Ethnobotanical study of medicinal plants in southwestern Nigeria and traditional healers' perception of indigenous knowledge digitisation

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Abstract

This paper investigated the ethnobotany of medicinal plants among traditional healers in southwest Nigeria. It identified plants, the diseases they are used to treat, and explored the indigenous healers' perceptions of digitisation of their medical knowledge. Structured interview schedule was used to elicit information from 18 interviewees. The study showed that 44 families, comprising 82 genera and 96 species with Asteraceae, Malvaceae, Euphorbiaceae, Poaceae and Fabaceae having the highest number of genera and species. Species cited with high fidelity levels included Phragmanthora capitata (100%), Anacardium occidentale (100%), Anacardium occidentale (100%) and Gossypium hirsutum (80%). Interviewees possessed an appreciation for computer; and were in full support of documentation and digitisation of traditional medical knowledge. They perceived documentation, digitisation and involving libraries as ways of preserving traditional knowledge. Barriers to traditional healers' practice included use of herbicides, scarcity of medicinal plants, urbanisation, undefined dosages and/or side effects, deforestation, overgrazing activities, and bush burning. Documentation and digitisation of traditional healing knowledge should be treated with urgency thereby preserving the rich culture of Yoruba people for posterity. Libraries for indigenous knowledge systems should be established across Nigeria. Mounting courses at the general or first-degree levels can be contributory to medicinal plants preservation.

Keywords: Digitisation, documentation, ethnobotany, medicinal plants, nigeria, traditional healers.

Introduction

The relationship between plants and human beings has been from time immemorial. All through history, human dependence on plants for food, clothing, shelter, medicine, ornament, horticulture, furniture, wind breaking, organic manure, soil stability, dyes, pesticides, gums, warmth, religious sacrifices, and food for other animals among others cannot be jettisoned. Some ecological services supplied by plants include providing support for energy flow and chemical recycling, air and water purification, soil erosion prevention, influencing local and regional climates, serving as carbon sink, air balances and providing habitats for other organisms (Ijatuyi 2005a; Miller and Spoolman 2013). The effects of plants are becoming more pronounced even in the present day threatened environment.

The use of herbal plants as indigenous remedies to diseases and ailments continues to gain more attention in scientific research. Evidence from Wyk (2002) indicated that a growing international attention in ethnobotany was demonstrated by upsurge in ethnotourism and documented that over 20 universities in USA make available courses in ethnobotany at undergraduate and postgraduate levels. Researchers (Sharma and Kumar 2013) confirmed that

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many of the present-day diseases are attributable to the type of lifestyle one engages in. These diseases can be in form of diabetes, nervous disease, vitality, reproductive and others, the use of herbal medicines has proved potent in their treatment.

Ethnobotany is a branch of ethnobiology and is dichotomised as “ethno” – the study of people and “botany” – the branch of science that studies plants (Sharma and Kumar 2011). Ethnobotany provides important information needed for the extraction of active substances from plant sources (Quereshi, Gloazanfar, Obied, Vanleva and Tariq 2016) and up till today, discoveries are continuously being made about plants as sources of drugs capable of tackling human and animal diseases (Quereshi, *et al.* 2016). Quereshi *et al.* (2016) also observed that only 10% of plant resources species inhabiting the earth numbering between 500,000 and 750,000 have had their biological and chemical components examined worldwide. Thus, their potentials and potency are yet to be investigated.

The practice of indigenous medicine is predominantly done by traditional healers who derive their sources of medicine from plants. Ijatuyi (2005b) citing Mundy and Crompton identified some people as sources of indigenous knowledge based on certain factors including age, experience, gender and profession. Among the indigenous communities are professionals who possessed indigenous knowledge including healers, scribes, midwives, blacksmiths, and irrigation tunnel builders (Mabawonku 2005) and are still part of the existing communities today. These skilled practitioners possess knowledge – which is poorly documented, and highly limited in circulation and sharing. To give the indigenous knowledge a broad base, there is the need to properly document and digitise it. Thus, engaging the use of information and communication technologies (ICTs) is imperative. The widespread, availability and convergence of these ICTs provide an incredible capacity for a better way of disseminating information and knowledge, overcoming the barriers of geographical space and time. Wyk (2002) opined that the ICT operating environments for the different countries of the world are uneven. For example, the telephone availability in Tokyo the capital of Japan is far greater than what is available in the whole of Africa put together. However, we have to begin somewhere and continue to progress. The gap identified in the literature in the area of traditional healing lies in the negligibly low documentation and digitisation of beneficial information of plant resources since most of the indigenous knowledge in this regard are confined to oral societies. It is apparent that such knowledge will vanish at the death of their possessors. Apart from death, memory loss can be challenging to indigenous knowledge especially as these healers advance in age.

The focus of this study, ethnobotanical study of plants among indigenous healing practitioners versus their perception of possible digitising of their knowledge shows a long overdue action that can reduce the limitation of orally keeping the records of indigenous medicinal plants and expand circulation and sharing. Information communication technologies (ICTs), the convergence of computers and communications technologies, allow faster, instant and effective processing, storage and accessing of information. ICTs have increased the rate of conversion of information and data into electronic format thereby promoting availability and easy access to information at a very low cost on fingertips globally. In this sense, the internet enables people to gain access to information, create content and disseminate ideas more efficiently (Chu and Du 2013).

Purpose of the study

The objectives of this research include focusing on ethnobotany of medicinal plants by traditional healers in southwest Nigeria; investigating the perception of these traditional healers about digitising; looking into these healers’ awareness on the issue of possible biopiracy of their products and/or service; finding out any challenges to their indigenous profession and proffering some suggested solutions. This is to contribute to efforts that can form precursor for documentation and processing indigenous healing practices in Africa using e-content.

Methodology

Research paradigm

This discourse has adopted mixed methods of quantitative and qualitative research using a survey design. This is because it combines numerical values (quantitative) in the discussion of the socio-demography, frequency of genera and species as identified by interviewees, and the Fidelity Level (FL) of highly cited plant species, while the interviews and ensuing discussions are associated with the qualitative paradigm. The practicality of these mixed methods will be expounded upon in subsequent discussions.

Context of the study

The study was carried out in southwest Nigeria – one of the six geopolitical zones in the country – which also enjoys tropical climate and vegetation and is inhabited by Yoruba people who are one of the major tribes in Nigeria and they have Yoruba as their language. The people in the region are unique with reference to their language, dressing, appearance, socialisation, building style, culture and practices of indigenous medicine. This study used a multistage random sampling technique covering southwest Nigeria- one out of the six geopolitical zones in the country, and focusing on Ondo State, one of the six states in the zone. Two Local Government Areas (LGAs) namely Akure South and Ifedore Local Government Areas were selected from the State for the study because of some parameters: Akure South Local Government Area incorporates Akure, Ondo State Capital and Ifedore Local Government Area has some proximity to the State capital.

Instrument for data collection

The survey focused on eliciting information from 18 traditional healers from the two Local Government Areas stated above. Instrument for data collection was a structured interview schedule but the language of communication throughout the interview was Yoruba, because all the interviewees and interviewers were Yoruba thereby making it easy to flow in the language and atmosphere of the cultural heritage of the study area. The interview was held with the assistance of the researcher's colleague, a traditional healer and the researcher herself. Some of the healers were at first sceptical and unwilling to respond for fear of losing the secrecy of the profession. However, painstakingly, the interviewers were able to explain the objectives of the study and disabuse the interviewees' scepticism thereby soliciting for their freedom in participating in the interview. The interview elicited information on the demographics of respondents, plants names and disease treatment, how the traditional healers got the knowledge on their profession, their perceived computer knowledge, perception of digitisation of indigenous healing procedures and processes, issues of biopiracy and constraints interviewees face in their profession. Since most of the plants cited by study participants were in indigenous names, botanical sources such as information sources (Odugbemi & Akinsulire 2006a; Odugbemi and Akinsulire 2006b; Aigbokan 2014) containing indigenous names, and pictures of plants were used to identify cited plants when difficulty occurred.

Findings

Socio-demographic information of interviewees

Eighteen traditional healers participated in the study with women carrying 72.2% as against 27.8% men participants. Cheikhyoussef, Shapi, Matenge and Ashekele (2011) found women to be more than men in their study. However, this contrasts Tugume, Kakudidi, Buyinza, Namaalwa, Kamatenesi, Mucunguzi and Kalema (2016) who found male practitioners to be dominant. Of all the traditional healers, a majority (78%) of the healers fell above 40 years of age, with 55.6% having tertiary education and 66.7% practiced from their personal houses. Majority (88.9%) of the interviewees had no registration status with the government and 66.7% had no affiliation with

Traditional Healers Association. Means of enrolment mentioned by the healers included mother (33.3%), father (27.8%), grandparents (33.3%), and apprenticeship (5.6%). This is in tandem with that of Cheikhyoussef *et al.* (2011) who found that 90% of their respondents gained their knowledge from their family members and friends. The traditional healers were consulted for many reasons ranging from proximity (72%), affordability (66.7%), and availability (50%). Others noted that modern health facilities around them were inadequate (38.9%), and farther away (27.8%). Zank and Hanazaki (2017) in their study found that one reason that motivated indigenous people to use medicinal plants for health purposes was their low cost. The finding of Dey, Rashid, Millat and Rashid (2014) that modern medical facilities were not sufficient in the areas covered by their research was also of relevance to this study.

Ethnobotanical information of medicinal plants mentioned by study participants

The medicinal plants cited by interviewees were classified into families, genera and species. In all, there were 44 families comprising 82 genera and 96 plant species for the treatment of various ailments. The most cited families of medicinal plants are *Asteraceae* with eight genera and eight species followed by *Malvaceae* having five genera and eight species. *Euphorbiaceae* has five genera and six species, while *Poaceae* has four genera and five species, and *Fabaceae* comprised four genera and four species. Simbo (2010) confirmed in his study that *Asteraceae* is the most applied medicinal plant family in Cameroon. It can be said that the families of most cited medicinal plants may face extinction due to overuse by the traditional healers. Medicinal plants that were cited by at least two interviewees for one disease treatment or the other were sorted and displayed in Table 1.

Table 1: Medicinal plants cited by interviewees and their classification information

S/N	Family	Frequency of genera in each family	Species in each genus
	Laranthaceae	1	1
	Annonaaceae	1	1
	Musaceae	1	2
	Asteraceae	8	8
	Laminaceae	1	2
	Urticeae	1	1
	Malvaceae	5	8
	Anarcardiaceae	3	3
	Myrtaceae	1	1
	Apocynaceae	2	2
	Rutaceae	1	3
	Caricaceae	1	1
	Solanaceae	2	3
	Zingiberaceae	2	2
	Meliaceae	3	3
	Poaceae	4	5

	Compositae	2	2
	Portucaceae	1	1
	Basellaceae	1	1
	Bignoniaceae	2	2
	Moraceae	1	1
	Palmae	1	1
	Piperaceae	3	3
	Fabaceae	4	4
	Araceae	2	2
	Leguminosae	2	2
	Cucurbitaceae	3	4
	Rubiaceae	1	1
	Liliaceae	2	3
	Periplocaceae	2	2
	Bromeliaceae	1	1
	Euphorbiaceae	5	6
	Myristiceae	1	1
	Lauraceae	1	1
	Moringaceae	1	1
	Polygalaceae	1	1
	Steruliaceae	1	1
	Cyperaceae	1	2
	Boraginaceae	1	1
	Morantaceae	1	1
	Crussulaceae	1	1
	Convulvulaceae	1	1
	Nyctaginaceae	1	1
	Amaranthaceae	1	1

Medicinal plants cited by at least two interviewees for the treatment of one disease or the other were sorted and displayed in Table 2.

Table 2: Common names and species of medicinal plants and the disease treatment cited by at least two interviewees

Common Names	Species	Disease Treatment

Mistletoe	*Phragmathera capitata*	Heart problems, Insomnia, Diabetes, Cancer, Anaemia
Bitter leaf	*Vernonia amygdalina*	Diabetes, High blood pressure, Stomach disorder, Skin blemishes, Rashes, Nervous system problem, Typhoid fever, Malaria fever, Sleeplessness
Scent leaf (Tea bush)	*Ocimum gratissimum*	Diarrhoea, Dysentery, Gynaecological problem Pile, Stomach disorder, Backache, Haemorrhoids
Pawpaw	*Carica papaya*	Pile, Infection, Yellow fever, Typhoid fever
Goat weed	*Ageratum conyzoides*	Stomach disorder, Malaria fever, Antibiotic, Backache, Wound/Cut, Bleeding, Heart problem, Ulcer, Cough, Hiccups, Jaundice, Haemorrhoids
Cotton	*Gossypium hirsutum*	Malaria fever, Typhoid fever
Coconut	*Cocos nucifera*	Internal heat, Pile, Typhoid fever, Skin rashes, Diabetes, Detoxification of poison, Solvent for medicines
Yellow Mombim	*Spondias mombin*	Gonorrhoea, Fibroids, Cataract, Typhoid fever, Stomach disorder, Back ache
Plantain	*Musa paradisiaca*	Nervous system problem, Ringworm, Kidney problem
Sand Paper Tree	*Ficus exasperate*	Sleeplessness, Hypertension
Guava	*Psidium guajava*	Malaria fever, Rheumatism
Ginger	*Zingiber officinale*	Malaria fever, High blood pressure, Arthritis, Cancer
Sobo (Red Millet)	*Hibiscus sabdariffa*	Anaemia, Cough
Water leaf	*Talinum triangulare*	Anaemia, Ulcer
Tobacco	*Nicotiana tabacum*	Convulsion, Eczema
Hornbean-leaf sida	*Sida acuta*	Infertility, Arthritis, Malaria fever, Body weakness, Kidney problem, Rheumatism, Gonorrhoea, Blood vomiting
Sausage tree	*Kigelia africana*	Fibroid, Malaria fever, Stomach disorder, Infertility
Siam weed	*Chromolaena odorata*	Body fat reduction, Malaria fever, Headache, Tooth problem, Skin problem, Typhoid fever
Wild lettuce	*Launaea taraxacifolia*	Skin problem, Eye problem
Stool wood	*Alstonia congensis*	Growth of premature baby, Typhoid fever
Lemon	*Citrus limon*	Malaria fever, Cancer, Sore Throat
Bell bean tree	*Markhamia tomentosa*	Anaemia, Infertility
Pigeon pea	*Cajanus cajan*	Boil, Measles, Anaemia

Lemon grass	*Cymbopogon citrates*	Jaundice, Malaria fever, Obesity, Sleeplessness
Corn	*Zea mays*	Oedema, Weak erection
Morinda	*Morindamo morindioides*	Malaria, Cough
Red oil palm	*Elaesis guineensis*	Weak erection, Haemorrhoids
Mango	*Mangifera indica*	Malaria fever
Stinging bean	*Mucuna sloanei*	Malaria fever, Pregnancy sustenance, Haemorrhoids
African parguetina	*Parquetina nigrescens*	Pile, Anaemia, Backache
Pineapple	*Ananas comosus*	Yellow fever, Hepatitis
Christmas bush	*Alchornea cordifolia*	Malaria fever, Anaemia, Sore throat, Cough, Bleeding, Bronchitis
Candle bush	*Senna alata*	Back ache, Skin problem
Alligator pepper	*Alframomum melegueta*	Malaria fever, Fungal finger infection
Neverdie	*Kalanchoe crenata*	Body pain, High blood pressure, Malaria fever, High body temperature
Black night shade	*Solanum nigrum*	Eye problem, Snoring, Headache, Hiccups
Hog weed	*Boerhavia diffusa*	Malaria fever, Heart problem, Kidney stone (Hepatitis), Jaundice, Pile, Rheumatism
Mexican sunflower	*Tithonia diversifolia*	Malaria fever, Typhoid fever, Tumour, Jaundice
Bitter kola	*Garcinia kola*	Cough
African mahogany	*Khaya ivorensis*	Arthritis
Soya-bean (Soybean)	*Glycine max*	Anaemia
Common wild sorghum	*Sorghum bicolour*	Blood purification
Avocado pear	*Persea americana*	High blood pressure

Table 2 shows that the medicinal plants cited by at least two interviewees have potency for the treatment of many diseases. While all of them were used to treat at least a disease, medicinal plants such as *Vernonia amygdalina*, *Argeratum conyzoides, Sida acuta*, *Cocos nucifera, Chromolaena odorata, Occimum gratissimum, Alchornea cordifolia, Kalanchoe crenata, Spondias mombin*, and *Boerhavia diffusa* were used to treat at least six diseases.

A factor that was tested is the fidelity level (FL) of the medicinal plants, which is the frequency of interviewees who mentioned the plant species and the disease treatment. It was calculated in percentage using the formula (Cheikhyoussef *et al.* 2011):

$$FL = N_{P/}N \times 100,$$

Where, N_P is the number of interviewees that cited the particular species, and, N is the number of interviewees that cited the particular species in relation to the disease under consideration (Table. 3).

Table 3: Fidelity Level (FL) of highly cited plant species

Species	Basic Disease Treatment	N	N_P	FL (%)
Phragmanthera capitata	High blood pressure	4	4	100
Vernonia amygdalina	High blood pressure	8	3	37.5
Occimum gratissimum	Pile and stomach disorder	7	3	42.86
Anacardium occidentale	Malaria fever	5	5	100
Carica papaya	Malaria fever	6	3	50.0
Argeratum conyzoides	Malaria fever, fresh wound/cut	6	4	66.67
Gossypium hirsutum	Malaria fever	5	4	80.0
Spendias mombin	Gonorrhea	5	2	40.0
Hibiscus asper	Anaemia	3	2	66.67
Sorghum bicolour	Blood purification	3	3	100
Launaea taraxacifolia	Skin diseases	3	2	66.67

In this study, three species with high (100%) FL are *Phragmanthera capitata, Anacardium occidentale* and *Sorghum bicolour,* used for the treatment of high blood pressure*,* malaria fever and blood purification, and *Gossypium hirsutum* with 80% FL for Malaria fever treatment respectively. Coming next to these are the species with FL 66.67% *Argeratum conyzoides* for malaria fever and fresh wound/cut treatment, *Hibiscus asper* for anaemia treatment and *Launaea taraxacifolia* for the treatment of skin diseases. *Carica papaya* with 50% FL is used in the treatment of malaria fever. The remaining species have a fidelity level that is less than 50%; however, this does not affect their purported potency. Research has demonstrated that plants with high fidelity level are more actively used (Cheikhyoussef *et al.* 2011), and can form precursors of pharmaceutical products but, there may be the problem of overexploitation of such plants.

Traditional healers' perception of indigenous knowledge digitisation: Interviewees' perceived knowledge of computer

The traditional healers were asked whether their indigenous knowledge was documented or not. A majority (72.2%) indicated that it was largely not documented. Three people gave the following reasons for the undocumented status respectively:

I know everything.

The medicinal plants are too many to be documented.

They are found all around us.

The interviewees were asked if they had seen a computer before. About 89% of them had seen one before at home or in offices, while 67% of them had used it before. Further probing was given to digitisation issue; therefore, the interviewees were asked to respond to some general subtheme-statements as shown in Table 4 on the bases of "strongly agree", "agree", "disagree" or "strongly disagree". The responses were dichotomised into documenting and digitising subthemes: firstly, names of medicinal plants, parts used and diseases that such plants are used to treat; and secondly, documenting and digitising including preparation of traditional mixtures, their administration to patients including dosage, and storage.

Table 4: Traditional healers' perception on digitisation of their indigenous knowledge							
		SA	A	D	SD	M	Std
i	Computer can be used to store names of traditional medicinal plants	55.0	44.6	0	0	3.6	0.51
ii	Their records of growth/ecology should be digitised	50.0	50.0	0	0	3.5	0.51
iii	The kinds of diseases the plants are used to treat should be documented	61.1	38.9	0	0	3.61	0.50
iv	The kinds of diseases the plants are used to cure should be digitised	55.6	44.4	0	0	3.59	0.51
v	The health effects of the diseases should be digitised	55.6	44.4	0	0	3.56	0.51
vi	The parts of plants for healing the diseases should be documented	50.0	50.0	0	0	3.50	0.51
vii	The parts of the plants of plants for healing the diseases should be digitised	61.1	38.9	0	0	3.61	0.50
viii	Preparation of traditional mixtures should be documented	50.0	38.9	11.1	0	3.39	0.70
ix	Preparation of mixtures should be digitized	44.4	55.6	0	0	3.44	0.51
x	Administration of traditional mixtures should be documented and digitised	50.0	38.9	11.1	0	3.39	0.70

(The mean values (M) for the responses in Table 3 are as follows: SA (Strongly Agree) is 3.5-4.0, A (Agree) is 2.5-3.4, SD (Strongly Disagree) is 1.5-2.4, and D (Disagree) is 1-1.4)

The responses from interviewees showed that most of them consented to documenting and digitising those subthemes either on a "strongly agree" or "agree" basis as also revealed by their mean values. From this finding, the traditional healers did not perceive documenting and digitising their knowledge as a threat to their profession. The study participants appear to have an understanding of the significance of ICTs in traditional medical practice and were therefore in full support of the use of these technologies on their practice. Houshyari, Gardiner, Pena, Bahadorani, Tootoochi and Adibi (2012) noted that ICT has advanced many changes in the training and practice of medicine with access being one effect of ICT on medical education. In the words of Oluwalana (2018:3), "Nigeria's ethnic landscape is full of very valuable indigenous knowledge systems that can form a springboard for the country's scientific and technological lifting."

Perceived ways of preserving traditional healing knowledge – documentation, digitisation and library Involvement

In order to explore the issues of preserving indigenous healing, traditional healers were asked to state ways by which their practices could be preserved for future generations. All of them (100%) stated that documentation was one way, and 72.2% each identified digitisation, and involving libraries as other ways of preserving their practices for posterity. Rai (2008) regarded the traditional healers as the primary sources from whom information about healing philosophy, methodology and practice can be gained. An interviewee stated that:

> *My father passed down the knowledge on traditional healing to me but I have forgotten much of it in the process of time because I did not write them down. So I think it is not enough to rely on passing it through the word of mouth only.*

She further said that writing the practices down and hosting them on the computer would foster access because things are changing.

Issues of biopiracy

When asked about the controlling body (National Agency for Food and Drugs Administration Council [NAFDAC]) for food, drug and others in the country, about 94% of them also knew the Council and mentioned its acronym as NAFDAC with 61.6% stating its role as that of regulating drugs for use.

Intellectual property rights

The study interviewees were requested to explain what Intellectual Property Rights mean. Two healers responded. One said that:

> *These refer to effective knowledge behind traditional healing.*

Another stated that:

> *They pertained to issues of piracy.*

In addition, these healers were asked to mention what they would do in the event that their "ritual ceremonies, music, symbols, signs, creative arts, objects, preparation and way of administration of their drugs were reworked or rearranged, copied, and even sold for profit without their authorisation," The participants' responses were diverse including:

> *I will be angry.*
>
> *The person will not find it easy.*
>
> *The action is unfair.*
>
> *I will challenge the authority.*

About 28% stated that they would take legal action.

Though biopiracy covers a wide range of area, Rose (2016) pointed out that it occurs when researchers and research organisations take bioresources or traditional knowledge without acknowledging officially their generators or originators, owners, less affluent countries, the indigenous people themselves who are more or less marginalised. Runguphan (2004), therefore, warned that about the rising cases of biopiracy and encouraged the developing countries to urgently address the issues in order to disallow the loss of these biological resources before they invariably become extinct.

Constraints to indigenous healing practices

The traditional healers were requested to mention barriers to their medical practice. Those mentioned include scarcity of medicinal plants (33.3%) due to urbanisation and deforestation and grazing activities (16.7%), use of herbicides (11.1%) which have denatured the plants (16.7%), and defined dosages or side effects (11.1%) not stated on the medicines.

Discussions and conclusion

This study showed that Southwestern Nigeria is quite endowed with a wealth of medicinal plants that are used by traditional healers to treat many diseases, and that there is an undeniable quantum momentum in the natural treatment of diseases in the area. This study revealed the relationship between plants and ailments that people battle with, and that traditional healers used medicinal plants for the therapeutic treatment of many diseases. This is indicative of the fact that these healers provide significant solutions to many health issues and possess valuable knowledge. They acquired this through family relationships or ancestral lineage accompanied with no documentation of any kind other than oral transfer. Identification of medicinal plants, as shown in this study can further enhance their economic and pharmaceutical importance. Plants with high fidelity level were found to be more used than others and as such; this poses risks including their being overexploited.

Certain factors influence local people in consulting these healers, and these include proximity to and inadequacy of modern health facilities. The study also found that indigenous healers possessed some computer knowledge appreciation and opined that the content of their traditional knowledge should be documented and digitised in order to popularize their knowledge and provide easy access in these modern times. Many methods suggested by the study participants in preserving their knowledge were the recent advances including documentation, digitisation libraries. These are scientific means by which traditional knowledge can be preserved and passed on to future generations. On the issue of piracy, many of the traditional healers did not understand the rudiments of intellectual property rights. However, majority would not be passive in the event that their knowledge was tampered with or used without their permission. Among the steps they would like to take are legal action and challenging the authority of such person or group. At the present, there seems to be no legal or legislative body put in place in Nigeria to address, checkmate or take charge of biopiracy issues. This in effect may give room to porous biotrade and thus, the bioresources can be taken over by offenders. In this instance, the sustainable survival of plants especially those with high fidelity level can be jeorpadised.

However some factors constitute problems to indigenous medical practice including use of herbicides which have denatured the plants, scarcity of medicinal plants due to urbanisation and deforestation and grazing activities, and defined dosages or side effects not stated on the medicines.

This study contributed to the documentation of medicinal plants, for which ethnobotany is known. Since the study showed that participants possessed an appreciation for computer, and were in full support of documentation and digitisation of traditional medical knowledge, it will not be too difficult to involve them in these processes. Also, traditional healers, if well recognised and their knowledge popularised, they can be more economically empowered. Valles and Garnatje (2015) opined that citizen science helps the participation of the various populations in any area, and provide for research to be communicated to the academic community and the general citizenry. Thus, this ethnobotanical study is part of the body of citizen science which is contributory to human knowledge and living.

Some limitations exist for this study in that the number of participants could be regarded as small. Also, two out of 18 Local Government Areas were considered. For future however the scope of research could be expanded to accommodate more participants, more LGAs and more states in Nigeria.

The study recommends that documentation and digitisation of these plants should be treated with urgency to preserve traditional knowledge of Yoruba people, for posterity. Libraries including databases for indigenous knowledge systems should be established across Nigeria. Mounting courses for first degree levels can be considered by the nation's education ministry. Creating awareness and setting up an arm of the government to tackle issues surrounding biopiracy and environmental problems are necessary. More research is suggested regarding the

use of medicinal plants and their digitisation among the Yoruba people in particular and Nigerian peoples in general.

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