Journal of Medicinal Plants for Economic Development
ISSN: (Online) 2616-4809, (Print) 2519-559X

Ethnomedicinal survey of indigenous medicinal plants in Jos Metropolis, Nigeria

Authors:
Babajide C. Falemara[1]
Victoria I. Joshua[2]
Temitope I. Ogunkanmi[2]
Wilfred O. Mbeng[3]

Affiliations:
[1]Research Coordinating Unit, Forestry Research Institute of Nigeria, Ibadan, Nigeria

[2]Department of Forestry, Federal College of Forestry, Jos, Nigeria

[3]Department of Biology and Environmental Sciences, Faculty of Agriculture and Natural Sciences, University of Mpumalanga, Mbombela, South Africa

Corresponding author:
Wilfred Mbeng,
wilfred.mbeng@ump.ac.za

Dates:
Received: 04 June 2021
Accepted: 30 July 2021
Published: 27 Oct. 2021

How to cite this article:
Falemara, B.C., Joshua, V.I., Ogunkanmi, T.I. & Mbeng, W.O., 2021, 'Ethnomedicinal survey of indigenous medicinal plants in Jos Metropolis, Nigeria', *Journal of Medicinal Plants for Economic Development* 5(1), a128. https://doi.org/10.4102/jomped.v5i1.128

Background: Indigenous knowledge is progressively fading out because of a lack of proper record-keeping, as the knowledge is transmitted verbally. There is, therefore, a dire need for preserving this valuable knowledge by ensuring proper documentation and sharing of traditional knowledge.

Aim: This research study sought to explore the indigenous knowledge used by herbal medicine practitioners for treating various human ailments in Jos Metropolis of Plateau State, Nigeria.

Setting: The study was conducted using a structured questionnaire administered to 100 registered traditional healers in Jos North LGA of Plateau State.

Methods: Selected medicinal plants were collected, pressed and transported to the Forestry Research Institute of Nigeria (FRIN), Ibadan for identification, authentication and deposition of voucher specimens for voucher number at FRIN herbarium, Ibadan. Descriptive statistics were used to analyse the ethnomedicinal data.

Results: Thirty-nine plant species, distributed in 33 families and 39 genera, were cited by the respondents. The Fabaceae was the most represented family, followed by the Euphorbiaceae and Myrtaceae. Leaves were the most used plant part (29%), whilstthe most cited plant habit forms include trees (48%) and herbs (31%). The herbal remedies were mostly administered orally (53%) and topically (26%), whilst the most common method of preparation was decoction (42%). The highest consensus factor (1.00) was detected for chickenpox or measles or leprosy, haemorrhoids and sickle cell ailments.

Conclusion: There is an existence of a wide gap in traditional healing knowledge between the elderly and the younger generations in the study area. The high fidelity level observed in this study implied a general acceptance and preferred usage of such herbal plants for the treatment of particular ailments.

Keywords: ethnomedicinal; survey; indigenous; medicinal plants; traditional healers; Jos; Nigeria.

Introduction

Ethnobotany is defined as the scientific study of how people of particular regions and cultures utilise plants in their local environments. These uses include medicines, food, fuel, shelter, cosmetics, clothing, rituals and religious ceremonies (Abera 2014). Ethnobotany, therefore, aims to describe, document and explain the complex relationships between culture and the uses of plants across various human societies. However, the native people usually harvest and exploit the plant resources around them unsustainably, which significantly affects the biodiversity and conservation of ecosystem resources at large (Adebayo-Tayo et al. 2010). Ethnobotany plays a critical role in the study of herbal medicine. This is because there is an inextricable link between peoples' cultural heritage, indigenous traditions and nature, as well as between indigenous knowledge and conventional technology (Adebayo-Tayo et al. 2010). This by so doing provides better insight and detailed knowledge of herbal medicine. Nature, through medicinal herbs, bequeath human health with a treasured gift within our natural environment, such that humans significantly and directly benefit from ecosystem biodiversity (Upasania et al. 2017).

Ethnomedicine is a sub-discipline of ethnobotany that comprises the study of traditional medicines, especially for those whose knowledge and practice have been orally transmitted down from one generation to another. Ethnobotanical survey is an important strategy for the continuous search for natural plant products as medicines, and it serves as a major approach for the selection of plants for pharmacological screening. Also, the ethnomedicinal uses of plants remain one of the most

important criteria in the search of novel therapeutic compounds by ethnopharmacologists and pharmaceutical companies.

Indigenous knowledge involving the use of herbal medicine for healing is progressively fading out because of a lack of proper record-keeping (Petros & Nokwanda 2021), modernisation (Gakuya et al. 2020; Megenase, Gelaye & Dara 2019) and language loss (Cámara-Leret & Bascompte 2021). Knowledge is usually transmitted verbally from generation to generation without proper documentation (Gakuya et al. 2020; Petros & Nokwanda 2021). Contributory threats to erosion in the knowledge of some of these valuable herbal plant resources include unscientific mode of collection, lack of sensitisation in harvesting regulations and conservation, deforestation, uncontrolled exploitation, transferring of herbal healers to other jobs and environmental degradation (Abera 2014). There is, therefore, the dire need to preserve this endangered and valuable knowledge before they disappear by ensuring documentation, preservation and sharing of the traditional knowledge across communities (Kassim et al. 2016). Indigenous knowledge of medicinal plants by traditional healers is significant for healthcare delivery in rural communities, and may serve as leads for the discovery and synthesis of novel drugs with alternative mechanisms of action (Pei 2005). Hence, proper documentation of indigenous knowledge is vital to help researchers to investigate and characterise herbal plants with active ingredients for treating chronic ailments and for the benefits of humanity (Abera 2014).

Whilst most urban communities depend on conventional medicine (because of modernisation and civilisation) to meet their health needs, the majority of rural communities still depend on traditional medicine (Jimam et al. 2015). This over-reliance on traditional medicine by local communities has been explained by the fact that it is a core component of the custom, ethos or tradition of the people who use it. Secondly, traditional medicine is economical, and many pharmaceutical drugs are not affordable by the majority of poor people in local communities. For example, it is estimated that only about 20% of malaria cases are treated in the primary healthcare centre (PHCs) in Nigeria because primary healthcare facilities for malaria management are very limited in rural areas (Jimam et al. 2015). The PHC is the entry point into the healthcare sector of Nigeria and is aimed at providing healthcare services in rural communities. On the positive side, the diversity and richness of the African flora serve as a reservoir and inexhaustible source of therapies for a myriad of ailments. Africa has rich biodiversity resources with about 45 000 species of plant, out of which 5000 species are used for medicinal purposes and many remain untapped (Afolayan, Grierson & Mbeng 2014). Unfortunately, these natural resources and their associated indigenous or traditional ecological knowledge are being subjected to threats that are promulgated by cultural and environmental changes, thus, highlighting the need for the preservation of local knowledge and medicinal plants in the natural ecosystems. This can be achieved partly through ethnobotanical studies. This study, therefore, sought to explore the indigenous knowledge used by herbal medicine practitioners in Jos Metropolis in Plateau State Nigeria for treating various human ailments.

Materials and methods

Study area

The research study was conducted in Jos North Local Government Area (LGA) of Plateau state (Figure 1), with a population density of 439 217 constituting 220 856 men and 216 361 women (National Population Commission 2006). Jos North LGA has a land area of 291 km^2 inhabited by various ethnic groups, such as Irigwe, Berom, Ngas, Anaguta, Rukuba and Mwaghavul, as well as different tribes, including Fulani, Hausa, Igbo and Yoruba.

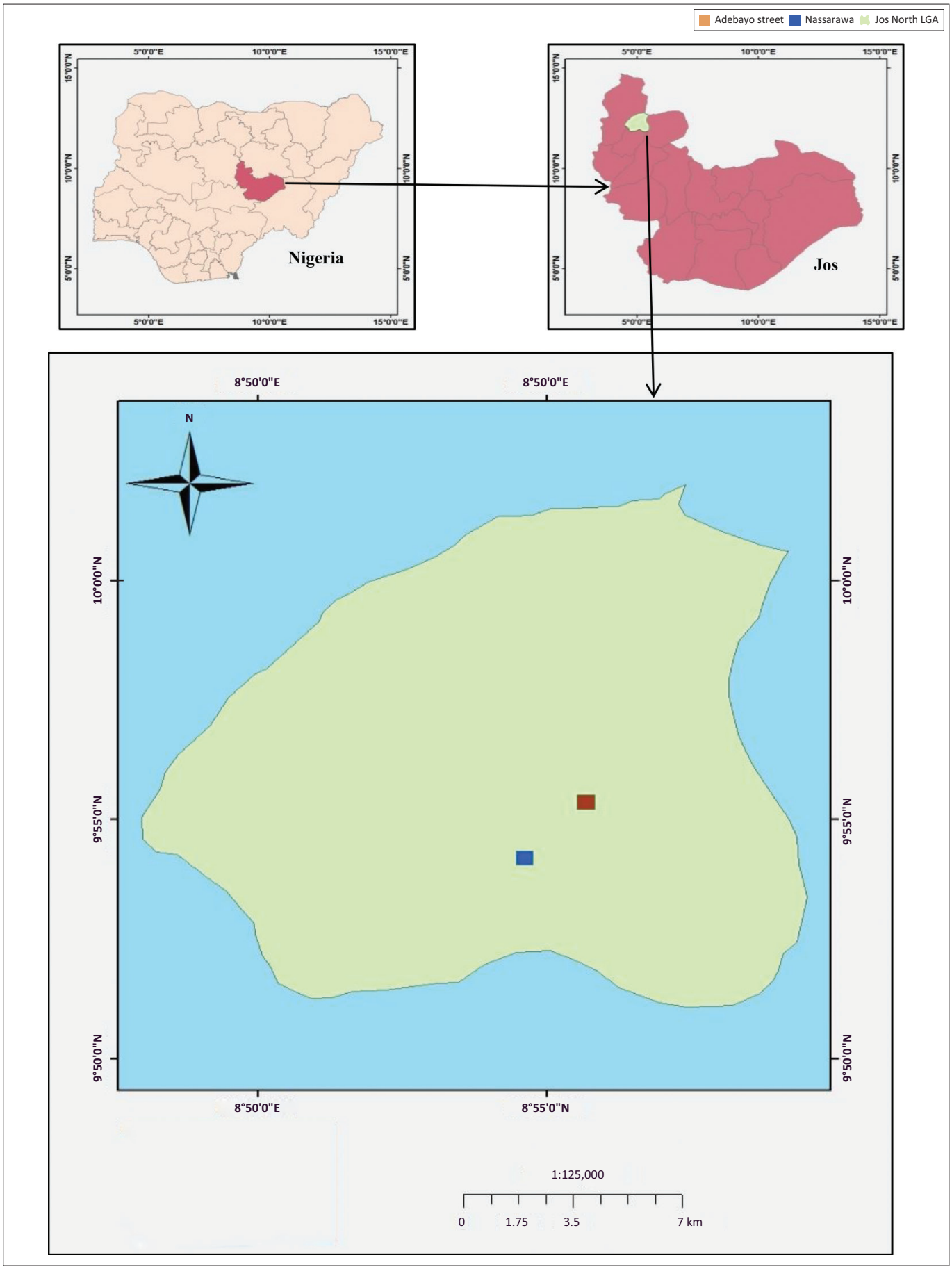
Ethnomedicinal investigation

This study focused on traditional healers who use medicinal plants for the treatment of various human ailments in Jos North LGA. This was conducted through interviews and discussions with 100 traditional healers who were registered with the traditional healers' association, Jos North LGA. The choice of the sample size and the purposive selection were based on a reconnaissance survey and interview, which were conducted before the study.

The interviews and discussions were conducted in the local languages of the traditional healers (Hausa, Yoruba and Igbo) using a well-structured questionnaire. The questionnaires consisting of both open-ended and closed-ended questions were administered to the respondents. Interview or discussion themes targeted the names of the common diseases or disorders, local names of the medicinal plants, life form, the plant parts used, method of preparation and administration of the herbal medicine. Where necessary, the aetiology and symptomatology of some diseases were described to the traditional healers in order to enable them to recollect the exact medicinal plants that they usually use to manage the diseases. The authenticity of claims was verified by cross-checking the acquired data in different locations either by showing the medicinal plants or telling the local names to other informants (Afolayan et al. 2014). The medicinal use of a particular plant was validated only when the answers of two or more traditional healers coincided with the same use of a similar part of the plant, irrespective of the method of preparation. Data were also obtained from secondary sources, such as relevant literature, books, journals, conference proceedings, newspapers, magazines and online sources. The results of the study are tabulated to include scientific or botanical name, plant family, local name, plant part used, and method of preparation and application.

Identification and preservation of voucher specimens of medicinal plants

The traditional healers assisted in the collection of the cited medicinal plants to ensure that the correct plants were



Source: Digital map of Nigeria, 2018.

FIGURE 1: Map of Nigeria showing the location of research study.

collected. The fresh specimens of the collected medicinal plants were pressed and later transported to the Forestry Research Institute of Nigeria (FRIN), Ibadan, where they were identified by botanists using floristic works of Nigeria. Voucher specimens were deposited at FRIN herbarium, Ibadan.

Data analysis

Descriptive statistics, such as means and percentages, were used for the demographical information of the respondents, whilst two analytical tools (informant consensus factor [ICF] and fidelity level [FL]) were used to analyse the ethnomedicinal data that were obtained during the study.

Informant consensus factor

The user's variability of herbal plants was determined using the informant or respondent consensus factor (F_{IC}) with the method of Heinrich et al. (2001) and Canales et al. (2005). The consensus value ranged between 0 and 1. According to Heinrich et al. (2009), high value connotes high usage of one or few plant species to treat a specific ailment, whilst a low value indicates disagreement between informants over the use of any particular plant. Informant consensus factor was obtained from Eqn 1:

$$\mathrm{ICF} = \frac{N_{ur} - N_t}{N_{ur} - 1}, \qquad \text{[Eqn 1]}$$

where N_{ur} refers to the number of individual plant use reports for a certain illness category, whilst N_t connotes the total number of herbal species utilised by all respondents for this illness category.

The fidelity level

The potency of a particular medicinal plant to treat or heal an ailment in a cultural group was quantified using the FL. Fidelity level is derived from the comparative healing power of the herbal plant species concerning the proportion of respondents' agreement on the usage of a particular medicinal plant for treatment against a specific ailment category (Teklehaymanot 2009). However, reported diseases were classified into major ailment categories before the determination of the FL (Heinrich et al. 2001). Fidelity level was obtained from Eqn 2:

$$F_L(\%) = \frac{N_P}{N} \times 100, \qquad \text{[Eqn 2]}$$

where 'N_p' refers to the number of respondents who claimed using a medicinal plant to treat a given disease or some major ailments, whilst 'N' connotes the number of respondents who use the plants as a medicine to treat any specific disease or ailment.

Ethical considerations

Ethical clearance and approval for the research study were obtained from the Forestry Research Institute of Nigeria's ethics committee.

Results and discussion

Demographic information

The demographic information of the traditional healers who participated in the study is presented in Table 1. Close to half of the respondents (47%) were in the age range of 51-60 years and 30% were with the age bracket of 61-70 years. Generally, the majority of the respondents were older than 51 years. Amongst the respondents, 62% were men, whilst 38% were women. Most of the traditional healers practised Islamic religion (60%), whilst 35% of them professed Christianity. However, 78% of the traditional healers had formal education. Majority of the traditional healers have been engaged in this practice for last 7–10 years (31%), whilst 47% and 27% of them have their own private jobs and personal businesses, respectively.

As observed in this study, the traditional healers were within the age brackets of 51–60 years, that is, generally above 51 years. In a similar consonance, the study also reported that elders (> 60 years) were the ones who possess significant traditional knowledge and were practising traditional medicine. As similarly reported (Cheikhyoussef et al. 2011; Mahwasane, Middleton & Boaduo 2013), elders above 60 years are usually endowed with significant traditional knowledge

TABLE 1: Demographic characteristics of the traditional healers.

Respondent variable	Description	Response (%)
Age (years)	31–40	4
	41–50	12
	51–60	47
	61–70	30
	≥ 71	7
	Total	100
Gender	Male	62
	Female	38
	Total	100
Religion	Islam	60
	Christianity	35
	Traditional	5
	Total	100
Educational status	No formal education	22
	Has formal education	78
	Total	100
Duration of practice (years)	3–6	8
	7–10	31
	11–14	26
	15–18	15
	≥ 18	20
	Total	100
Occupational status	Government Job	2
	Private Job	47
	Business	27
	Farming	24
	Total	100

and practice of traditional medicine. This consequently validates the fact that a wide gap exists between the elderly and the younger generation on the knowledge of traditional healing (Ohemu et al. 2014). This finding also suggests that the legacy of traditional knowledge in the study area is endangered, especially if the knowledge is not being passed by the elders to the younger generation. However, Shapi, Matengu and Mu Ashekele (2009) posited that with regard to traditional knowledge, a considerable period is required for the indigenous people to acquire the inherent knowledge of traditional healing.

The findings of Arowosegbe, Olanipekun and Kayode (2015), however, contradict with those of this present investigation. They reported that the age bracket of 61 years and above had the least number of traditional medicine practitioners in Ekiti State, Nigeria. This could be ascribed to the fact that locality can be a determinant factor in the integration of new healers in traditional medicine practices. In consonance with the report of findings of Regassa (2013) and Arowosegbe et al. (2015), men are more involved in traditional medicine practices than women. This negates the assertion of Cheikhyoussef et al. (2011), who reported more female (70%) traditional healers than male (30%).

Diversity of medicinal plants utilised by the traditional healing practitioners

The medicinal plants cited in this investigation are presented in alphabetical order, including their botanical and local names, plant parts used, methods of preparation and administration, as shown in Table 2. Thirty-nine plant species, distributed in 33 families and 39 genera, were cited by the respondents as being used in the treatment of one or more ailments. The Fabaceae was the most representative family with three species, followed by the Euphorbiaceae and Myrtaceae with two species each.

Plant parts used, habits, methods of administration and preparation of the medicinal plants

Leaves (29%) and tree bark (23%) were the most commonly used plant parts for treatment. Other plant parts include seeds (13%), fruit (13%), roots (11%), flowers (9%) and pulp (2%) (Figure 2). Out of the 39 plant species cited for the treatment of diverse ailments by the traditional healers, 48% were trees, 31% were herbs and 21% included shrubs (Figure 3). The herbal remedies (Figure 4) were mostly administered orally (53%) and topically (26%) (Figure 5), whilst the most common method of preparation was decoction (42%), followed by maceration (25%), pounding (16%), crushing (9%) and chewing (8%).

Amongst the plant parts used against various ailments in the study area, leaves and barks are reported to be the most frequently used (Figure 6), contrary to the findings of Steenkamp (2003) and Shrivastava (2013) who both reported a high frequency of roots plant parts. The observed inference of high frequency of leaves can be attributed to the ease of collection and processing of abundant quantities (Rehmana et al. 2017; Tugume et al. 2016). This occurrence can also be ascribed to existence of biologically active compounds against diseases, compared with other plant parts (Faruque et al. 2018; Passulacqua et al. 2007). The leaf area of any plant constitutes the major photosynthetic area and the most metabolically active part – this enhances the production of secondary metabolites (through various biochemical pathways), which are responsible for its healing potential (Ghorbani 2005).

Majority of the herbal remedies in the study area were sourced from trees, contradicting the reports of Tumoro and Maryo (2016) and Faruque et al. (2018) that herbs were the most common life forms. From a conservationist perspective, the exploitation of leaves from trees is more sustainable as opposed to herbs because trees are more resilient, probably because of their large sizes. Notwithstanding, the harvesting of leaves should be regulated - harvesting in large quantities is destructive as it restrains the physiological processes in flowers, seeds and fruits, and this subsequently affects the regeneration potential of the plant (Tugume et al. 2016).

The administration of the herbal medicine mostly by oral means, as well as through topical, nasal and optical routes, corroborates previous findings (Kankara et al. 2015; Keo et al. 2018; Tugume et al. 2016; Tumoro & Maryo 2016; Umair, Altaf & Abbasi 2017). A high frequency of oral administration as reported was believed to be associated with the easy conveyance of the herbal remedies, which are mixed with some solvents or additives (Tugume et al. 2016).

As revealed in the study findings, different methods of herbal drug preparation were utilised by the traditional healers, which ranged (in ascending order) from decoction, maceration, pounding, crushing to chewing. Decoction was found to be the widely adopted method as corroborated by similar findings (Afolayan et al. 2014; Keo et al. 2018; Tugume et al. 2016; Umair et al. 2017). Conversely, Tumoro and Maryo (2016) and Habtamu, Mulatu and Tsdeke (2014) reported crushing, whilst Faruque et al. (2018) indicated paste as the most popular mode of herbal medicine preparation. Nonetheless, decoction is generally utilised in preparing herbal remedies because of the ease of preparation, in which the medicinal plant is boiled in a solvent, such as water, soup and tea (Rokaya, Münzbergová & Timsina 2010). Hot extraction by boiling was found to have more efficacy compared with cold extraction as it helps to preserve the efficacy of the herbal decoction over a long time (Hirt & M'pia 2008).

Consensus factor amongst the traditional healers

The diseases that were mentioned by the traditional healers and their ICFs, as shown in Table 3, were classified into seven categories: *blood-related ailments, skin diseases, skeletal, gastrointestinal, STDs or genital, respiratory and others,* and

TABLE 2: Diversity of medicinal plants used by traditional healers in Jos Metropolis.

S/N	VN	Major ailments	Plant species	Family	Local name	Habit	Parts used	Preparations	Administration	N	Np	NA	FL
1	FB1	Dysentery/purging	*Alchornea cordata* Benth.	Euphorbiaceae	Bambami, Esinsin and ububo	Herb, shrub	Bark, leaf, root and fruit	Boiling	Oral and dermal	32	30	20	93.8
2	FB2	Hypertension	*Allium sativum* L.	Amaryllidaceae	Garlic	Herb	Flower and seed,	Chewing	Oral and dermal	15	13	7	86.7
3	FB3	Malaria/fever/typhoid	*Anacardium occidentale* L.	Anacardaceae	Cashew and Kasu	Tree	Bark, seed, leaf and fruit	Boiling, crushing, squeezing	Oral	24	16	5	66.7
4	FB4	Malaria/fever/typhoid	*Asparagopsis flagellaris* Kunth	Asparagaceae	Asparagus and Aye-kosun	Herb	Bark and leaf	Pounding	Oral	11	10	3	90.9
5	FB5	Malaria/fever/typhoid	*Azadirachta indica* A.Juss.	Meliaceae	Neem, Eke-oyibo and Dongoyaro	Tree	Bark and leaf	Pounding	Oral	32	20	7	62.5
6	FB6	Dysentery/purging	*Byrsocarpus coccineus* Schumach. & Thonn.	Connaraceae	kímbár máhàlbaá and Amùję wę́wę	Shrub	Flower	Boiling	Oral	12	10	12	83.3
7	FB7	Malaria/fever/typhoid	*Carica papaya* L.	Caricaceae	Pawpaw, Gwanda and Ibepe	Herb	Leaf, seed and fruit	Boiling, pounding, squeezing, crushing	Oral and dermal	72	32	15	44.4
8	FB8	Diabetes	*Citrus aurantiifolia* (Christm.) Swingle	Rutaceae	Lime	Herb	Fruit	Boiling	Oral	6	5	5	83.3
9	FB9	Rheumatism/ osteoarthritis/arthritis	*Cocos nucifera* L.	Arecaceae	Coconut palm, Agbon and Kwakwar	Tree	Bark, root, fruit and milk	Pounding, squeezing, chewing, decoction, infusion	Oral and dermal	20	13	9	65
10	FB10	Aphrodisiac/libido/ stimulants	*Cola acuminata* (P. Beauv.) Schott and Endl.	Malvaceae	Kola-nut	Herb	Leaf and seed	Pounding, crushing, chewing	Oral	6	3	6	50
11	FB11	Convulsion/epilepsy/ spasm	*Cymbopogon citratus* (DC.) Stapf	Poaceae	Lemon grass	Shrub	Flower and seed	Boiling, pounding	Oral	4	4	3	100
12	FB12	Colic/meningitis/jaundice	*Detarium microcarpum* Guill. & Perr.	Leguminosae	Sweet detar, Tallow tree and Tauraa	Tree	Bark, leaf and root	Pounding	Oral, nasal and dermal	10	8	12	80
13	FB13	Malaria/fever/typhoid	*Dioscorea dumetorum* (Kunth) Pax	Dioscoreaceae	Bitter yam, Trifoliate yam and Esuru	Herb	Fruit and tuber	Chewing	Oral	4	4	11	100
14	FB14	Cough/cold/catarrh	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	River red gum	Tree	Leaf and bark	Boiling, pounding	Dermal, oral and nasal	40	29	12	72.5
15	FB15	Rheumatism/ osteoarthritis/arthritis	*Garcinia kola* Heckel	Clusiaceae	Bitter kola, Orogbo, Adi and Akuilu	Shrub	Fruit	Chewing, boiling	Oral and optical	8	4	5	50
16	FB16	Diarrhoea/cholera	*Grewia venusta* Fresen	Malvaceae	Ururu and Dargaza	Herb	Leaf and bark	Pounding	Oral	3	3	5	100
17	FB17	Diarrhoea/cholera	*Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.	Irvingiaceae	Wild mango and Goron	Tree	Fruit and leaf	Chewing, boiling, pounding	Oral	12	10	4	83.3
18	FB18	Scabies/skin itches/ rabies/eczema	*Jatropha curcas* L.	Euphorbiaceae	Physic nut	Shrub	Bark, leaf, flower and seed	Pounding, crushing, boiling, squeezing	Oral and dermal	75	52	16	69.3
19	FB19	Colic/meningitis/jaundice	*Khaya senegalensis* (Desv.) A.Juss.	Meliaceae	African mahogany	Tree	Bark, seed and leaf	Infusion, pounding, boiling	Oral	60	39	12	65
20	FB20	Scabies/skin itches/ rabies/eczema	*Lantana camara,* L.	Verbenaceae	Big-sage and Wild-sage	Shrub	Leaf	Boiling	Oral	20	11	12	55
21	FB21	Malaria/fever/typhoid	*Mangifera indica* L.	Anacardiaceae	Mango	Tree	Bark, pulp, seed, flower and leaf	Infusion, boiling, concoction, pounding	Oral	72	48	18	66.7
22	FB22	Rheumatism/ osteoarthritis/arthritis	*Mesua ferrea* L.	Calophyllaceae	Indian rose chestnut	Tree	Bark, fruit, seed and flower	Pounding, boiling	Oral and dermal	24	19	9	79.2
23	FB23	Malaria/fever/typhoid	*Moringa oleifera* Lam.	Moringaceae	Moringa, Drumstick tree and Ben oil	Shrub	Leaf, bark and fruit	Boiling, pounding, infusion, concoction	Oral, dermal, nasal and optical	84	48	9	57.1
24	FB24	Rheumatism/ osteoarthritis/arthritis	*Musanga cecropioides* R.Br. ex Tedlie	Urticaceae	African corkwood and Umbrella tree	Tree	Bark and leaf	Boiling, decoction, pounding	Oral	9	7	10	77.8
25	FB25	Diarrhoea/cholera	*Ocimum gratissimum* L.	Lamiaceae	Scent leaf, Efirin, Nchanwu leaf and Daidoya	Herb	Leaf and seed	Boiling, squeezing	Oral and dermal	40	28	13	70
26	FB26	Asthma/nasal congestion	*Olea europaea* L.	Oleaceae	Wild olive	Shrub	Fruit	Chewing, boiling	Oral and dermal	12	6	8	50
27	FB27	Malaria/fever/typhoid	*Parkia biglobosa* (Jacq.) G.Don	Leguminosae	African locust bean, Dorawa and Dadawa	Tree	Leaf and bark	Boiling, infusion, pounding	Oral	54	32	5	59.3
28	FB28	Schistosomiasis/ flatulence/bloating	*Persea americana* Mill.	Lauraceae	Avocado and Alligator pear	Tree	Leaf, fruit, bark and seed	Boiling, infusion	Oral and dermal	24	14	10	58.3

Table 2 starts on the next page →

TABLE 2 (Continues...): Diversity of medicinal plants used by traditional healers in Jos Metropolis.

S/N	VN	Major ailments	Plant species	Family	Local name	Habit	Parts used	Preparations	Administration	N	Np	NA	FL
29	FB29	Ulcer	*Piliostigma thonningii* (Schum.) Milne-Redh.	Leguminosae	Camel's foot and Monkey bread	Tree	Bark, leaf, root and seed	Boiling	Oral	4	4	3	100
30	FB30	Dysentery/purging	*Prosopis africana* (Guill. & Perr.) Taub.	Leguminosae	African mesquite/Iron tree/Kiriya	Tree	Leaf, bark and root	Pounding, decoction, boiling	Dermal and oral	24	15	13	62.5
31	FB31	Malaria/fever/typhoid	*Psidium guajava* L.	Myrtaceae	Guava	Shrub	Leaf, fruit, bark and root	Boiling, infusion, pounding, concoction, decoction	Oral	48	33	15	68.8
32	FB32	Diabetes	*Scoparia dulcis* L.	Plantaginaceae	Sweet broom weed, Goatweed and Scoparia-weed	Shrub	Flower	Squeezing	Oral	9	7	5	77.8
33	FB33	Dizziness/nausea	*Selaginella lepidophylla* (Hook. & Grev.) Spring	Selaginellaceae	Rose of Jericho and Resurrection plant	Herb	Flower	Boiling, infusion	Oral and dermal	3	2	2	66.7
34	FB34	Malaria/fever/typhoid	*Tamarindus indica* L.	Leguminosae	Tamarind, Tsamiya and Ajagbon	Tree	Leaf, pulp, bark and fruit	Boiling, pounding, infusion	Oral and dermal	60	41	12	68.3
35	FB35	Colic/meningitis/jaundice	*Trianthema portulacastrum* L.	Aizoaceae	Horse purslane, Blackpigweed and Carpetweed	Herb	Leaf and root	Decoction, boiling, infusion	Oral	24	14	12	58.3
36	FB36	Diabetes	*Vernonia amygdalina* Delile	Compositae	Bitter leaf, Onugbu, Shiwaka and Ewuro	Herb	Flower and leaf	Squeezing, boiling, infusion	Oral	66	43	5	65.2
37	FB37	Rheumatism/ osteoarthritis/arthritis	*Vitex doniana* Sweet	Lamiaceae	Black plu, Dinya, Oori-nla and Dinyar	Herb	Leaf, bark and root	Boiling, pounding	Oral	44	27	11	61.4
38	FB38	Diarrhoea/cholera	*Waltheria Americana* L.	Malvaceae	Sleepy morning	Tree	Leaf	Infusion, chewing, boiling	Oral	2	2	4	100
39	FB39	Cough/cold/catarrh	*Zingiber officinale* Roscoe	Zingiberaceae	Ginger	Herb	Root and seed	Boiling, squeezing, pounding	Oral	26	19	5	73.1

FL, fidelity level; N, total number of informants; Np, number of respondents who reported use of species; NA, number; VN, voucher number.

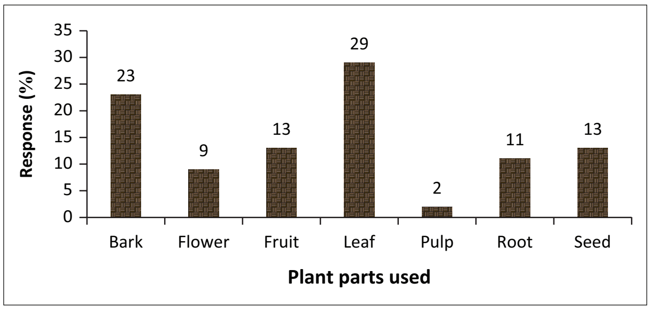


FIGURE 2: Plant parts used.

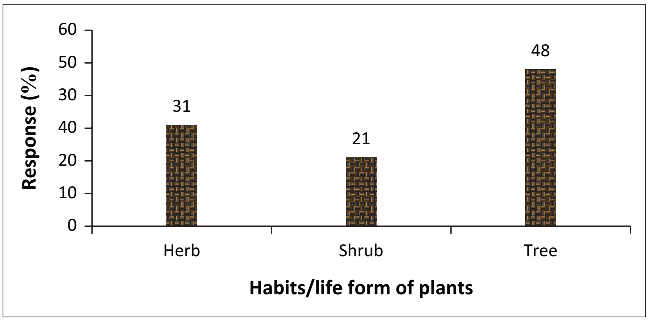


FIGURE 3: Habits or life forms of the plant species used by the traditional healers.

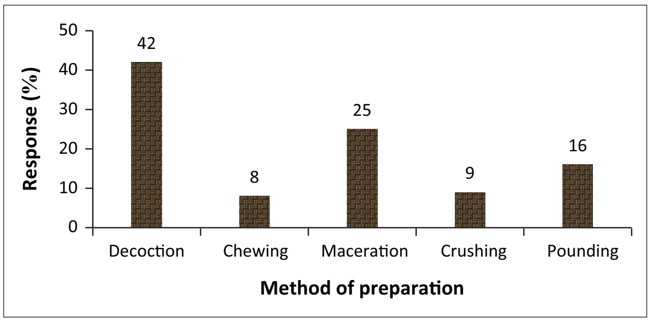


FIGURE 4: Methods of preparation of the herbal remedies.

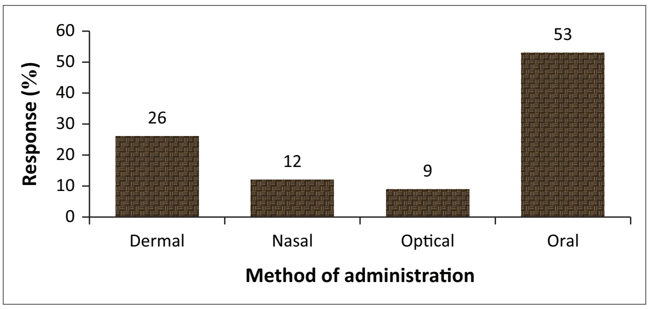


FIGURE 5: Mode of administration of the herbal remedies.

their ICFs ranged from 0.33 to 1. The highest consensus factor (1.00) was detected for chickenpox or measles or leprosy (four use reports), haemorrhoids (two use reports), and sickle cell ailments (two use reports). The lowest ICFs were revealed for the following categories of ailments, such as paralysis or stroke (ICF = 0.60; six use reports), ulcer (ICF = 0.50; 13 use reports) and cancer (ICF = 0.33; four use reports). Malaria or fever had the highest number of use reports (180), followed by diarrhea or cholera (71) and rheumatism or arthritis (70). However, the lowest use reports were observed for

FIGURE 6: Refined herbal drugs (a–g) marketed by traditional healers in the study area.

haemorrhoids (2), sickle cell (2), chickenpox or measles or leprosy (4) and cancer (4). Malaria or fever (20), diarrhea or cholera (17), dysentery or purging (15), and rheumatism or osteoarthritis or arthritis (15) had the highest number of medicinal plant species (Table 3).

The level of agreement by the respondents in using a particular medicinal plant for treating several ailment categories (Rehmana et al. 2017), as well as a means of establishing the most widely used plant species for the treatment of various diseases (Chekole 2017), is measured by ICF. Higher ICF (0.67 and 1) indicates ailments with a high frequency of prevalence in the study location. According to Kankara et al. (2015), this high ICF might be attributed to the efficacy of the plants in providing a remedy to the reported diseases. It can also be ascribed to communication and sharing of information on the potency of the medicinal plants, prolonged usage and feedback on the effectiveness of the medicinal plants. Albeit, the highest ICF observed for chickenpox or measles or leprosy, haemorrhoids and sickle cell ailment categories (Table 3) with fewer use reports implies that information on medicinal treatments as regards these ailment categories are kept secret amongst the traditional healers (Chekole 2017). In contrast, the low ICF values reported for paralysis or stroke (0.60), ulcer (0.50) and cancer (0.33) revealed a gap in communication and knowledge usually common with herbal healers divulging information for fear of copyrights (Chekole 2017).

Fidelity level

As revealed in the study findings, the identified medicinal plants used for the treatment of different categories of ailments has FL ranging from 44.4% to 100%. *Cymbopogon citratus, Dioscorea dumetorum, Grewia venusta, Piliostigma thonningii* and *Waltheria americana* revealed a 100% FL (Table 2). *Cola acuminate* (50%), *Garcinia kola* (50%), *Olea europaea* (50%) and *Carica papaya* (44.4%) indicated the lowest FLs (Table 2).

Medicinal plants showing high FLs indicate higher pharmacological potentials because of the presence of potent phytochemicals, which requires further laboratory screening for the discovery of novel curing possibilities (Hassan-Abdallah et al. 2013). The percentage of FL (Table 2), as revealed in this study, ranged from 44.4% to 100%. This aligns with the range of values (45% – 100%) affirmed by Rehmana et al. (2017). They also acknowledged high FLs amongst plant species such as *Cymbopogon citratus, Dioscorea dumetorum, Grewia venusta, Piliostigma thonningii* and *Waltheria americana*.

Cymbopogon citratus (Poaceae), commonly known as lemon grass, was cited by respondents as being used in the treatment of convulsion, epilepsy and spasms. Many plants that contain essential oils (EOs) have been reported to exhibit anticonvulsant activity and might benefit people with epilepsy (Bahr et al. 2019). For example, clove, lemon grass and lavender contain constituents, such as citral, carvone, linalool and eugenol, which are phyto-constituents with potential antiepileptic activity. Whilst further research studies are needed to confirm their modes of action, it seems that the anticonvulsant properties of EOs are mainly because of their ability to regulate the GABAergic system of neurotransmission and their capacity to change ionic currents via ion channels (Bahr et al. 2019). A decoction of the leaves of *G. venusta* and *W. americana* was reported to be used for the treatment of diarrhea and dysentery by the traditional healers in the study area. The Grewia genus (Tiliaceae) encompasses about 150 species of small shrubs and trees, distributed in tropical and subtropical regions of the world, and is the sole genus that yields edible fruits in the family (Zia-Ul-Haq et al. 2013). The genus is reputed to cure stomach upsets, intestinal and

TABLE 3: Categories of ailments and their informant consensus factor.

Categories of ailments	Use citation per category	Ailments	Nt	Nur	ICF
Skin ailments	33	Chicken pox/measles/leprosy	1	4	1.00
		Scabies/skin itches/rabies/eczema	2	16	0.93
		Ulcer	7	13	0.50
Blood ailments	267	Haemorrhoids	1	2	1.00
		Sickle cell	1	2	1.00
		Hypertension	5	40	0.90
		Malaria/fever	20	180	0.89
		Diabetes	7	43	0.86
Skeletal	80	Rheumatism/osteoarthritis/ arthritis	15	70	0.80
		Lumbago/back pain	3	10	0.78
Respiratory	55	Asthma/nasal congestion	5	17	0.75
		Cough/cold/catarrh	7	38	0.84
STDs/genital	76	Venereal diseases (STD/ gonorrhoea/syphilis)	9	33	0.75
		Urinary infections/vaginal discharge	4	24	0.87
		Aphrodisiac/libido/stimulants	7	19	0.67
Gastrointestinal	143	Diarrhoea/cholera	17	71	0.77
		Dysentery/purging	15	67	0.79
		Schistosomiasis/flatulence/ bloating	2	5	0.75
Others	74	Convulsion/epilepsy/spasm	3	10	0.78
		Paralysis/stroke	3	6	0.60
		Dizziness/nausea	2	10	0.89
		Cataract/glaucoma	3	18	0.88
		Cancer	3	4	0.33
		Jaundice	4	26	0.88

ICF, Informant consensus factor; Nt, number of taxa; Nur, number of use reports; STD, Sexually Transmitted Diseases.

skin infections, and seem to have mild antibiotic properties (Zia-Ul-Haq et al. 2013). *Waltheria* americana is considered as one of the 10 most important medicinal plants in Hawaii used as an aspirin-like drug for the management of inflammatory conditions, and the plant has also been reported for the treatment of diarrhea by traditional healers in other parts of Nigeria (Zongo et al. 2013). The high FL, as revealed in this study, indicates a wide acceptance and preferred usage of such herbal plants in treating specific ailments (Bibi et al. 2014; Islam et al. 2014; Zhang et al. 2015).

Conclusion and recommendations

This research study was undertaken to explore the level of indigenous knowledge in using medicinal plants for the treatment of various human ailments in Jos Metropolis of Plateau State, Nigeria. The study revealed that a total of 39 plant species, distributed in 33 families and 39 genera, were cited by the respondents as being used in the treatment of one or more ailments. The Fabaceae was the most representative family, followed by the Euphorbiaceae and Myrtaceae. A wide gap, as identified, exists between the older and younger generations in the transfer of knowledge and information sharing. This needs to be proactively bridged over time to prevent total dearth in critical medicinal knowledge. As observed in this study, the high FL indicates wide acceptance and preferred usage of certain medicinal plants in treating particular ailments. This ethnobotanical research study has added knowledge and discoveries in indigenous herbal medicine, especially in the study location. The findings further validate the continued existence of traditional healing practices using natural herbal plants. As a result of unsustainable harvesting and exploitation of medicinal tree species, especially the vegetative and photosynthetic parts for medicinal use, there is the dire need for conservation and preservation of this endangered and valuable knowledge before they disappear. Traditional healing practitioners should be generally enlightened on the imperative importance of documentation, information and knowledge sharing for preservation of relevant information, which should be archived for the future generations.

Acknowledgements

Competing interests

The authors have declared that no competing interest exists.

Authors' contributions

F.B.C. conceived the research idea, wrote the original draft of the manuscript, analysed the data, reviewed and edited the manuscript; J.V.I participated in the review and editing of the manuscript, as well as the supervision of the research survey; O.T.I. conducted the research survey and collected the research data; W.O contributed to writing, reviewing and editing of the article.

Funding information

This research received financial support from the National Research Foundation (Grant ID: 115754) and the University of Mpumalanga, South Africa.

Data availability

The authors confirm that the data supporting the findings of this study are available within the article.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

References

Abera, B., 2014, 'Medicinal plants used in traditional medicine by Oromo people, Ghimbi District, Southwest Ethiopia', *Journal of Ethnobiology and Ethnomedicine* 10(40), 1–15. https://doi.org/10/1186/1746-4269-10-40

Adebayo-Tayo, B.C., Adegoke, A.A., Okoh, A.I. & Ajibesin, K.K., 2010, 'Rationalizing some medicinal plants used in the treatments of skin diseases', *African Journal of Microbiology Research* 4(10), 958–963. https://doi.org/10.5897/AJMR.9000626

Afolayan, A.J., Grierson, D.S. & Mbeng, W.O., 2014, 'Ethnobotanical survey of medicinal plants used in the management of skin disorders among the Xhosa communities of the Amathole District, Eastern Cape, South Africa', *Journal of Ethnopharmacology* 153(1), 220–232. https://doi.org/10.1016/j.jep.2014.02.023

Arowosegbe, S., Olanipekun, M.S. & Kayode, J., 2015, 'Ethnobotanical survey of medicinal plants used for the treatment of diabetes mellitus in Ekiti south senatorial district, Nigeria', *European Journal of Botany, Plant Sciences and Phytology* 2(4), 1–8.

Bahr, T.A., Rodriguez, D., Beaumont, C. & Allred, K., 2019, 'The effects of various essential oils on epilepsy and acute seizure: A systematic review', *Evidence-Based Complementary and Alternative Medicine* 62(16), 745. https://doi.org/10.1155/2019/6216745

Bibi, T., Ahmad, M., Bakhsh Tareen, R., Mohammad Tareen, N., Jabeen, R., Rehman, S.U. et al., 2014, 'Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan', *Journal of Ethnopharmacology* 157, 79–89. https://doi.org/10.1016/j.jep.2014.08.042

Cámara-Leret, R. & Bascompte, J., 2021, 'Language extinction triggers the loss of unique medicinal knowledge'. *Proceedings of the National Academy of Sciences of United States of America* 118(24), e2103683118. https://doi.org/10.1073/pnas.2103683118

Canales, M., Hernandez, T., Caballero, J., Romo de Vivar, A., Avila, G., Duran, A. et al., 2005, 'Informant consensus factor and antibacterial activity of the medicinal plants used by the people of San Rafael Coxcatlan, Puebla, Mexico', *Journal of Ethnopharmacology* 97(3), 429–439. https://doi.org/10.1016/j.jep.2004.11.013

Cheikhyoussef, A., Shapi, M., Matengu, K. & Ashekele, H.M.U., 2011, 'Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia', *Journal Ethnobiology and Ethnomedicine* 7(1), 1–11. https://doi.org/10.1186/1746-4269-7-10

Chekole, G., 2017, 'Ethnobotanical study of medicinal plants used against human ailments in Gubalafto District, Northern Ethiopia', *Journal of Ethnobiology and Ethnomedine* 13(1), 1–29. https://doi.org/10.1186/s13002-017-0182-7

Faruque, M.O., Uddin, S.B., Barlow, J.W., Hu, S., Dong, S., Cai, Q. et al., 2018, 'Quantitative Ethnobotany of Medicinal Plants Used by Indigenous Communities in the Bandarban District of Bangladesh', *Frontiers in Pharmacology* 40(9), 12. https://doi.org/10.3389/fphar.2018.00040

Gakuya, D.W., Okumu, M.O., Kiama, S.G., Mbaria, J.M., Gathumbi, P.K., Mathiu, P.M. et al., 2020, 'Traditional medicine in Kenya: Past and current status, challenges, and the way forward', *Scientific African* 8, e00360. https://doi.org/10.1016/j.sciaf.2020.e00360

Ghorbani, A., 2005, 'Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran: (Part 1): General results', *Journal of Ethnopharmacology* 102(1), 58–68. https://doi.org/10.1016/j.jep.2005.05.035

Habtamu, A., Mulatu, O. & Tsdeke, L., 2014, 'Traditional medicinal plants utilization, management and threats in Hadiya Zone, Ethiopia', *Journal of Medicinal Plants Studies* 2(2), 94–108.

Hassan-Abdallah, A., Merito, A., Hassan, S., Aboubaker, D., Djama, M. & Asfaw, Z., 2013, 'Medicinal plants and their uses by the people in the region of Randa, Djibouti', *Journal of Ethnopharmacology* 148(2), 701–713. https://doi.org/10.1016/j.jep.2013.05.033

Heinrich, M., Ankli, A., Frei, B., Weimann, C. & Sticher, O., 2001, 'Medicinal plants in Mexico: Healers' consensus and cultural importance', *Social Science and Medicine* 47(11), 1859–1871. https://doi.org/10.1016/s0277-9536(98)00181-6

Heinrich, M., Edwards, S., Moerman, D.E. & Leonti, M. 2009, 'Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods', *Journal of Ethnopharmacol*ogy 124(1), 1-17. https://doi.org/10.1016/j.jep.2009.03.043.

Hirt, H.M. & M'pia, B., 2008, *Natural medicine in the tropics*, 3rd edn., Marianum Press, Kisubi.

Islam, M.K., Saha, S., Mahmud, I., Mohamad, K., Awang, K. & Uddin, J.S., 2014, 'An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh', *Journal of Ethnopharmacology* 151(2), 921–930. https://doi.org/10.1016/j.jep.2013.11.056

Jimam, N.S., David, S., Galam, N.Z., Joseph, B.N. & Buoye, O.S., 2015, 'Patients' perception of the quality of malaria treatment in primary health care centers of Jos and Environs', *Medicinal Journal of DY Patil University* 8(4), 441–446. https://doi.org/10.4103/0975-2870.160782

Kankara, S.S., Ibrahim, M.H., Mustafa, M. & Go, R., 2015, 'Ethnobotanical survey of medicinal plants used for traditional maternal healthcare in Katsina state, Nigeria', *South African Journal of Botany* 97, 165–175. https://doi.org/10.1016/j.sajb.2015.01.007

Kassim, D.H.A., Raduan, S.Z., Abdul Aziz, M.W., Chelum, H.A, Morni, A.A.M. & Wahab, R.A., 2016, 'Indigenous knowledge of medicinal plants used and it's implication towards health-seeking behavior among the Melanau in Pulau Bruit, Sarawak, Malaysia', *Journal of Advance Research of Social and Behavioural Science* 4(2), 136–145.

Keo, S., Chrin, B., Dim, D., Buth, B., Chea, S., Chan, R. et al., 2018, 'Ethnobotanical survey of medicinal plants used by traditional healers in Kampong Speu province, Cambodia', *Asian Journal of Pharmacogn* 2(1), 21–32.

Mahwasane, S.T., Middleton, L. & Boaduo, N., 2013, 'An ethnobotanical survey of indigenous knowledge on medicinal plants used by the traditional healers of the Lwamondo area, Limpopo province, South Africa', *South African Journal of Botany* 88, 69–75. https://doi.org/10.1016/j.sajb.2013.05.004

Megenase, J.A., Gelaye, K.T. & Dara, P.K., 2019, 'Indigenous knowledge and practices on medicinal plants used by local communities of Gambella Region, South West Ethiopia', *International Journal of Tropical Disease & Health* 39(2), 1–14. https://doi.org/10.9734/IJTDH/2019/v39i230203

National Population Commission, 2006, 'Population and Housing Census of the Federal Republic of Nigeria', *Plateau State Priority Tables*, pp. 1–2, National Population Commission, Abuja.

Ohemu, T.L., Agunu, A., Olutu, P.N., Ajima, U., Dafam, D.G. & Azilla, J.J., 2014, 'Ethnobotanical survey of medicinal plants used in the traditional treatment of viral infections in Jos, Plateau State, Nigeria', *International Journal of Medicinal and Aromatic Plants* 4(2), 74–81.

Passulacqua, N.G., Guariera, P.M, & De Fine, G., 2007, 'Contribution to the knowledge of folk plant medicine in Calabria region (Southern Italy)', *Filoterapia*. 78, 52–68.

Pei, S.J., 2005, 'Ethnobotany and modernization of traditional Chinese medicine', in Y. Thomas, M. Karki, K. Gurung & D. Parajuli (eds.), *Himalayan medicinal and aromatic plants, balancing, use and conservation, Ministry of Forest and Soil Conservation*, HMG, Nepal.

Petros, D. & Nokwanda, N.K., 2021, 'Preservation of traditional medicinal knowledge: Initiatives and techniques in rural communities in KwaZulu-Natal' *Library Philosophy and Practice. (e-journal)* 17, 4824.

Regassa, R., 2013, 'Assessment of indigenous knowledge of medicinal plant practice and mode of service delivery in Hawassa city, Southern Ethiopia', *Journal of Medicinal Plants Research* 7(9), 517–535. https://doi.org/10.5897/JMPR12.1126

Rehmana, M.N., Ahmada, M., Sultanaa, S., Zafara, M. & Edwards, S., 2017, 'Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan', *Revista Brasileira de Farmacognosia* 27(6), 751–775. https://doi.org/10.1016/j.bjp.2017.09.004

Rokaya, M.B., Münzbergová, Z. & Timsina, B., 2010, 'Ethnobotanical study of medicinal plants from the Humla district of western Nepal', *Journal of Ethnopharmacology* 130(3), 485–504. https://doi.org/10.1016/j.jep.2010.05.036

Shapi, M., Matengu, K. & Mu Ashekele, H., 2009, *Indigenous knowledge system pilot study – Oshikoto region*, Multidisciplinary Research Centre, University of Namibia, Windhoek.

Shrivastava, A., 2013, 'Ethnomedicinal plants used for treatment of gynecological disorders by tribal of Dindori district of Madhya Pradesh', *International Journal of Pharmacy and Life Science* 40(12), 3185–3189.

Steenkamp, V., 2003, 'Traditional herbal remedies used by South African women for gynaecological complaints', *Journal of Ethnopharmacology* 86(1), 97–108. https://doi.org/10.1016/s0378-8741(03)00053-9

Teklehaymanot, T., 2009, 'Ethnobotanical study of knowledge and medicinal plants use by the people in Dek Island in Ethiopia', *Journal of Ethnopharmacology* 124(1), 69–78. https://doi.org/10.1016/j.jep.2009.04.005

Tugume, P., Kakudidi, E.K., Buyinza, M., Namaalwa, J., Kamatenesi, M., Mucunguzi, P. et al., 2016, 'Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda', *Journal of Ethnobiology and Ethnomedicine* 12(5), 1–28. https://doi.org/10.1186/s13002-015-0077-4

Tumoro, G. & Maryo, M., 2016, 'Determination of informant consensus factor and fidelity level of ethnomedicinal plants used in Misha Woreda, Hadiya Zone, Southern Ethiopia', *International Journal of Biodiversity and Conservation* 8(12), 351–364. https://doi.org/10.5897/IJBC2016.1020

Umair, M., Altaf, M. & Abbasi, A.M., 2017, 'An ethnobotanical survey of indigenous medicinal plants in Hafizabad district, Punjab-Pakistan', *PLoS One* 12(6), e0177912. https://doi.org/10.1371/journal.pone.0177912

Upasania, S.V., Beldarb, V.G., Tatiyab, A.U., Upasanic, M.S., Suranab, S.J. & Patil, D.S., 2017, 'Ethnomedicinal plants used for snakebite in India: A brief overview', *Integrative Medicine Research* 6(2), 114–130. https://doi.org/10.1016/j.imr.2017.03.001

Zhang, L., Zhang, Y., Pei, S., Geng, S., Wang, C. & Yuhua, G., 2015, 'Ethnobotanical survey of medicinal dietary plants used by the Naxi People in Lijiang Area, Northwest Yunnan, China', *Journal Ethnobiology and Ethnomedicine* 11(1), 40. https://doi.org/10.1186/s13002-015-0030-6

Zia-Ul-Haq, M., Stanković, M.S., Rizwan, K. & De Feo, V., 2013, '*Grewia asiatica* L., a food plant with multiple uses', *Molecules* 18(3), 2663–2682. https://doi.org/10.3390/molecules18032663

Zongo, F., Ribuot, C., Boumendjel, A. & Guissou, I., 2013, 'Botany, traditional uses, phytochemistry and pharmacology of Waltheria indica L. (syn. Waltheria americana): A review', *Journal of Ethnopharmacology* 148(121), 14–26. https://doi.org/10.1016/j.jep.2013.03.080