

Frequency of Citation (FC): This is the number of informants mentioning the use of a particular plant species as antidiabetic.

Relative Frequency of Citation (RFC): This was calculated according to Tardio and Pardio (2008).

$$RFC = \frac{Frequency\ of\ citation}{Total\ number\ of\ informants}$$

Fidelity Level (FL): This is the percentage of informants claiming they use a certain plant for diabetes. (Abouzid and Mohamed 2011). It is calculated as follows;

$$FL(\%) = \frac{Np}{N} \times 100$$

N_p is the number of informants that claim they use for a plant species to treat diabetes, and N is the total number of informants.

Antidiabetic Activity

Information on the antidiabetic activities of recorded plants was retrieved from journal websites, including Google Scholar, PubMed, ScienceDirect, SciFinder, and Scopus, using different combinations of the following keywords: "α-amylase", "α-glucosidase", "antidiabetic activity", "hypoglycemic activity", and "anti-hyperglycemic activity" with the name of each of the recorded plants.

Ethical approval

Ethical principles of data collection concerning traditional resource rights, as stated in the latest edition of the International Society of Ethnobiology (2006), were followed.

Results and Discussion

Informants

The demographic information of the 135 informants interviewed for this study is presented in Table 1. Seventy-eight were men, fifty-seven were women, with the age bracket 51-59 (36%) for most informants. Most informants (34%) received primary school education, while 29% had no formal education. More traditional healers (29) and drivers (28) were interviewed, while others were into professions like hunting, herb selling, trading, and farming.

Table 1. Demographic characteristics of informants

Variables	Categories	Number of informants	Percentage (%)
Gender	Men	78	57.78
	Women	57	42.22
Age	≤30	6	4.44
	31-40	21	15.56
	41-50	21	15.56
	51-59	49	36.30
	≥60	38	28.15
Educational Background	None	39	28.89
	Adult education	13	9.63
	Primary school	46	34.07
	Secondary school	22	16.30
	Beyond Secondary school	15	11.11
Occupation	Farmers	21	15.56
	Traditional healers	29	21.48
	Herb sellers	23	17.04
	Drivers	28	20.74
	Traders	19	14.07
	Hunters	15	11.11

Inventory of Plant Species

This study recorded 39 medicinal plant species for treating and managing diabetes in the study area (Table 2). This number is relatively small considering the number of informants and that Nigeria has the highest population of diabetic patients in Africa (Adeloye *et al.* 2017). However, our results show a high consensus among informants, suggesting the efficacy of the recorded plants in treating and managing DM. Similarly, there is a consensus on the species of plants recorded from published research on the ethnobotanical survey of antidiabetic plants from southwestern Nigeria, though the numbers differ. For example, Ajayi *et al.* (2020) recorded 60 plants in Ibadan, while Abo *et al.* (2008) and Sidiq *et al.* (2020) documented 31 and 77 plants from different communities and villages in southwestern Nigeria, respectively. This study shares at least 12 plant species with the previous studies. This high consensus may reveal that these plants contain valuable antidiabetic agents or that knowledge has been shared over time among the study areas. In this study, nine plants are reportedly used as antidiabetic agents that have not been previously reported in the region.

Table 2. Medicinal plants used for the treatment and management of diabetes in Ede

Scientific name	Family	Voucher number	Yoruba name	Habit/Plant form	Part used	Mode of preparation	FC	RFC	FL (%)
Crinum jagus (J. Thomps.) Dandy	Amaryllidaceae	IFE19221	Ogede odo	Herb	Bulb	The bulbs are cut into pieces and macerated in water for seven days	101	0.75	75
Allium sativum L.	Amaryllidaceae	IFE19157	Alubosa ayu	Herb	Bulb	The bulbs are blended with ginger and taken as tea with honey	91	0.67	67
Allium ascalonicum L.	Amaryllidaceae	IFE19052	Alubosa elewe	Herb	Bulb	Infusion	97	0.71	71
Mangifera indica L.	Anacardiaceae	IFE19158	Mongoro	Tree	Bark	Decoction of the bark	23	0.17	17
Xylopia aethiopica (Dunal) A. Rich	Annonaceae	IFE19229	Eru Alamo	Tree	Fruit	Infusion or maceration of the fruit	78	0.58	58
Uvaria chamae P. Beauv	Annonaceae	IFE19022	Eruju	Shrub	Root	Decoction of the leaves	65	0.48	48
Rauwolfia vomitoria Afzel.	Apocynaceae	IFE19122	Asofeyeje	Shrub	Bark	Decoction of stem and bark	72	0.53	53
Alstonia boonei De Wild	Apocynaceae	IFE19217	Awun	Tree	Bark	Decoction of the bark with that of *Mangifera indica*	68	0.50	50
Picralima nitida T. Durand & H. Durand	Apocynaceae	IFE19144	Erin	Shrub	Bark	Decoction of the bark	65	0.48	48
Aristolochia ringens Vahl	Aristolochiaceae	IFE19077	Akogun	Creeper/Climber	Root and bark	Decoction of root or bark or combination of the two	62	0.46	46
Gongronema latifolium Benth et Hook.	Asclepiadaceae	IFE19087	Madunmaro (arokeke)	Shrub	Leaf	Decoction of the leaves.	58	0.43	43
Gymnanthemum amygdalinum (Delile) Sch.	Asteraceae	IFE19112	*Ewuro*	Shrub	Leaf	Leaves are macerated with very little water	94	0.70	70
Bidens pilosa L.	Asteraceae	IFE19132	Abere oloko	Herb	Leaf	Decoction of the leaves	66	0.49	49
Melanthera scandens (Schumach. & Thonn.) Brena	Asteraceae	IFE19135	Yunrun	Scrambler / Climber	Leaf	Leaves macerated in water	18	0.13	13
Kigelia africana (lam.) Benth.	Bignoniaceae	IFE19231	Pandoro	Tree	Fruit	Powder made from the dried fruit is used as tea	84	0.62	62
Markhamia tomentosa (Benth) K. Schum.	Bignoniaceae	IFE19099	Oruru	Tree	Stem bark	Decoction of the stem bark	49	0.36	36
Carica papaya L.	Caricaceae	IFE19124	Ibepe	Tree	Fruit	Unripe fruits are boiled in water	38	0.28	28

Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	IFE19011	Baara	Climber or creeper	Fruit	Infusion of the fruit	88	0.65	65
Mormodica charantia L.	Cucurbitaceae	IFE19119	Ejinrin	Climbers	Leaf	Juice extract	94	0.70	70
Tetrapleura tetraptera (Schun & Thonn) Taub.	Fabaceae	IFE19172	Aridan	Tree	Root	Decoction of the root or fruit	87	0.64	64
Senna alata (L.) Roxb	Fabaceae	IFE19066	Asunwon	Shrub	Leaf	Decoction of the leaves	74	0.55	55
Parkia biglobosa Jacq	Fabaceae	IFE19200	Igba	Tree	Leaf	Powder made from the leaves is used as a tea	68	0.50	50
Garcinia kola Heckel	Hypericaceae	IFE19135	Orogbo	Tree	Fruit	Decoction of the fruit with red onion. The fruits can also be eaten raw	76	0.56	56
Curculigo pilosa (Schum & Thonn) Engl	Hypoxidaceae	IFE19103	Epakun	Tree	Fruit or root	Decoction of the fruits or roots	62	0.46	46
*Hyptis pectin*ata (L.) Poit	Lamiaceae	IFE19129		Shrub	Leaf	Decoction or juice extract of the leaves	28	0.21	21
Ocimum gratissimum L.	Lamiaceae	IFE19088	Efinrin	Herb	Leaf	Juice extract is taken alone or with juice extract from *Gymnanthemum amygdalinum*	79	0.59	59
Anthocleista djalonensis A. Chew.	Loganiaceae	IFE19205	Sapo	Tree	Stem bark	Decoction of stem bark	65	0.48	48
Gossypium barbadense L.	Malvaceae	IFE19209	Owu	Tree	Leaf	Decoction of the leaves	49	0.36	36
Sphenocentrum jollyanum Pierre	Menispermaceae	IFE19147	Akerejupon	Tree	Leaf	Juice made from the leaves or decoction of the leaves	70	0.52	52
Ficus thonningii Blume	Moraceae	IFE19149	Igi odan	Tree	Leaf	Infusion of ewe odan and *Allium ascalonicum* in water	43	0.32	32
Ficus exasperata Vahl	Moraceae	IFE19133	Eepin	Shrub	Leaf	Juice extract from the leaves using water.	56	0.41	41
Syzygium aromaticum (L.) Merr. & L.M. Perry,	Myrtaceae	IFE19137	Kanafuru	Tree	The unopened flower bud (clove)	Infusion of the cloves	68	0.50	50
Parquetina nigrescens (Afzel) Bullock	Periplocaceae	IFE19139	Ewe ogbo	Climber	Leaf	Juice extract from the leaves	63	0.47	47
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae	IFE19156	Eyin olobe	Herb	Whole plant	Decoction of the whole plant with bulbs of *Allium cepa*	91	0.67	67

Securidaca longepedunculata Fresen.	Polygalaceae	IFE19162	Ipeta	Tree	Root and bark	Dried root and *Aframomum melegueta* seeds are powdered and taken as tea. Decoction of the root and stem	71	0.53	53
Nauclea latifolia Smith	Rubiaceae	IFE19177	Egbesi	Tree	Leaf and root	Juice extract from the leaves. Decoction of the root and leaves	67	0.50	50
Morinda lucida Benth.	Rubiaceae	IFE19181	Oruwo	Tree	Leaf	Decoction of the leaves	83	0.61	61
Nicotiana tabacum L.	Solanaceae	IFE19203	Taaba	Herb	Leaf	Maceration of the leaves with the bulbs of *Allium ascalonicum*	64	0.47	47
Calliandra haematocephala Hassk.	Solanaceae	IFE19198	Tude	Shrub	Leaf	Decoction of the leaves	32	0.24	24

The recorded plants spread across 24 families, with the families Amaryllidaceae, Apocynaceae, Asteraceae, and Fabaceae having the highest species (three species each). Seven families - Annonaceae, Bignoniaceae, Cucurbitaceae, Lamiaceae, Moraceae, Rubiaceae, and Solanaceae - have two species each, while 13 plants species were sole representatives of their families (Figure 2). Fabaceae and Asteraceae have well-known reputations as medicinal plants as they are usually well-cited in many ethnobotanical studies (Molares 2012; Panda and Luyten 2018). Most species in the families are edible, with low glycemic index and high protein content (Ujinwal *et al.* 2019). Though members of the family Amaryllidaceae are known to be used for ornamental purposes, it has been reported that they also have species of medicinal value (Salesse *et al.* 2018). The family Apocynaceae includes some of the most popular medicinal plants in southwestern Nigeria and is among Africa's most commonly traded medicinal plant families (Lawal *et al.* 2020).

Crinum jagus in the family Amaryllidaceae has the highest RFC and FL of 0.75 and 75%, respectively. This may be attributed to its efficacy in the local treatment of diabetes in the study area. Unsurprisingly, a pharmacological study has confirmed the effectiveness of the aqueous and hydroethanolic extracts from the plant as antidiabetic agents in diabetic rats (Mvongo *et al.* 2016). Other plants in the family Amaryllidaceae also have relatively high FL; *Allium ascalonicum* (71) and *Allium sativum* (67). Many studies have confirmed the significance of the family in diabetic care in both *in vitro* and *in vivo* studies (Eidi *et al.* 2006; Fallahi *et al.* 2010; Sabiu *et al.* 2019).

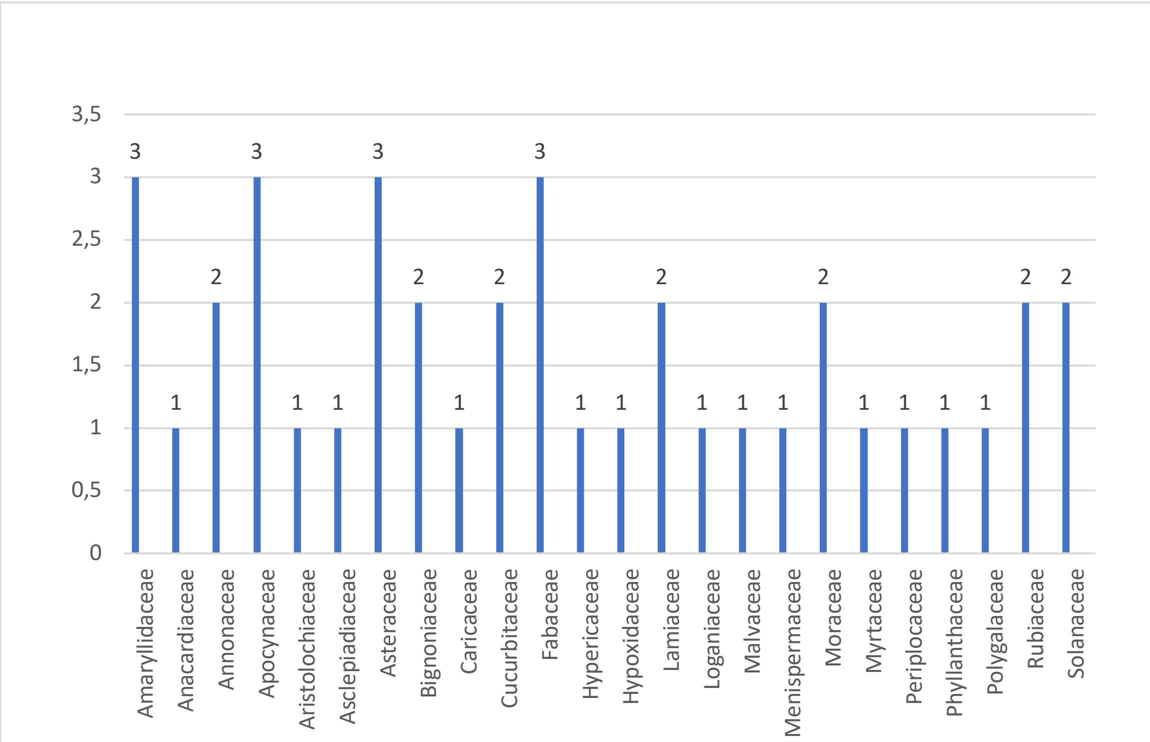

Figure 2. Frequency of plant families used in the management and treatment of diabetes

Life Forms of the Medicinal Plants

Based on habits of the recorded medicinal plants, trees were the most abundant, accounting for 46% of the plants, followed by shrubs at 46%, herbs at 18%, and only five species were climbers (Figure 3). This is not unexpected for a location within the rainforest, as it has been established that there is a strong connection between the local flora and the choice of medicinal plants among community members (Bekalo *et al.* 2009). The prevalence of woody plant species (trees and shrubs) has also been reported in ethnobotanical studies within the rainforest region in Nigeria (Lawal *et al.* 2020; Ajayi *et al.* 2020). The preference for trees may also be related to the availability of some parts of it, like roots and bark, throughout the year (Mukaila *et al.* 2021).

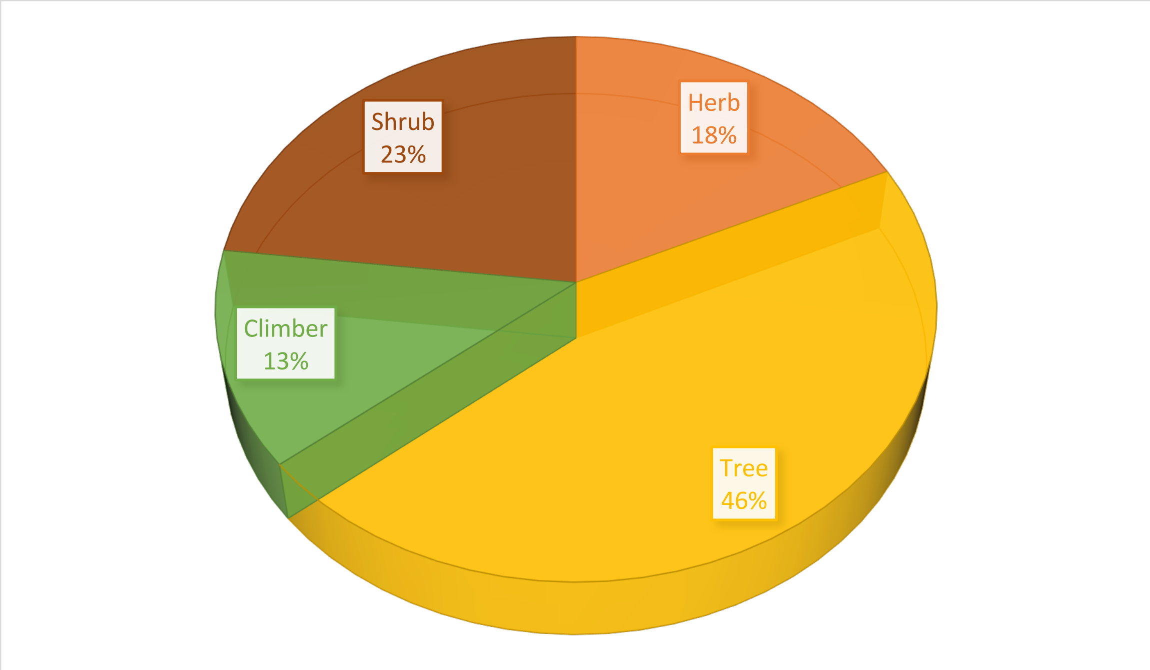

Figure 3. Life forms of recorded medicinal plants used for the treatment and management of diabetes in Ede

Plant Parts

Plant parts reportedly used by informants in treating and managing diabetes include bark, bulb, flower, fruit, leaf, root and sometimes the whole plant. Among these, the leaf was the most used part in 43% of remedies, followed by bark (19%), fruit (14%), and root (12%) (Figure 4). This agrees with many ethnobotanical studies where leaves were reportedly the most used plant part (Ajayi *et al.* 2020; Mukaila *et al.* 2021; Lawal *et al.* 2020; Natcha *et al.* 2019), which was attributed to the abundance of leaves coupled with the ease of access to leaves of plants (Farooq *et al.* 2019). The prevalence of leaves as the most used plant part also places the slightest pressure on the conservation of the plants, as it ensures the plant's survival, unlike other plant parts like the root and stem bark (Moyo *et al.* 2015).

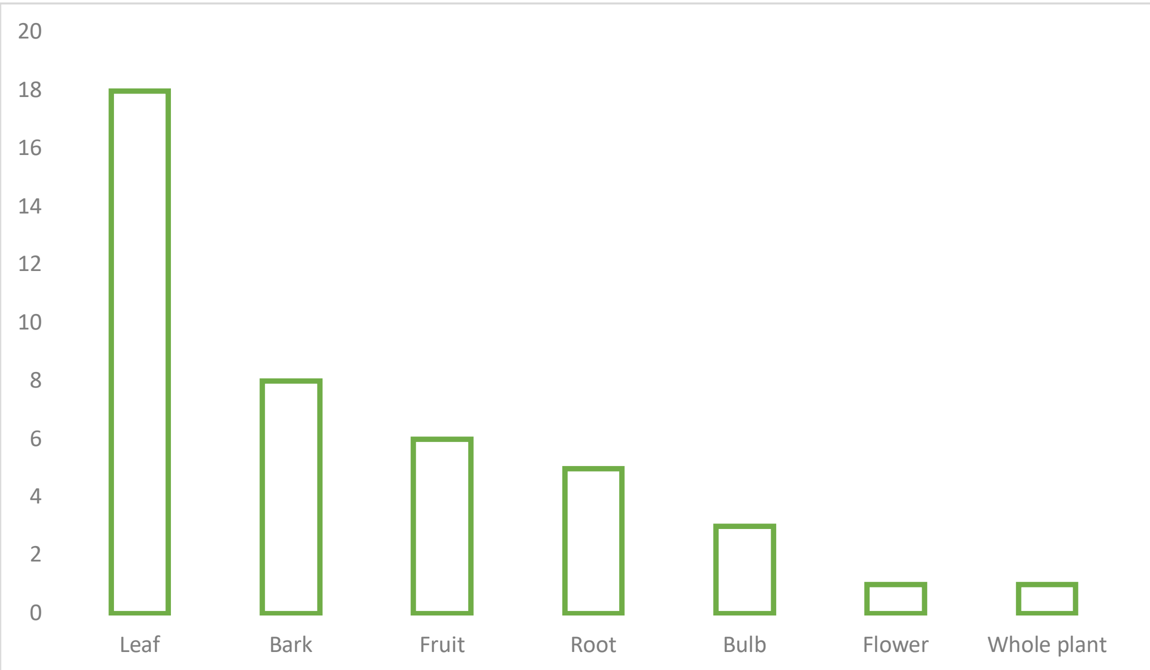

Figure 4. Plant parts used in used for the treatment and management of diabetes in Ede

Methods of Preparation

In this study, methods of preparation used by informants include decoction, grinding, infusion, juicing, maceration, and powdering (Figure 5). The decoction is overwhelmingly preferred, as approximately 54% of remedies were prepared with this method. The popularity of decoction as a method of preparation of herbal medicines has been reported earlier (Mukaila *et al.* 2021; Lawal *et al.* 2020). However, infusion may offer a better alternative as it preserves volatile phytochemicals that may have evaporated during boiling (Ajao *et al.* 2019). Though most of the remedies recorded were mono-herbal, some treatments involve the combination of two or more plants; in one case, honey is used with herbal preparation. The amount of water to be added to the decoction or maceration of any plant varies, which determines the concentration of the extracts the informants believe will be adequate for the ailment. The belief is plausible because the action of many phytochemicals is concentration-dependent (Eze *et al.* 2023).

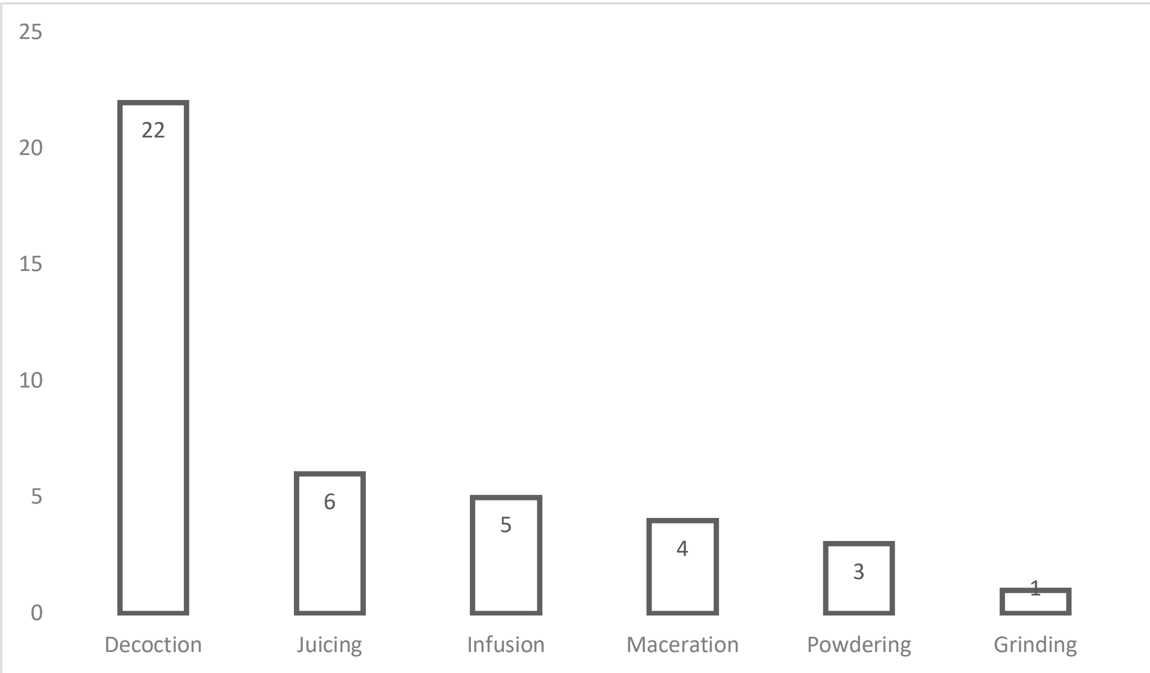

Figure 5. Methods of preparation of medicinal plants used for the treatment and management of diabetes in Ede

Antidiabetic activities of the recorded plants

The scientific validation using either *in vitro* or *in vivo* techniques is vital for the acceptance and development of herbal medicine. A summary of the published work on the antidiabetic activities of the mentioned plants is presented in Table 2. Interestingly, there were records of the antidiabetic actions of different parts of 34 of the 39 recorded plants. However, five plants, including *Calliandra haematocephala*, *Gossypium barbadense*, *Hyptis pectinata, Markhamia tomentosa*, and *Syzygium aromaticum,* have not been evaluated for their antidiabetic properties, while the ethanolic root bark extract of *Securidaca longepedunculata* was found not to be effective in diabetic mice. The case for *S. longipendunculata* may be attributed to the fact that most herbal medicines are administered as a polyherbal mixture, in which case one of the components may not necessarily be active. Among the plants recorded in Table 2, the aqueous leaf extracts of *Ficus exasperata* appear to be the most active. At a concentration of 12.5 to 25 mg/kg body weight, it exhibited an almost 100% urine glucose reversal to normal levels in diabetic rats while reducing serum glucose and cholesterol (Yakubu *et al.* 2014).

Similarly, 100 mg/kg of the hydro-ethanol root extract of *Uvaria chamae* reduced serum glucose and cholesterol by up to 85% in streptozotocin(STZ)-induced diabetic rats. In general, many of the plants exhibited antidiabetic activity but at a high concentration, which calls for robust studies on the toxicity of these plants. Given the activities of most recorded plants, it is imperative to access the activities of the remaining five plants and research the possible synergistic effects of some of these plant extracts. Further*, in-silico*, *in-vivo*, and clinical trials are required to develop these plants into commercial antidiabetic drugs.

Table 3:.Antidiabetic activities of the recorded plants

Plant Species	Plant part(s) used	Extract	Main result of the test	References
Crinum jagus	Bulb	Aqueous Hydro-ethanol	Extracts significantly (P<0.01) reduced all diabetes parameters tested for. The hydroethanolic extract was more effective than the aqueous extract.	Mvongo *et al.* 2016
Allium sativum	Bulb	Ethanol	Extract significantly (P<0.01) lowered all the diabetes parameters tested for and was more effective than the standard drug glibenclamide (600 µg/kg).	Eidi *et al.* 2006
Allium ascalonicum	Bulb	Crude extract	Extract significantly (P<0.01) lowered the serum glucose and lipid levels in diabetic rats. The activity increased with time.	Fallahi *et al.* 2010
Mangifera indica	Leaves	Aqueous	Extracts reduce serum glucose levels in glucose-induced hyperglycaemia.	Aderibigbe *et al.* 2001
	Leaves	Ethanol	Extracts inhibited yeast α-glucosidase and rat α-glucosidase invitro with an IC_{50} of 0.0503 mg/ml and 1.4528 mg/ml, respectively.	Ganogpichayagrai *et al.* 2017
Xylopia aethiopica	Fruits	Ethanol	Extracts significantly reduced the blood sugar level of Wistar rats in a dose-dependent manner.	Ogbuagu *et al.* 2021
		Acetone	300 mg/kg body weight (bw) of extracts reversed all measured parameters in diabetic rats to near normal.	Mohammed *et al.* 2016
Uvaria chamae	Roots	Hydro-ethanol	100 mg/kg bw of extracts reduced serum glucose and lipids in STZ-induced diabetic rats by up to 85 %.	Emordi *et al.* 2016
Rauwolfia vomitoria	Leaves	Hydro-methanol	Extracts significantly (P<0.05) reduced blood glucose levels and increased plasma insulin levels in a dose-dependent manner.	Akpojotor *et al.* 2021
Alstonia boonei	Leaves	Ethanol Aqueous	Both extracts significantly (P<0.05) inhibited the action of α-glucosidase and α-amylase *in vitro* and exhibited a high binding affinity for both enzymes in-silico.	Oyebode *et al.* 2019
Picralima nitida	Leaves	Methanol	300 mg/ kg bw of extracts induced 38 % glycaemia reduction and has positive effects on all measured biomarkers.	Teugwa *et al.* 2013
Aristolochia ringens	Roots	Methanol Ethyl acetate	Extracts reduced blood glucose levels in diabetic rats by up 85 % (ethyl acetate extracts) and 69 % (methanol extracts) while also inhibiting the activities of α-amylase.	Sulyman *et al.* 2019
Gongronema latifolium	Leaves	Methanol Aqueous	Extracts exhibited a significant (P<0.05) antidiabetic activity and the methanol extract was more effective.	Akah *et al.* 2011
Gymnanthemum amygdalinum	Leaves	Ethanol	300 mg/kg bw of extracts showed significant (P<0.05) antidiabetic activity based on the measured parameters in STZ-induced diabetic rats.	Asante *et al.* 2016
Bidens pilosa	Whole plant	Hydro-ethanol	200-340 mg/kg bw of Extract showed hypoglycemic activities in normoglycemic and mildly glycemic mice but was ineffective in severely diabetic mice.	Alarcon-Aguilar *et al.* 2002
Melanthera scandens	Leaf	Ethanol	Extracts significantly (P<0.001) reduced blood glucose levels and total cholesterol of alloxan-induced diabetic rats.	Akpan *et al.* 2012

Kigelia africana	Leaf	Aqueous Ethyl acetate	Extracts significantly (P<0.05) reduced plasma glucose levels in alloxan-induced diabetic mice. The ethyl acetate extract was more effective.	Njogu *et al.* 2018
Carica papaya	Leaf	Ethanol	1000 mg/kg bw of extracts had more hypoglycemic activity than 2 mg/kg bw of glibenclamide.	Solikhah *et al.* 2020
Citrullus colocynthis	Pulpy flesh with seeds	Hydro-ethanol	Extract at (P<0.01) reduced serum glucose of STZ-induced diabetic rats significantly in a dose-dependent manner, though the activity was less than the standard control (glibenclamide).	Ghauri *et al.* 2020
	Roots	Aqueous	The extract reduced the serum glucose level of diabetic rats by 59 %.	Agarwal *et al.* 2012
Mormodica charantia	Fruit	Juice	The fruit juice reduced serum glucose and increased serum insulin in STZ-induced diabetic male Wistar rats.	Mahmoud *et al.* 2017
Tetrapleura tetraptera	Root bark	Aqueous	150 mg/kg bw of the extract significantly (P<0.05) reduced fasting blood sugar and lipids of STZ-induced diabetic rats, but the improvement in weight gain was not significant.	Omonkhua *et al.* 2014
Senna alata	Flower	Aqueous	Extract reversed all parameters associated with alloxan-induced diabetes in mice in a dose-dependent manner.	Yakubu *et al.* 2016
Parkia biglobosa	Fermented seed	Raw	Mixing ground fruits with feeds of diabetic rats reduced serum glucose concentration.	Sule *et al.* 2015
Garcinia kola	Seed	Aqueous	Extract (P<0.001) significantly reduced blood glucose level of alloxan-induced diabetic rats. An increase in body weight was also observed.	Ewenighi *et al.* 2015
Curculigo pilosa	Rhizome	Corn steep liquor	Extract reduced the serum glucose level of STZ-induced diabetic rats by 29 %. Plasma indices and hepatic oxidative stress were also returned to near normal.	Karigidi *et al.* 2020
Ocimum gratissimum	Leaf	Aqueous Ethanol	100 to 300μg/g bw of the extract elicited a significant (P<0.01) reduction in the blood glucose level of STZ-induced diabetic rats in a dose-dependent manner. The aqueous extract was more active.	Oguanobi *et al.* 2012
Anthocleista djalonensis	Leaves and Stem bark	Hydro-methanol	Both extracts inhibited 73 % α-amylase invitro. Stem bark extracts exhibited significant (P<0.05) reduction in the blood glucose level of diabetic rats (73 %), higher in comparison to the leaves extract (46 %).	Olubomehin *et al.* 2013
Sphenocentrum jollyanum	Roots	Methanol	200 mg/kg bw of extracts reversed the blood glucose and lipid level of diabetic rats to near normal.	Alese *et al.* 2014
		Aqueous	200 mg/kg bw of the extracts reduced the blood sugar level of alloxan-induced diabetic rats but was less effective compared to glibenclamide.	Godwin *et al.* 2009
Ficus thonningii	Stem bark	Ethanol	Extract reduced blood glucose levels in non-diabetic and STZ-induced diabetic rats.	Musabayane *et al.* 2007
Ficus exasperata	Leaves	Aqueous	12.5 to 25 mg/kg bw of the extract reduced fasting blood sugar and total cholesterol of alloxan-induced diabetic rats. It also completely reversed urine sugar to the normal level.	Yakubu *et al.* 2014

Parquetina nigrescens	Leaves	Aqueous	The extract reduced fasting blood glucose, serum lipase and total cholesterol while increasing the glucose tolerance of diabetic rats.	Ojuade *et al.* 2021
Phyllanthus amarus	Whole plant	Aqueous Hydro-ethanol	Both extracts at 500 mg/kg bw reduced blood glucose and increased serum insulin, but only the aqueous extract has an effect on weight loss.	Lawson-Evi *et al.* 2011
Securidaca longepedunculata	Root bark	Ethanol	The extracts showed no significant effect on the blood sugar level of STZ-induced diabetic mice up to a concentration of 500 mg/kg bw.	Keshebo et al. 2014
Nauclea latifolia	Leaves	Ethanol	100, 200, and 400 mg/kg bw of extracts showed significant hypoglycemic activities in STZ-induced diabetic rats. The effects were not dose-dependent.	Abubakar *et al.* 2009
	Leaves	Aqueous	200 mg/kg bw of the extract significantly ($p<0.05$)reduced the blood glucose level of alloxan-induced diabetic rats by 45 % within four hours.	Gidado *et al.* 2005
	Root	Ethanol	150 to 450 mg/kg bw of extracts had similar effects to 10 mg/kg bw of glibenclamide.	Anita and Okokon, 2014
Morinda lucida	Stem bark	Aqueous Methanol	Both extracts significantly ($p<0.05$) reduced the fasting blood glucose of alloxan-induced diabetic rats. The aqueous extract lowered blood glucose by 74 % greater than the methanol extract (39 %).	Odutuga *et al.* 2010
	Leaves	Methanol	In normal rats, extracts exhibited a significant ($p<0.05$) hypoglycaemic effect, which was dose-dependent within 4 hours. In STZ-induced diabetic rats, extracts showed antidiabetic effects at 400 mg/kg bw after three days.	Olajide *et al.* 1999
Nicotiana tabacum	Leaves	Aqueous Acetone	Extracts inhibited the actions of α-glucosidase and α-amylase *in vitro*. The aqueous extract was a more potent inhibitor of α-amylase , while the acetone extract inhibited α-glucosidase better.	Kazeem *et al.* 2014

Conclusion

The study documented alternative and complementary herbal remedies for managing and treating DM in Ede, Osun State. Nigeria. Based on the number of plants recorded from the study area, it was evident that people depend on plants as a remedy for DM. Thirty-nine medicinal plant species from 24 families were recorded from the interview with 135 informants showing high consensus among informants. Amaryllidaceae is one of the most represented families, and one of its members, *C. Jagus* has the highest citation and fidelity level. Trees were the dominant plant habit, and leaves were the most used plant part used. Most of the remedies were mono-herbal and prepared by the method of decoction. A literature search revealed that 35 of the 39 recorded plants possess antidiabetic activities, albeit at a generally high concentration. Hence, robust toxicological, pharmacological and phytochemical studies are recommended for all the plant species recorded in this study to aid the search for potent and safe antidiabetic agents.

Declarations

List of abbreviations: Bw Body weight; DM, diabetes mellitus; STZ, streptozotocin.
Ethical approval and consent to participate: All the participants provided prior informed consent before the interviews.
Data and material availability: Voucher specimens are deposited at Obafemi Awolowo University Ile-Ife, herbarium (IFE).
Disclosure statement: The authors declare that there is no competing interest.
Author's contributions: All authors contributed equally to the manuscript.
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Literature cited

Abo KA, Fred-Jaiyesimi AA, Jaiyesimi AE. 2008. Ethnobotanical studies of medicinal plants used in the management of diabetes mellitus in South Western Nigeria. Journal of Ethnopharmacology 115(1):67-71.

Abouzid SF, Mohamed AA. 2011. Survey on medicinal plants and spices used in Beni-Sueif, Upper Egypt. Journal of Ethnobiology and Ethnomedicine 7(1):1-6.

Abubakar G, Danladi AA, Sunday EA, Sani I. 2009. Antidiabetic effect of *Nauclea latifolia* leaf ethanolic extract in streptozotocin-induced diabetic rats. Pharmacognosy Research 1(6).

Adeloye D, Ige JO, Aderemi AV, Adeleye N, Amoo EO, Auta A, Oni G. 2017. Estimating the prevalence, hospitalisation and mortality from type 2 diabetes mellitus in Nigeria: a systematic review and meta-analysis. BMJ 7(5):e015424.

Aderibigbe AO, Emudianughe TS, Lawal BA. 2001. Evaluation of the antidiabetic action of *Mangifera indica* in mice. Phytotherapy Research 15(5):456-458.

Adetunji A, Olorunfemi AO, Abe O, Adesiyan TA. 2018. Anomalous concentrations of radionuclides in the groundwater of Ede area, southwestern Nigeria: a direct impact of geology. Environmental and Earth Sciences 77:1-8.

Agarwal VI, Sharma AK, Upadhyay AN, Singh GO, Gupta RA. 2012. Hypoglycemic effects of *Citrullus colocynthis* roots. Acta Polonica Pharmacologica 69(1):75-79.

Ajao AA, Sibiya, NP, Moteetee AN. 2019. Sexual prowess from nature: A systematic review of medicinal plants used as aphrodisiacs and sexual dysfunction in sub-Saharan Africa. South African Journal of Botany 122:342-359.

Ajayi TO, Attah AF, Bafor EE, Tokede GO. 2020. Ethnobotanical Survey of Medicinal Plants Used in the Management of Diabetes in Ibadan North-East and Ibadan South-East, Oyo State, Nigeria. Research Square Article ID: rs.3.rs-41424/v1.

Ajayi TO, Moody JO, Anthony CS. 2019. Ethnobotanical survey of plants used in the management of hypertension in Ibadan North Local Government Area of Oyo State, Nigeria. Nigerian Journal of Pharmacy Research 15(1): 61-73.

Akah PA, Uzodinma SU, Okolo CE. 2011. Antidiabetic activity of aqueous and methanol extract and fractions of *Gongronema latifolium* (Asclepidaceae) leaves in alloxan diabetic rats. Journal of Applied Pharmaceutical Science 30:99-102.

Akpan EJ, Okokon JE, Offong E. 2012. Antidiabetic and hypolipidemic activities of ethanolic leaf extract and fractions of *Melanthera scandens*. Asian Pacific Journal of Tropical Biomedicine 2(7):523-537.

Akpojotor P, Ebomoyi MI. 2021. Effect of hydromethanolic extract of *Rauvolfia vomitoria* leaf on blood glucose, plasma insulin and histomorphology of the pancreas of streptozotocin-induced diabetic male wistar rats. Journal of the African Assocociation of Physiological Sciences 9(1):40-47.

Alarcon-Aguilar FJ, Roman-Ramos R, Flores-Saenz JL, Aguirre-Garcia F. 2002. Investigation on the hypoglycaemic effects of extracts of four Mexican medicinal plants in normal and alloxan-diabetic mice. Phytotherapy Research 16:383-386

Alese MO, Adewole OS, Ijomone OM, Ajayi SA, Alese OO. 2014. Hypoglycemic and hypolipidemic activities of methanolic extract of *Sphenocentrum jollyanum* on streptozotocin-induced diabetic wistar rats. European Journal of Medicinel Plants 4(3):353-564.

Amad MS, Zahoor U, Bussmann RW, Altaf M, Gardazi SMH, Abbasi AM. 2020. Ethnobotanical survey of medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan. Journal of Ethnobiology and Ethnomedicine 16:1-28.

Antia BS, Okokon JE. 2014. Phytochemical composition and antidiabetic activity of ethanol root extract of *Nauclea latifolia*. Journal of Phytopharmacology 3(1):52-56.

Asante DB, Effah-Yeboah E, Barnes P, Abban HA, Ameyaw EO, Boampong JN, Ofori EG, Dadzie JB. 2016. Antidiabetic effect of young and old ethanolic leaf extracts of *Vernonia amygdalina*: A comparative study. Journal of Diabetes Reserch 16:47-53.

Bekalo TH, Woodmatas SD, Woldemariam ZA. 2009. An ethnobotanical study of medicinal plants used by local people in the lowlands of Konta Special Woreda, southern nations, nationalities and peoples regional state, Ethiopian Journal of Ethnobiology and Ethnomedicine 5:1-5.

Eidi A, Eidi M, Esmaeili E. 2006. Antidiabetic effect of garlic (Allium sativum L.) in normal and streptozotocin-induced diabetic rats. Phytomedicine 13(9-10):624-9.

Emordi JE, Agbaje EO, Oreagba IA, Iribhogbe OI. 2016. Antidiabetic and hypolipidemic activities of hydroethanolic root extract of *Uvaria chamae* in streptozotocin induced diabetic albino rats. BMC Complementary and Alternative Medicine 16(1):1-8.

Ewenighi C. 2015. Estimation of glucose level and body weight in alloxan induced diabetic rat treated with aqueous extract of *Garcinia kola* seed. Ulutas Medicinal Journal 1(2):26-30.

Eze MN, Odoh HE, Apeh MC. 2023. Assessment of phytochemicals and antioxidant potential of the stem bark of *Albizia chevalieri*. Bioscience Journal 11(1):43-56.

Fallahi F, Roghani M, Bagheri A. 2010. Time-dependent hypoglycemic and hypolipidemic effect of *Allium ascalonicum* L. feeding in diabetic rats. Journal of the Babol University of Medical Science 12(1):16-23.

Farooq A, Muhammad SA, Khalid A, Muhammad A, Muhammad U, Arshad MA. 2019. Ethno-medicinal knowledge of the rural communities of Dhirkot, Azad Jammu and Kashmir, Pakistan Journal of Ethnobiology and Ethnomedicine 15:45-52.

Ganogpichayagrai A, Palanuvej C, Ruangrungsi N. 2017. Antidiabetic and anticancer activities of *Mangifera indica* cv. Okrong leaves. Journal of Advances in Pharmaceutical Technology Research 8(1):19.

Gasu, MB. 2018. Assessment of livelihood assets of wetland farmers at Ede region, southwestern Nigeria. EJESM 11:526-538.

Gbolade AA. 2009. Inventory of antidiabetic plants in selected districts of Lagos State, Nigeria. Journal of Ethnopharmacology 121(1):135-139.

Ghauri AO, Ahmad S, Rehman T. 2020. In vitro and in vivo antidiabetic activity of *Citrullus colocynthis* pulpy flesh with seeds hydro-ethanolic extract. Journal of Complementary Integrative Medicine 17(2).

Gidado A, Ameh DA, Atawodi SE. 2005. Effect of *Nauclea latifolia* leaves aqueous extracts on blood glucose levels of normal and alloxan-induced diabetic rats. African Journal of Biotechnology 4(1):91-3.

Godwin M, Olufunmilayo A, Abraham O, Crescie N, Abayomi O. 2009. The effect of aqueous root extract of *Sphenocentrum jollyanum* on blood glucose level of rabbits. Journal of Medicinal Plant Research 3(11):870-874.

Karigidi KO, Olaiya CO. 2020. Antidiabetic activity of corn steep liquor extract of *Curculigo pilosa* and its solvent fractions in streptozotocin-induced diabetic rats. Journal of Traditional and Complementary Medicine 10(6):555-564.

Kazeem MI, Ogungbe SM, Saibu GM, Aboyade OM. 2014. In vitro study on the hypoglycemic potential of *Nicotiana tabacum* leaf extracts. Bangladesh Journal of Pharmacology 9(2):140-145.

Keshebo DL, Choudhury MK, Dekebo AH. 2014. Investigation on toxicity, hypoglycaemia effect of the root bark of *Securidaca longipedunculata* Fresen (Polygalaceae) and determination of heavy metals. Annals of Biological Research 5(6):15-19.

Lawal IO, Olufade II, Rafiu BO, Aremu AO. 2020. Ethnobotanical survey of plants used for treating cough associated with respiratory conditions in Ede South local government area of Osun State, Nigeria. Plants 9(5):647.

Lawson-Evi P, Eklu-Gadegbeku K, Agbonon A, Aklikokou K, Creppy E, Gbeassor M. 2011. Antidiabetic activity of *Phyllanthus amarus* Schum and Thonn (Euphorbiaceae) on alloxan induced diabetes in male Wistar rats. Journal of Applied Science 11(16):68-73.

Mahmoud MF, El Ashry FE, El Maraghy NN, Fahmy A. 2017. Studies on the antidiabetic activities of *Momordica charantia* fruit juice in streptozotocin-induced diabetic rats. Pharmaceutical Biology 55(1):758-765.

Mohammed A, Koorbanally NA, Islam MS. 2016. Antidiabetic effect of *Xylopia aethiopica* (Dunal) A. Rich.(Annonaceae) fruit acetone fraction in a type 2 diabetes model of rats. Journal of Ethnopharmacology 180:131-139.

Molares S, Ladio A. 2012. The usefulness of edible and medicinal Fabaceae in Argentine and Chilean Patagonia: environmental availability and other sources of supply. Evidence-Based Complementary and Alternative Medicine Article ID 901918.

Moyo M, Aremu AO, Van Staden J. 2015. Medicinal plants: An invaluable, dwindling resource in sub-Saharan Africa. Journal of Ethnopharmacology 174:595-606.

Mukaila YO, Oladipo OT, Ogunlowo I, Ajao AA, Sabiu S. Which plants for what ailments: A quantitative analysis of medicinal ethnobotany of Ile-Ife, Osun State, Southwestern Nigeria. 2021. Evidence-Based Complementary and Alternative Medicin Article ID 5711547.

Mukaila YO, Oladipo OT, Arogundade OO, Ajao AA. 2022. Traditional knowledge of medicinal plants used in Ile-Ife, southwestern Nigeria. Asian Journal of Ethnobiology 5(2).

Musabayane CT, Gondwe M, Kamadyaapa DR, Chuturgoon AA, Ojewole JA. 2007. Effects of *Ficus thonningii* (Blume)[Morarceae] stem-bark ethanolic extract on blood glucose, cardiovascular and kidney functions of rats, and on kidney cell lines of the proximal (LLC-PK1) and distal tubules (MDBK). Renal Failure 29(4):389-397.

Mvongo C, Mfopa A, Kamgang R, Essame Oyono JL. 2016. Antidiabetic and antioxidant activities of *crinum jagus* extracts on induced diabetes rats MACAPOS 1. International Journal of Pharmacological and Phytochemical Ethnomedicine 5:86-95.

Natcha S, Prasit W, Henrik B, Angkhana I. 2019. Traditional uses of Leguminosae among the Karen in Thailand. Plants 8:600.

National Population Commission (NPC). Nigeria 2006 census figures. Nigeria master web. National Population Commission (NPC, Abuja, Nigeria, 2006.

Njogu SM, Arika WM, Machocho AK, Ngeranwa JJ, Njagi EN. 2018. In vivo hypoglycemic effect of *Kigelia africana* (Lam): studies with alloxan-induced diabetic mice. Journal of Evidence Based Integrative Medicine 23:25-34.

Odutuga AA, Dairo JO, Minari JB, Bamisaye FA. 2010. Antidiabetic effect of *Morinda lucida* stem bark extracts on alloxan-induced diabetic rats. Annals of Biological Research 15(9):75-81.

Ogbuagu EO, Nweke IN, Airaodion AI, Ogbuagu U. 2021. Weight gain reduction and hypoglycemic effects of *Xylopia aethiopica* fruit extract on Wistar rats. International Journal of Reserach Reorts on Hematology 3(2):60-68.

Oguanobi NI, Chijioke CP, Ghasi S. 2012. Antidiabetic effect of crude leaf extracts of *Ocimum gratissimum* in neonatal streptozotocin-induced type-2 model diabetic rats. International Journal of Pharmaceutical and Pharmagognisctic Science 4(Suppl 5):77-83.

Ojuade FI, Olorundare OE, Akanbi OB, Afolabi SO, Njan AA. 2021. Antidiabetic and antihyperlipidemic effects of aqueous extract of *Parquetina nigrescens* in streptozotocin-nicotinamide induced type 2 diabetic rats. Heliyon 7(6):e07363.

Olajide OA, Awe SO, Makinde JM, Morebise O. 1999. Evaluation of the antidiabetic property of *Morinda lucida* leaves in streptozotocin-diabetic rats. Journal Pharmacy and Pharmacognosy 51(11):1321-1324.

Olubomehin OO, Abo KA, Ajaiyeoba EO. 2013. Alpha-amylase inhibitory activity of two Anthocleista species and in vivo rat model antidiabetic activities of *Anthocleista djalonensis* extracts and fractions. Journal of Ethnopharmacology 146(3):811-814.

Omonkhua A, Adebayo E, Saliu J, Adeyelu T, Ogunwa T, Omonkhua AA. 2014. Effect of aqueous root bark extract of *Tetrapleura tetraptera* (Taub) on blood glucose and lipid profile of streptozotocin diabetic rats. Nig QJ Hospital Medicine 24(4):279-283.

Oyebode OA, Erukainure OL, Ibeji CU, Koorbanally NA, Islam MS. 2019. Phytochemical constituents, antioxidant and antidiabetic activities of different extracts of the leaves, stem and root barks of *Alstonia boonei*: an in vitro and in silico study. Botany Letters 166(4):444-456.

Panda SK, Luyten W. 2018. Antiparasitic activity in Asteraceae with special attention to ethnobotanical use by the tribes of Odisha, India. Parasite 25.

Sabiu S, O'neill FH, Ashafa AOT. 2016. Kinetics of α-amylase and α-glucosidase inhibitory potential of Zea mays Linnaeus (Poaceae), *Stigma maydis* aqueous extract: An in vitro assessment. Journal of Ethnopharmacology 183:1-8.

Sabiu S, Madende M, Ajao AA, Ogundeji OA, Lekena N, Alayande KA. 2019. The scope of phytotherapy in southern African antidiabetic healthcare. Transactions of the Royal Society of South Africa 74(1):1-18.

Sabiu S, Madende,M, Ajao A.A, Aladodo RA, Nurain IO, Ahmad JB 2019. The genus *Allium* (Amaryllidaceae: Alloideae): features, phytoconstituents, and mechanisms of antidiabetic potential of *Allium cepa* and *Allium sativum*. Bioactive food as dietary interventions for diabetes, 137-154. Elsevier Inc

Salesse D, Medeiros FC, da Silva CC, Lourenço EL, Jacomassi E. 2018. Ethnobotany and ethnopharmacology of Amaryllidaceae, Anacardiaceae, Annonaceae and Apiaceae species. Arquivos de Ciências da Saúde da UNIPAR 22(3):205-216.

Sidiq LO, Segun PA, Ogbole OO. 2020. Medicinal plants used in four Local Government Areas of Southwestern Nigeria for the management of diabetes and its comorbidities: An ethnobotanical survey. Researcg Square doi: 10.21203/rs.3.rs-30491/v1.

Solikhah TI, Setiawan B, Ismukada DR. 2020. Antidiabetic activity of papaya leaf extract (*Carica papaya* L.) isolated with maceration method in alloxan-induces diabetic mice. Systematic Review of Pharmacology 11(9):774-778.

Sule O, Godwin J, Abdu AR. 2015. Preliminary study of hypoglycemic effect of locust bean (*Parkia biglobosa*) on wistar albino rat. Journal of Science Researh Reports 4:467-472.

Sulyman AO, Akolade JO, Sabiu S, Ibrahim RB, Aladodo RA, Ahmad JB, Na'Allah A, Nurudeen BO, Ibrahim GA. 2019. Antidiabetic efficacies of methanolic and ethyl acetate extracts of *Aristolochia ringens* (Vahl) roots: in vivo comparative studies. Comparative Clinical Pathology 28:1267-1274.

Tardio J, Pardo-de-Santayana M. 2008. Cultural importance indices: A comparative analysis based on the useful wild plants of Cantabria (Northerm Spain). Economic Botany 62(1):24-39.

Teugwa CM, Mejiato PC, Zofou D, Tchinda BT, Boyom FF. 2013. Antioxidant and antidiabetic profiles of two African medicinal plants: *Picralima nitida* (Apocynaceae) and *Sonchus oleraceus* (Asteraceae). BMC Complementary and Alternative Medicine 13:1-9.

Ujinwal M, Sahani PA, Singh N. 2019. Comparative sequence and structural analysis of lectin protein in chickpea (Cicer arietinum L.) and their relationship with fabaceae family. International Journal of Proteomics Bioinform 4(1):1-6.

Uloko AE, Musa BM, Ramalan MA, Gezewa ID, Puepet FH, Uloko AT, Sada KB. 2018. Prevalence and risk factors for diabetes mellitus in Nigeria: A systemic review and meta-analysis. Diabetes Ther 9:1307-1316.

World Health Organisation. 2022. https://www.afro.who.int/news/african-region-tops-world-undiagnosed-diabeteswho-analysis. Accessed February 2, 2022.

Yakubu TM, Salau AK, Oloyede OB, Akanji MA. 2014. Effect of aqueous leaf extract of *Ficus exasperata* in alloxan-induced diabetic Wistar rats. Cameroon Journal of Experimental Biology 10(01):35-43.

Yakubu MT, Uwazie NJ, Igunnu A. 2016. Antidiabetic activity of aqueous extract of *Senna alata* (Fabaceae) flower in alloxan-induced diabetic male rats. Cameroon Journal of Experimental Biology 14(10):09-16.