

ETHNOBOTANICAL SURVEY AND THERAPEUTIC POTENTIALS OF SELECTED APOCYNACEAE SPECIES IN ILE-IFE, NIGERIA

**Aiyedatiwa Adepeju Morenike*¹, Owa Seyi Sunday², Dada Caleb Mayokun³, Folorunso,
Abayomi Ezekiel⁴**

¹Department of Botany, Obafemi Awolowo University, Ile-Ife, Osun State.

²IFE Herbarium, Obafemi Awolowo University, Ile-Ife, Osun State.

³Department of Botany, University of Ibadan, Oyo State.

⁴Department of Botany, Obafemi Awolowo University, Ile-Ife, Osun State.

Article Received on 15 Sept. 2026,
Article Revised on 05 October 2026,
Article Published on 16 October 2026,

<https://doi.org/10.5281/zenodo.23432389>

***Corresponding Author**

Aiyedatiwa Adepeju Morenike

Department of Botany, Obafemi
Awolowo University, Ile-Ife, Osun
State.



How to cite this Article: Aiyedatiwa Adepeju Morenike*¹, Owa Seyi Sunday², Dada Caleb Mayokun³, Folorunso, Abayomi Ezekiel⁴. (2026). Ethnobotanical Survey And Therapeutic Potentials Of Selected Apocynaceae Species In Ile-Ife, Nigeria. World Journal of Pharmaceutical Research, 15(20), 1338–1367. This work is licensed under Creative Commons Attribution 4.0 International license.

ABSTRACT

This study investigated the ethnobotanical status and therapeutic potentials of selected medicinal plants in the family Apocynaceae in Ile-Ife, Osun State, Nigeria. The study aimed to document the indigenous medicinal uses of the selected species, identify the plant parts utilized, determine the methods of preparation and routes of administration, and assess their therapeutic importance among local herbal practitioners and herb sellers. Ethnobotanical information was obtained through semi-structured questionnaires, oral interviews, and direct field observations involving knowledgeable informants within the study area. The data collected were analysed using descriptive statistics, while quantitative ethnobotanical indices, including Relative Frequency of Citation (RFC), Use Value (UV), Fidelity Level (FL), and Informant Consensus Factor (ICF), were employed to assess the cultural significance and medicinal

value of the species. Morphological characteristics of the selected species were also examined to facilitate proper identification and taxonomic description.

The results showed that the twelve medicinal species were widely utilized in the treatment of malaria, fever, hypertension, gastrointestinal disorders, skin infections, cough, infertility, rheumatism, and wounds. Leaves and stem bark were the most frequently utilized plant parts,

while decoction was the predominant method of preparation and oral administration was the most common route of application. A high level of agreement among informants demonstrated the continued reliance on these species for primary healthcare within the study area.

The study concludes that the twelve selected medicinal species possess considerable ethnomedicinal and therapeutic importance and remain valuable components of indigenous healthcare systems. The study recommends the conservation of these species and further phytochemical and pharmacological investigations to validate their traditional medicinal uses and promote their sustainable utilization.

KEYWORDS: Apocynaceae, Ethnobotany, Ethnomedicine, Fidelity Level, Use Value, Informant Consensus Factor, Relative Frequency of Citation.

INTRODUCTION

Apocynaceae commonly known as the Dogbane family, is a large and diverse family of flowering plants that include trees, shrubs, herbs, stem succulents, and vines (Endress *et al.*, 2014; APG, 2016). It comprises about 424 genera and over 5,000 species, found primarily in tropical and subtropical regions, with some members in the temperate zones (Mabberley, 2017). The Apocynaceae family consist of 5 subfamilies; Apocynoideae, Asclepiadoideae, Periplocoideae, Rauvolfioideae, Secamonoideae and 25 tribes in it current accepted classification (APG, 2016). The family has worldwide distribution, primarily in tropical and subtropical regions rather than being confined to a single continent (Mabberley, 2017). This wide distribution has contributed to its diverse floral trait, wood evolution, and secondary metabolites in adapting to various environments, particularly dry and disturbed habitats (Ollerton *et al.*, 2019 and Bitencourt *et al.*, 2021).

The most prominent attribute of the Apocynaceae family is the presence of a characteristic milky or clear latex in most species (Endress *et al.*, 2014; Mabberley, 2017). Many members of the family are also known for their therapeutic uses, yielding compounds used in treating various ailments, including cancer and hypertension, while others are sources of potent arrow poisons (Iwu, 2014; van Wyk *et al.*, 2009).

Ethnobotany is the study of people's classification, management, and use of plants. It is defined as "local people's interaction with the natural environment: how they classify, manage and use plant available around them" (Bentjee, 2010). From the beginning of humanity, indigenous people have developed their own locality specific knowledge on plant use, management and conservation (Stevens, 2013). This complex knowledge, systems of beliefs and practices are generally known as indigenous knowledge or traditional knowledge. Indigenous knowledge has developed as a result of human interaction with their environment. In this view, ethnobotanical studies are useful in documenting, analyzing and communicating knowledge and interaction between biodiversity and human society, how diversity in nature is used and influenced by human activities (Solbrig *et al.*, 2011).

Ethnobotany is an interdisciplinary field that examines the interactions between people and plants, with increasing emphasis on its role in healthcare and biodiversity conservation in the 21st century. Recent studies highlight that ethnobotanical research not only documents traditional plant use but also contributes to drug discovery, sustainable resource management, and preservation of indigenous knowledge systems (WHO., 2019; Convention on Biological Diversity, 2020). In developing countries such as Nigeria, a significant proportion of the population relies on medicinal plants for primary healthcare, making ethnobotanical investigations essential for validating traditional practices and identifying bioactive compounds (Iwu, 2014; Sofowora *et al.*, 2013).

Ethnobotany integrate knowledge from Botany, Anthropology, Ecology and Chemistry to study plant related custom across culture. Researchers in this field document, analyze how different societies classify plants for various purposes including medicine, food, religious use, intoxicant, building materials, fuels and Clothings (Rahman, 2009).

Members of the Apocynaceae family are widely utilized in traditional medicine across tropical regions, including Nigeria, where they play an important role in primary healthcare systems. Several species are employed in the treatment of ailments such as malaria, gastrointestinal disorders, infections, and hypertension due to their rich content of bioactive compounds, particularly alkaloids and cardiac glycosides (Iwu, 2014; Endress *et al.*, 2014).

MATERIALS AND METHODS

Study Area

The research was conducted in Obafemi Awolowo University at Ile-Ife, Osun State, Nigeria, which lies on the geographical coordinates 7° 27' 59.99" N and 4° 33' 59.99" E in South West, Nigeria. The study was conducted in Ile-Ife, Osun State, southwestern Nigeria. Plant specimens were collected from selected locations within Obafemi Awolowo University. The project records collection points around the university environment. The recorded coordinates and locations are presented in Table 1.

The field ethnobotanical survey was conducted over a three-month period. Respondents were selected to obtain information from people with knowledge of medicinal plant use, including traditional/local healers, herb sellers, traders, farmers, academic staff and other knowledgeable residents.

Plant Collection, Identification and Voucher Specimens

Fresh and mature specimens of the selected species were collected from the field. Information recorded during collection included botanical name, local name, serial number, locality, habitat and collector. Specimens were prepared for herbarium preservation using standard botanical procedures. The collections were identified and authenticated through the Department of Botany and IFE Herbarium, Obafemi Awolowo University, Ile-Ife. Representative specimens were assigned voucher numbers and deposited in the IFE Herbarium. Relevant floristic literature was also consulted during identification.

Species of Apocynaceae Studied

For the purpose of this study, 12 species of Apocynaceae species studied are:

Alafia barteri Oliv., *Allamanda cathartica* L., *Alstonia boonei* De Wild., *Funtumia elastica* (Preuss) Stapf, *Holarrhena floribunda* (G.Don) T.Durand & Schinz, *Nerium oleander* L., *Plumeria* spp L., *Rauvolfia vomitoria* Afzel., *Tabernaemontana pachysiphon* Stapf, *Thevetia neriifolia* Juss. ex A.DC., *Vinca rosea* (L.) G.Don and *Voacanga africana* Stapf.

Ethnobotanical Survey

Ethnobotanical information was obtained through semi-structured questionnaires and open-ended interviews. The questionnaires included respondents characteristics and questions concerning the selected plant species, local/common names, uses, plants parts utilized, methods of preparation and route of application. A total of 132 respondents participated in

this survey. The approach followed ethnobotanical field methods emphasizing the selection of informants with relevant local knowledge (Martin, 1995; Alexiades and Sheldon, 1996).

Quantitative Ethnobotanical Analysis

The survey data were analyzed using frequency and percentage calculations. Socio-demographic information was summarized descriptively. Four quantitative indices were used to assess the ethnobotanical importance and consensus of the selected species.

Relative Frequency of Citation (RFC): RFC measures the relative prominence of a plant species according to the number of informants who cited it. It was calculated as $RFC = F_c/N$, where F_c is the number of informants who cited a species and N is the total number of informants (Tardío and Pardo-de-Santayana, 2008).

Use Value (UV): UV evaluates the relative importance of a species based on the uses reported by informants. It was calculated as $UV = \sum U_i/N$, where U_i represents the number of uses mentioned by an informant for a species and N is the total number of informants (Tardío and Pardo-de-Santayana, 2008).

Fidelity Level (FL): FL measures the proportion of informants who cited a particular species for a specific ailment category. It was calculated as $FL = N_s/N \times 100$, where N_s is the number of citations of a species for a particular ailment category and N is the total number of citations of that species (Ali-Shtayeh *et al.*, 2000).

Informant Consensus Factor (ICF): ICF was used to evaluate the degree of agreement among respondents regarding medicinal plants used for each ailment category. It was calculated as $ICF = (n_{ur} - n_t)/(n_{ur} - 1)$, where n_{ur} is the number of use reports for an ailment category and n_t is the number of species reported for that category (Garedew and Abebe, 2018).

RESULTS

The GPS coordinates of the location of the Apocynaceae Species Studied are shown in Table 1 while the representative specimen of the Apocynaceae species collected with the voucher numbers and name of collector are shown in Table 2.

Table 1: GPS coordinates and locations of the selected Apocynaceae species studied.

S/N.	Plant Species	GPS Coordinates	Locations
	<i>Alafia barteri</i>	7°31'24"N 4°31'0"E	Front of Health Centre, O.A.U., Ile-Ife
	<i>Allamanda cathartica</i>	7°32'32"N 4°32'37"E	O.A.U. Teaching and Research Farm, O.A.U., Ile-Ife
	<i>Alstonia boonei</i>	7°31'34"N 4°30'32"E	Habotoreum, behind Department of Botany, O.A.U., Ile-Ife
	<i>Funtumia elastica</i>	7°31'9"N 4°31'24"E	Front of Humanities building 1, O.A.U., Ile-Ife
	<i>Holarrhena floribunda</i>	7°31'9"N, 4°31'23"E	Front of Hezekiah Oluwasanmi Library, O.A.U., Ile-Ife.
	<i>Nerium oleander</i>	7°31'7"N, 4°31'42"E	Behind Chemical Engineering Lecture Theatre, O.A.U., Ile-Ife.
	<i>Plumeria spp</i>	7°31'3"N, 4°31'23"E	Behind Faculty of Clinical Sciences.
	<i>Rauvolfia vomitoria</i>	7°30'58"N, 4°31'35"E	Back of Faculty of Pharmacy department., O.A.U., Ile-Ife.
	<i>Tabernaemontana pachysiphon</i>	7°31'11"N, 4°31'34"E	High forest at the back of Botanical Garden.
	<i>Thevetia neriifolia</i>	7°31'11"N, 4°31'34"E	High forest at the back of Botanical Garden.
	<i>Vinca rosea</i>	7°30'35"N, 4°30'35"E	Parks and Garden, O.A.U., Ile-Ife.
	<i>Voacanga africana</i>	7°31'34"N, 4°30'32"E	Habotoreum, behind Department of Botany, O.A.U., Ile-Ife

Table 2: Representatives Specimens Examined in the IFE Herbarium of the Twelve Species Studied.

S/N.	Plants Species	Voucher Number	Collector
1.	<i>Alafia barteri</i>	IFE 18582	Aiyedatiwa Adepeju M.
2.	<i>Allamanda cathartica</i>	IFE 18575	Aiyedatiwa Adepeju M.
3.	<i>Alstonia boonei</i>	IFE 18576	Aiyedatiwa Adepeju M.
4.	<i>Funtumia elastica</i>	IFE 18577	Aiyedatiwa Adepeju M.
5.	<i>Holarrhena floribunda</i>	IFE 18572	Aiyedatiwa Adepeju M.
6.	<i>Nerium oleander</i>	IFE 18573	Aiyedatiwa Adepeju M.
7.	<i>Plumeria spp</i>	IFE 18580	Aiyedatiwa Adepeju M.
8.	<i>Rauvolfia vomitoria</i>	IFE 18574	Aiyedatiwa Adepeju M.
9.	<i>Tabernaemontana pachysiphon</i>	IFE 18581	Aiyedatiwa Adepeju M.
10.	<i>Thevetia neriifolia</i>	IFE 18578	Aiyedatiwa Adepeju M.
11.	<i>Vinca rosea</i>	IFE 18571	Aiyedatiwa Adepeju M.
12.	<i>Voacanga africana</i>	IFE 18579	Aiyedatiwa Adepeju M.

Table 3: Demographic Profile of the Respondents Who took Part in the Ethnobotanical Survey.

S/N.	Variables	Category	Key Informant	General Informant	Total	Frequency
1.	Age range	13-35years	9	15	24	18.18
		36-50years	23	29	52	39.39
		51-65years	20	20	33	25.00
		65years and above	06	17	23	17.42
2.	Gender	Male	32	46	78	59.09
		Female	23	31	54	40.91
3.	Level of Education	None	10	15	25	18.94
		Primary level	13	19	32	24.24
		Secondary level	22	31	53	40.15
		Tertiary level	08	14	22	16.67
4.	Occupation	Trader	06	10	16	12.12
		Local Healer	21	29	50	37.88
		Herb seller	10	13	23	17.42
		Farmer	03	05	08	06.06
		Academic staff	02	02	04	03.03
		Others	11	20	31	23.48

Ethnobotanical Information

Ethnobotanical information for each of the selected species studied, including botanical/scientific name, local or common name, life forms, cultivation status, plant part(s) used, route of application, mode of preparation is presented in Table 4. Data on the local names of these plants, traditional uses were also recorded. Among the species studied, 7 are wild and the other 5 are either wild or cultivated. These five cultivated species include *Thevetia neriifolia*, *Nerium oleander*, *Allamanda cathartica*, *Plumeria* spp, *Vinca rosea*, some of the species can be found growing in the wild (Table 4). Most of the species were recorded to be used for more than one purpose. Among the selected and recorded species, *Nerium oleander* were recorded to be used externally due to its poisonous nature, while other plants can be used for various therapeutic purposes.

Table 4: Ethnobotanical Information of the 12 Species of Apocynaceae Studied.

S/N	Plant's Scientific Name	Plant's Local Name	Plant Habit	Cultivation Status	Uses	Part(s) Used	Route of Application	Mode of Preparation
1	<i>Alafia barteri</i> Oliv.	Agbari etu; Ibo-agba Ota nza	Climbers	Wild	Treatment of malaria and fever; infusion taken for stomach disorders and diarrhea; remedy for cough and rheumatism; treatment of inflammatory conditions; leaf paste applied on wounds and skin infections; Decoction administered for body pains, weakness and parasitic infections.	Leaves Stem Bark	Oral Topical	Decoction Infusion Leaf paste
2.	<i>Allamanda cathartica</i> L.	Ododo allamanda	Shrub	Cultivated	Treatment of malaria; Decoction taken for jaundice and constipation; remedy for intestinal	Leaves Latex	Oral Topical	Decoction Infusion Leaf paste

					worms; treatment of enlarged spleen; leaf preparation applied on skin infections.			
3.	<i>Alstonia boonei</i> De wild.	Ahun; Egbu	Tree	Wild	Treatment of typhoid fever; bark decoction administered for malaria fever; remedy for rheumatism and toothache, intestinal infections; management of fever and generalized body pains.	Stem Bark Leaves	Oral Topical	Decoction Infusion Powder Bark
4.	<i>Funtumia elastica</i> (Preuss) Stapf.	Ireh; Ofruntum	Tree	Wild	Treatment of diarrhea; bark decoction for chest infections and painful menstruation; latex applied on wounds, fungal infections and haemorrhoids; leaf infusion taken for whooping cough; treatment of fever and skin diseases; remedy for respiratory ailments.	Bark Leaves Latex	Oral	Decoction Infusion Latex
5.	<i>Holarrhena floribunda</i> (G.Don) T.Durand and Schinz	Ako-Irene; Bakin itache	Shrub Tree	Wild	Treatment of stomach ache; Decoction taken for dysentery and diarrhea; seed powder and leaf infusion are administered for gastrointestinal disorders; remedy for parasitic infections; management of fever	Bark Seeds Leaves	Oral	Decoction Powder Infusion

6.	<i>Nerium oleander</i> L.	Ododo Aworan	Shrub	Cultivated	Leaf paste applied for the treatment of skin diseases; latex used externally for dermatological conditions.	Leaves Latex	Topical	Leaf paste Latex application
7.	<i>Plumeria</i> spp L.		Tree	Cultivated	Decoction administered for rheumatism and body pain's; treatment of fever and cough; Latex and leaf paste applied on wounds and ulcers; remedy for boils, swellings and inflammatory conditions; treatment of skin infections.	Leaves Latex Bark	Oral Topical	Decoction Infusion Leaf paste
8.	<i>Rauvolfia vomitoria</i> Wennberg	Asofeyeje; Akanta; Wadda	Shrub Tree	Wild	Treatment of hypertension; Decoction taken for insomnia and mental disorders; remedy for nervous disorders; treatment of fever; leaf preparation used against snakebite, management of convulsion and anxiety; sedative agent.	Roots Barks Leaves	Oral	Decoction Powder
9.	<i>Tabernaemontana pachysiphon</i> Stapf.	Abo-dodo; Achi	Shrub	Wild	Leaf infusion is taken for the treatment of fever and cough; Decoction of the bark is administered for diarrhea, ulcer and rheumatic conditions; latex is applied on wounds and skin infections; leaf	Leaves Bark Latex	Oral Topical	Decoction Infusion Latex application

					preparation also used to relieve body weakness and pains; bark extract is employed in the management of inflammatory conditions.			
10.	<i>Thevetia neriifolia</i> Juss. ex A.DC	Olomiojo	Shrub	Cultivated	Treatment of ringworm and eczema; leaf paste applied on itching and skin diseases; latex used on swelling, boils and ulcers; remedy for wounds, inflammatory conditions and rheumatism	Leaves Latex Seeds	Topical	Leaf paste Latex application
11.	<i>Vinca rosea</i> (L.) G.Don	Madagascar periwinkle; Graveyard plant	Herb	Cultivated	Management of diabetes mellitus; treatment of hypertension; remedy for sore throat; infusion administered for leukemia and other cancer-related ailments	Leaves Whole plants	Oral	Decoction Infusion
12.	<i>Voacanga africana</i> Stapf.	Ako-dodo; Sinrin-pin	Tree	Wild	Bark decoction is administered for the treatment of hypertension and nervous disorders; seed preparations are used to alleviate fatigue and physical weakness; leaf infusions is taken for fever and insomnia; remedy for anxiety, epilepsy and convulsive disorder; bark	Bark Seeds Leaves	Oral	Decoction Powder Infusion

					and seed extract are employed in the management of mental illnesses and body pains.			
--	--	--	--	--	---	--	--	--

Relative Frequency of Citation (RFC), Use Value (UV), Fidelity Level (FL) and Informant Consensus Factor (ICF) of the 12 Apocynaceae Species Studied

The Relative Frequency of Citation (RFC), which represents the relative importance of plant species, depends on the number of informant who report the use of the species. In Table 5, the RFC value carried out in this survey ranged from 0.34 to 0.95. The highest RFC value was recorded for *Vinca rosea* (0.95). The lowest RFC value was recorded for *Tabernaemontana pachysiphon* (0.34).

Use value (UV) represents the relative importance of plant species according to the number of uses reported for each plant species. In this survey, use values ranged from 0.01 to 0.09 (Table 5). The highest use value was recorded for *Alafia barteri*. For these species, 121 informant reported 12 traditional uses for *Alafia barteri*. Fidelity level was evaluated based on the number of times a species was cited by an informant to be used as a cure for an ailment category. Fidelity level ranges from 40.20 to 94.70 (Table 5), with *Nerium oleander* having the highest FL value. Only one particular use was reported for the species by the respondents due to its poisonous nature, it is mainly apply on fresh cuts/wound to stop bleeding and facilitate wound healing. High FL values were also recorded for *Voacanga africana* (86.40), *Alstonia boonei* (77.30), *Plumeria* spp (66.70), *Tabernaemontana pachysiphon* (61.40).

This study reported a total of 12 ailment categories. The ailment categories with the highest use reports were infections/infestations (96 citations, 3 species), digestive system disorders (91 citations, 4 species), skin and subcutaneous tissue diseases (84 citations, 5 species), and pain and inflammation (76 citations, 4 species). These ailment categories recorded high Informant Consensus Factor (ICF) values ranging from 0.95 to 0.97, indicating a high level of agreement among the respondents on the medicinal plant species used for their treatment. The highest ICF value (1.00) was recorded for sleep disorder, endocrinal system disorder, and snakebite/poisoning, suggesting complete consensus among the informants regarding the use of the selected Apocynaceae species for these ailments. This was followed by blood system disorders, respiratory system infections, nervous system disorders, injuries and wounds, and musculoskeletal disorders, each with an ICF value of 0.98. Digestive system disorders recorded an ICF value of 0.97, while pain and inflammation and infections/infestations each had an ICF value of 0.96. The least ICF value (0.95) was recorded for skin and subcutaneous tissue diseases, although this still reflects a high level of agreement among the respondents. Overall, the high ICF values obtained in this study indicate strong consensus in the traditional

use of the selected Apocynaceae species for treating the reported ailments, highlighting their ethnomedicinal importance and therapeutic potential (Table 6);

Table 5: Relative Frequency of Citation, Use Value and Fidelity Level of the 12 species of Apocynaceae studied.

S/N	Plant Species	RFC	UV	FL
1.	<i>Alafia barteri</i>	0.92	0.09	58.33
2.	<i>Allamanda cathartica</i>	0.59	0.05	50.80
3.	<i>Alstonia booneii</i>	0.70	0.05	77.30
4.	<i>Funtumia elastica</i>	0.58	0.07	59.85
5.	<i>Holarrhena floribunda</i>	0.64	0.05	40.20
6.	<i>Nerium oleander</i>	0.77	0.01	94.70
7.	<i>Plumeria spp</i>	0.43	0.08	66.70
8.	<i>Rauvolfia vomitoria</i>	0.73	0.06	54.55
9.	<i>Tabernaemontana pachysiphon</i>	0.34	0.08	61.40
10.	<i>Thevetia neriifolia</i>	0.77	0.08	44.70
11.	<i>Vinca rosea</i>	0.95	0.04	52.30
12.	<i>Voacanga africana</i>	0.42	0.08	86.40

Table 6: Informant consensus factor (ICF) values for the different ailment categories.

S/N Ailment Categories	Number of Citations for each Ailment category	Number of Species Reported	Informant Consensus Factor
1. Pain and Inflammation	76	4	0.96
2. Blood system Disorder	48	2	0.98
3. Infections/Infestation	96	3	0.96
4. Respiratory system Disorder	58	2	0.98
5. Skin and Subcutaneous Tissues Diseases	84	5	0.95
6. Sleep Disorder	41	1	1.00
7. Nervous system Disorder	67	2	0.98
8. Digestive system Disorder	91	4	0.97
9. Endocrinal system Disorder	52	1	1.00
10. Injuries and Wound	55	2	0.98
11. Musculoskeletal Disorder	63	2	0.98
12. Snakebite/Poisoning	37	1	1.00



Plate 1: Pictures showing the habits of the Apocynaceae species studied.

A – *Allamanda cathartica* ; B – *Vinca rosea*; C – *Holarrhena floribunda* ; D – *Funtumia elastica* ; E- *Plumeria* spp; F – *Rauvolfia vomitoria*

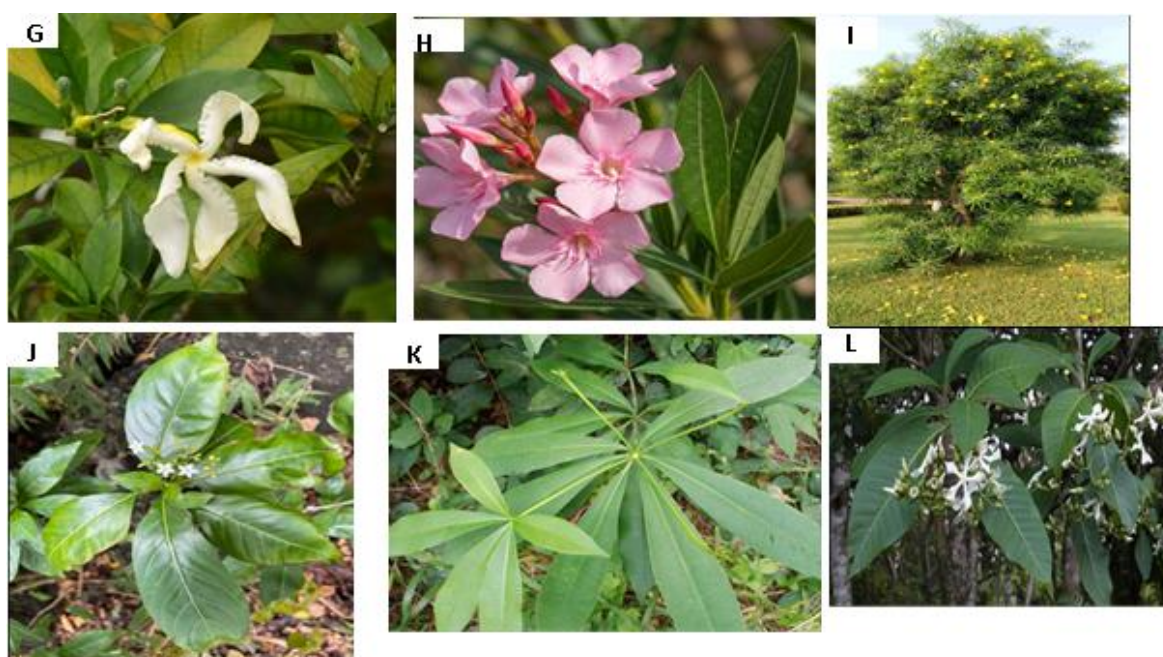


Plate 2: Pictures showing the habits of the Apocynaceae species studied.

G – *Tabernaemontana pachysiphon*; H- *Nerium oleander*; I – *Thevetia neriifolia*; J – *Alafia barteri*; K – *Alstonia booneii*; L- *Voacanga africana*

DISCUSSION

The present ethnobotanical survey demonstrates the considerable medicinal importance of selected members of the family Apocynaceae within the study area. Information obtained from 132 respondents showed that the documented species are traditionally employed in the management of a broad spectrum of human ailments, including malaria, fever, hypertension, diabetes mellitus, gastrointestinal disorders, skin infections, wounds, respiratory conditions, rheumatism, convulsion, insomnia, mental disorders, infertility, and inflammatory conditions. The diversity of therapeutic applications recorded in the present study suggests that Apocynaceae constitutes an important component of the local traditional healthcare system. Similar medicinal significance of Apocynaceae species has been documented in previous ethnobotanical and pharmacological studies (Burkill, 1985; Sofowora, 2008; Iwu, 2014; Salehi *et al.*, 2021; Abdel-Hameed *et al.*, 2022).

The wide range of medicinal applications recorded may be associated with the presence of diverse secondary metabolites reported from members of Apocynaceae. Several species within the family are known to contain biologically active alkaloids and other phytochemical constituents that have attracted considerable pharmacological interest. The traditional use of these plants for conditions such as malaria, inflammation, hypertension, diabetes, and nervous-system disorders therefore provides an important basis for further pharmacological investigation. However, ethnobotanical reports should be regarded as an indication of traditional therapeutic relevance rather than definitive evidence of clinical efficacy.

The study further revealed that ethnomedicinal knowledge was particularly prominent among respondents aged 36–50 years. This finding suggests that medicinal plant knowledge remains strongly associated with individuals who have had prolonged exposure to traditional healthcare practices. Such knowledge is commonly acquired through family and community-based oral transmission, particularly from older generations and traditional herbal practitioners. The observation is consistent with previous reports indicating that traditional plant knowledge may be more extensive among older members of local communities than among younger people. Modernization, urbanization, changing lifestyles, and reduced dependence on traditional healthcare practices may consequently contribute to the gradual loss of indigenous ethnobotanical knowledge (Kunwar *et al.*, 2021; WHO, 2023). Systematic documentation of such knowledge is therefore important for its preservation and potential contribution to future ethnopharmacological research.

The diversity of plant parts used in the preparation of remedies provides additional evidence of the depth of indigenous knowledge associated with the documented species. Leaves were the most frequently utilized plant parts, followed by roots, stem bark, latex, flowers, fruits, seeds, and whole plants. The predominance of leaves is consistent with findings from several ethnobotanical investigations and may be explained by their accessibility, relatively easy collection, and availability in comparison with underground plant parts. In addition, harvesting leaves is generally considered less destructive to individual plants than removing roots or stem bark, which may cause serious damage to plants and increase the risk of overexploitation (Heinrich *et al.*, 2009; Giday *et al.*, 2009; Sofowora, 2008). Nevertheless, the reported use of roots and stem bark warrants conservation attention because intensive harvesting of these parts may negatively affect plant regeneration and long-term population survival.

Decoction was the most frequently reported method of herbal preparation, followed by infusion, maceration, powders, leaf pastes, juices, latex extraction, and direct chewing. The predominance of decoction may reflect the simplicity and familiarity of this preparation method within traditional healthcare practices. Boiling plant materials is traditionally believed to facilitate the extraction of medicinal constituents into water, although the stability and bioavailability of individual phytochemicals may vary according to the plant species and preparation conditions (Heinrich *et al.*, 2009; Iwu, 2014). Oral administration was the principal route of administration recorded in the study, particularly for preparations such as decoctions and infusions. Topical application was mainly associated with wounds, boils, skin infections, ulcers, eczema, rheumatism, and inflammatory conditions, while inhalation was occasionally reported. These patterns demonstrate that preparation and administration practices are closely related to the type of ailment being managed.

The ethnobotanical indices further provide insight into the importance and consistency of the documented medicinal plants. The Informant Consensus Factor (ICF) ranged from 0.95 to 1.00, indicating a high degree of agreement among respondents regarding the plants used for the different ailment categories. The highest ICF value of 1.00 was recorded for sleep disorders, endocrine system disorders, and snakebite/poisoning, whereas the lowest value of 0.95 was recorded for skin and subcutaneous tissue disorders. High ICF values generally indicate substantial agreement among informants concerning the medicinal plants employed for particular categories of ailments and can therefore assist in prioritizing species for further

phytochemical and pharmacological investigations (Trotter and Logan, 1986; Ngoua-Meye-Misso *et al.*, 2019; Asiimwe *et al.*, 2014). The high overall consensus recorded in this study suggests that the therapeutic applications of the documented species are relatively well established within the local knowledge system.

The Relative Frequency of Citation (RFC) values ranged from 0.34 to 0.95, indicating variation in the popularity and recognition of the documented species among respondents. *Vinca rosea*, *Alafia barteri*, *Nerium oleander*, *Thevetia neriifolia*, and *Rauvolfia vomitoria* recorded the highest RFC values, suggesting that these species are particularly well known and frequently utilized within the study area. In contrast, *Tabernaemontana pachysiphon*, *Voacanga africana*, and *Plumeria* spp. recorded comparatively lower RFC values. Differences in RFC may reflect variations in plant availability, cultural preference, familiarity, medicinal applications, and the frequency with which individual species are encountered or utilized by members of the community (Faruque *et al.*, 2018). Species with lower citation frequencies should not necessarily be regarded as less medicinally important, since low citation may also reflect restricted availability or specialized uses.

The Fidelity Level (FL) values obtained in the study ranged from 40.20% to 94.70%. *Nerium oleander*, *Voacanga africana*, and *Alstonia boonei* exhibited the highest FL values, while *Holarrhena floribunda* recorded the lowest. Higher FL values indicate a greater proportion of respondents associating a particular plant species with the treatment of a specific ailment and may therefore reflect greater therapeutic specificity within the local healthcare system (Bouasla and Bouasla, 2017; Shil *et al.*, 2014). The relatively high FL values observed for some species suggest that particular plant–ailment associations are strongly established within the community. Conversely, lower FL values may reflect the use of a species for several unrelated ailments or limited agreement concerning its principal therapeutic application. Such species nevertheless remain worthy of investigation because poorly documented or less frequently cited medicinal plants may contain valuable therapeutic compounds and may also be vulnerable to loss of indigenous knowledge (Malik *et al.*, 2018). The Use Value (UV) of the documented species ranged from 0.01 to 0.09. Differences in UV indicate variation in the number and frequency of medicinal uses attributed to individual species. Species with higher UVs were associated with relatively greater use within the medicinal categories documented in the study. However, UV is influenced by cultural preferences, availability, knowledge distribution, and changes in medicinal plant utilization

over time and should therefore be interpreted within the specific cultural and ecological context of the study area (Camou-Guerrero *et al.*, 2008; Musa *et al.*, 2011). The relatively low use values recorded for some species may also be associated with their limited availability. In particular, the low use value observed for *Nerium oleander* may partly reflect concerns regarding its recognized toxicity, which could limit its use and availability within the community.

Several of the documented species demonstrated notable multipurpose medicinal applications. *Rauvolfia vomitoria* and *Voacanga africana* were reported for the management of hypertension, insomnia, mental illness, nervous disorders, and convulsion. These traditional applications are of particular pharmacological interest because members of these taxa contain indole alkaloids that have been associated with neuroactive and cardiovascular effects (Burkill, 1985; Iwu, 2014; Kuete, 2013). The consistency between traditional applications and reported pharmacological properties supports the value of ethnobotanical knowledge as a guide for selecting plants for further scientific investigation.

Vinca rosea was also of considerable medicinal importance in the present study, particularly in relation to diabetes mellitus and cancer-related conditions. The pharmacological significance of this species is well established, especially because of its production of the vinca alkaloids vincristine and vinblastine, which have important applications in modern cancer chemotherapy (Noble, 1990; van der Heijden *et al.*, 2004). Its documentation in the present ethnobotanical survey further demonstrates the potential relationship between traditional medicinal knowledge and the identification of pharmacologically valuable plant resources.

Alstonia boonei was frequently reported for malaria, fever, rheumatism, body pains, and inflammatory conditions. Its repeated citation for these ailments is consistent with previous pharmacological reports describing antimalarial, analgesic, anti-inflammatory, and antimicrobial activities associated with the species (Burkill, 1985; Iwu, 2014; Olajide *et al.*, 2000). The convergence between the ethnobotanical findings and previous pharmacological evidence provides further support for prioritizing *A. boonei* for detailed phytochemical and biological investigations.

Despite their medicinal importance, some of the documented species require particular attention because of their potential toxicity. *Nerium oleander* and *Thevetia neriifolia* were

recognized in the study as medicinally useful species with considerable toxicological concerns. Their therapeutic use therefore requires appropriate knowledge of preparation, dosage, and administration, particularly because improper use may result in adverse effects (El-Seedi *et al.*, 2021; Langford and Boor, 2020; Salehi *et al.*, 2021). This finding highlights the importance of integrating ethnobotanical documentation with toxicological studies before traditional preparations are promoted for wider therapeutic use.

Beyond their medicinal applications, several documented species possess ornamental, economic, and ecological importance. *Allamanda*, *Plumeria* spp., and *Nerium oleander*, for example, are valued for their attractive flowers and are commonly cultivated as ornamental plants. Such multipurpose value may influence the conservation status and continued cultivation of these plants within local communities. The combination of medicinal and ornamental importance may therefore provide an opportunity for promoting cultivation as an alternative to excessive harvesting from natural populations.

The findings of this study also emphasize the importance of conservation and sustainable utilization of medicinal plant resources. The increasing pressure associated with deforestation, habitat destruction, agricultural expansion, urbanization, and indiscriminate harvesting may threaten the availability of some medicinal species. Particular attention should be given to species from which roots and stem bark are harvested because removal of these organs may have greater consequences for plant survival than leaf harvesting. Sustainable collection practices, cultivation, domestication, and community-based conservation could therefore contribute to maintaining the availability of Apocynaceae species while preserving the indigenous knowledge associated with their therapeutic uses.

Overall, the ethnobotanical evidence obtained in this study demonstrates that the selected Apocynaceae species remain important components of traditional healthcare within the study area. The high ICF values, variation in RFC, FL and UV, diversity of medicinal applications, and correspondence between some traditional uses and previously reported pharmacological properties collectively indicate substantial ethnomedicinal potential. Nevertheless, traditional use alone cannot establish therapeutic efficacy or safety. Further phytochemical, pharmacological, toxicological, and clinical investigations are required to identify active constituents, determine mechanisms of action, establish appropriate dosage ranges, and evaluate the safety of the documented medicinal species. The present findings therefore

provide a useful ethnobotanical basis for prioritizing selected Apocynaceae species for future scientific research and possible development of standardized herbal preparations.

CONCLUSION

The ethnobotanical data gathered from this study revealed that selected Apocynaceae species are valuable medicinal plants with diverse traditional uses in the study area. The findings provide useful information for ethnomedicinal studies and further pharmacological research. The study also highlights the need for proper conservation and sustainable utilization of these medicinal plant species to ensure their continued availability.

ACKNOWLEDGEMENTS

The authors are grateful to the Head, Department of Botany, the IFE Herbarium, Department of Botany, Obafemi Awolowo University, Ile-Ife, and to the people of the study area for their cooperation during the ethnobotanical survey.

AUTHORS' CONTRIBUTIONS

All authors contributed to the study conception and design, field data collection, analysis and interpretation of the findings, manuscript preparation, critical revision of the manuscript, and approval of the final version.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

REFERENCES

1. Adebayo, J. O., & Krettli, A. U. (2011). Potential antimalarials from Nigerian plants: A review. *Journal of Ethnopharmacology*, 133(2): 289–302.
2. Adewunmi, C. O., Ojewole, J. A. O., & Adesina, S. K. (1990). Traditional medicine and indigenous knowledge in Nigeria. *Fitoterapia*, 61(3): 193–198.
3. Adotey, J. P. K., Adukpo, G. E., Opoku Boahen, Y., & Armah, F. A. (2012). A review of the ethnobotany and pharmacological importance of *Alstonia boonei*. *ISRN Pharmacology*, 2012; 587160.
4. Adjanohoun, E. J., Ahyi, M. R. A., Ake-Assi, L., Dramane, K., Elewude, J. A., Fadoju, S. O., Gbile, Z. O., Goudote, E., Johnson, C. L. A., Keita, A., Morakinyo, O., Ojewole, J. A. O., Olatunji, A. O., & Sofowora, E. A. (1991). Contribution to ethnobotanical and

- floristic studies in West Africa: *Traditional medicine and pharmacopoeia*. Organization of African Unity/Scientific, Technical and Research Commission.
5. Agyare, C., Spiegler, V., Sarkodie, H., Asase, A., Liebau, E., & Hensel, A. (2014). An ethnopharmacological survey and in vitro confirmation of ethnopharmacological use of medicinal plants used for wound healing in Bosomtwi-Atwima-Kwanwoma area, Ghana. *Journal of Ethnopharmacology*, 153(3): 742–752.
 6. Ajibesin, K. K. (2011). Ethnopharmacological survey of medicinal plants used in the Niger Delta region of Nigeria. *Journal of Medicinal Plants Research*, 5(7): 1105–1112.
 7. Akah, P. A., Nnamani, C. E., & Nworu, C. S. (2009). Medicinal plants used in the traditional treatment of malaria: A review. *Journal of Ethnopharmacology*, 126(3): 287–302.
 8. Akerele, O. (1988). Medicinal plants and primary health care: An agenda for action. *Fitoterapia*, 59(5): 355–363.
 9. Akinmoladun, A. C., Ibukun, E. O., Afor, E., Obuotor, E. M., & Farombi, E. O. (2007). Phytochemical constituent and antioxidant activity of extract from the leaves of *Alstonia boonei*. *African Journal of Biotechnology*, 6(10): 1197–1201.
 10. Alexiades, M. N., & Sheldon, J. W. (1996). Selected guidelines for ethnobotanical research: A field manual. New York Botanical Garden.
 11. Ali-Shtayeh, M. S., Yaniv, Z., & Mahajna, J. (2000). Ethnobotanical survey in the Palestinian area: A classification of the healing potential of medicinal plants. *Journal of Ethnopharmacology*, 73(1–2): 221–232.
 12. Angiosperm Phylogeny Group. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society*, 181(1): 1.
 13. Asase, A., Akwetey, G. A., & Achel, D. G. (2010). Ethnopharmacological use of herbal remedies for the treatment of malaria in Ghana. *Journal of Ethnopharmacology*, 129(3): 367–376.
 14. Ayensu, E. S. (1978). *Medicinal Plants of West Africa*. Reference Publications Inc.
 15. Bandara, V., Weinstein, S. A., White, J., Eddleston, M., & Fernando, R. (2010). A review of the natural history, toxicology, diagnosis and clinical management of *Thevetia peruviana* poisoning. *Toxicon*, 56(3): 273–281.
 16. Benz, B. F., Cevallos, J., Santana, F., Rosales, J., & Graf, S. (1994). Losing knowledge about plant use in the Sierra de Manantlán Biosphere Reserve, Mexico. *Economic Botany*, 48(4): 343–355.

17. Bhadane, B. S., Patil, M. P., Maheshwari, V. L., & Patil, R. H. (2018). Ethnomedicinal, phytochemical and pharmacological aspects of *Catharanthus roseus*: A review. *Journal of Integrative Medicine*, 16(5): 302–310.
18. Bruneton, J. (1999). *Pharmacognosy, phytochemistry and medicinal plants* (2nd ed.). Intercept Ltd.
19. Burkill, H. M. (2000). *The Useful Plants of West Tropical Africa* (2nd ed., Vol. 5). Royal Botanic Gardens, Kew.
20. Calixto, J. B. (2000). Efficacy, safety, quality control, marketing and regulatory guidelines for herbal medicines. *Brazilian Journal of Medical and Biological Research*, 33(2): 179–189.
21. Camou-Guerrero, A., Reyes-García, V., Martínez-Ramos, M., & Casas, A. (2008). Knowledge and use value of plant species in a Rarámuri community. *Human Ecology*, 36(2): 259–272.
22. Ceuterick, M., Vandebroek, I., Torry, B., & Pieroni, A. (2008). Cross-cultural adaptation in urban ethnobotany. *Journal of Ethnobiology and Ethnomedicine*, 4: 21.
23. Convention on Biological Diversity. (2020). *Global Biodiversity Outlook 5*. Secretariat of the Convention on Biological Diversity.
24. Cordell, G. A. (2000). Biodiversity and drug discovery—A symbiotic relationship. *Phytochemistry*, 55(6): 463–480.
25. Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, 12(4): 564–582.
26. Cragg, G. M., & Newman, D. J. (2013). Natural products: A continuing source of novel drug leads. *Biochimica et Biophysica Acta (BBA) - General Subjects*, 1830(6): 3670–3695.
27. Dalziel, J. M. (1937). *The Useful Plants of West Tropical Africa*. Crown Agents for the Colonies.
28. Eddleston, M., Ariaratnam, C. A., Meyer, W. P., *et al.* (1999). Epidemic of self-poisoning with yellow oleander in Sri Lanka. *The Lancet*, 354(9191): 1908–1911.
29. Ekor, M. (2014). The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in Pharmacology*, 4: 177.
30. Endress, M. E., Liede-Schumann, S., & Meve, U. (2014). An updated classification for Apocynaceae. *Phytotaxa*, 159(3): 175–194.
31. Elisabetsky, E. (1991). Sociopolitical, economical and ethical issues in medicinal plant research. *Journal of Ethnopharmacology*, 32(1–3): 235–239.

32. Endress, M. E., Liede-Schumann, S., & Meve, U. (2014). An updated classification of Apocynaceae. *Phytotaxa*, 159(3): 175–194.
33. Erharuyi, O., Falodun, A., & Langer, P. (2014). Medicinal uses, phytochemistry and pharmacology of *Voacanga africana*. *Journal of Ethnopharmacology*, 155(1): 14–23.
34. Evans, W. C. (2009). *Trease and Evans' Pharmacognosy* (16th ed.). Saunders Elsevier.
35. Ezuruike, U. F., & Prieto, J. M. (2014). The use of plants in the traditional management of diabetes in Nigeria: Pharmacological and toxicological considerations. *Journal of Ethnopharmacology*, 155(2): 857–924.
36. Fabricant, D. S., & Farnsworth, N. R. (2001). The value of plants used in traditional medicine for drug discovery. *Environmental Health Perspectives*, 109(Suppl. 1): 69–75.
37. Farnsworth, N. R. (1994). Ethnopharmacology and drug development. In *Ethnobotany and the Search for New Drugs* (Ciba Foundation Symposium 185, pp. 42–59). John Wiley & Sons.
38. Farombi, E. O. (2003). African indigenous plants with chemotherapeutic potentials. *African Journal of Biotechnology*, 2(12): 662–671.
39. Fishbein, M., Livshultz, T., Straub, S. C. K., Simões, A. O., Boutte, J., McDonnell, A., & Endress, M. E. (2018). Apocynaceae. In J. W. Kadereit and V. Bittrich (Eds.), *The Families and Genera of Vascular Plants* (Vol. 15). Springer.
40. Garedew, A., & Abebe, T. (2018). Ethnobotanical study of medicinal plants and quantitative analysis using ICF. *Journal of Ethnobiology*, 14(2): 45–58.
41. Gurib-Fakim, A. (2006). Medicinal plants: Traditions of yesterday and drugs of tomorrow. *Molecular Aspects of Medicine*, 27(1): 1–93.
42. Harborne, J. B. (1998). *Phytochemical methods: A guide to modern techniques of plant analysis* (3rd ed.). Chapman & Hall.
43. Heinrich, M., Barnes, J., Gibbons, S., & Williamson, E. M. (2018). *Fundamentals of pharmacognosy and phytotherapy* (3rd ed.). Elsevier.
44. Heinrich, M., Edwards, S., Moerman, D. E., & Leonti, M. (2009). Ethnopharmacological field studies: A critical assessment. *Journal of Ethnopharmacology*, 124(1): 1–17.
45. Heinrich, M. (2000). Ethnobotany and its role in drug development. *Phytotherapy Research*, 14(7): 479–488.
46. Hostettmann, K., Marston, A., Ndjoko, K., & Wolfender, J. L. (2000). The potential of African plants as a source of drugs. *Current Organic Chemistry*, 4(10): 973–1010.
47. Hutchinson, J., & Dalziel, J. M. (2014). *Flora of West Tropical Africa*. Royal Botanic Gardens, Kew.

48. Ibrahim, J. A., Muazzam, I., Jegede, I. A., Kunle, O. F., & Okogun, J. I. (2007). Ethnomedicinal plants and methods used by Gwandara tribe of Nigeria. *African Journal of Traditional, Complementary and Alternative Medicines*, 4(2): 211–218.
49. IUCN. (2019). *The IUCN Red List of Threatened Species*. International Union for Conservation of Nature.
50. Iwu, M. M. (2014). *Handbook of African medicinal plants* (2nd ed.). CRC Press.
51. Jain, S. K. (1991). *Dictionary of Indian folk medicine and ethnobotany*. Deep Publications.
52. Jones, A. (2014). Community participation in biodiversity conservation. *Environmental Conservation*, 41(3): 215–223.
53. Judd, W. S., Campbell, C. S., Kellogg, E. A., Stevens, P. F., & Donoghue, M. J. (2016). *Plant systematics: A phylogenetic approach* (4th ed.). Sinauer Associates.
54. Kamboj, V. P. (2000). Herbal medicine. *Current Science*, 78(1) : 35–39.
55. Kokwaro, J. O. (2009). *Medicinal plants of East Africa* (3rd ed.). University of Nairobi Press.
56. Kuete, V. (Ed.). (2014). *Medicinal Plant Research in Africa: Pharmacology and Chemistry*. Elsevier.
57. Kuete, V., & Efferth, T. (2010). Cameroonian medicinal plants: Pharmacology and derived natural products. *Frontiers in Pharmacology*, 1: 123.
58. Kumar, A., Shukla, R., Singh, P., & Dubey, N. K. (2013). *Rauvolfia serpentina*: A review of its ethnobotany, phytochemistry and pharmacology. *Journal of Medicinal Plants Research*, 7(30): 2149–2157.
59. Langford, S. D., & Boor, P. J. (1996). Oleander toxicity: An examination of human and animal poisoning. *Toxicology*, 109(1): 1–13.
60. Lautenschläger, T. (2022). The genus *Landolphia* P. Beauv. (Apocynaceae): A comprehensive review on its ethnobotanical utilizations, pharmacology and nutritional potential. *Journal of Ethnopharmacology*.
61. Lemmens, R. H. M. J., & Bunyapraphatsara, N. (2003). *Plant Resources of South-East Asia No. 12: Medicinal and Poisonous Plants* 3. Backhuys Publishers.
62. Lobay, D. (2015). *Rauvolfia* in the treatment of hypertension and anxiety. *Integrative Medicine*, 14(3): 40–46.
63. Mabberley, D. J. (2017). *Mabberley's Plant-book* (4th ed.). Cambridge University Press.

64. Magallón, S., Gómez-Acevedo, S., Sánchez-Reyes, L. L., & Hernández-Hernández, T. (2015). A metacalibrated time-tree documents the early rise of flowering plant phylogenetic diversity. *New Phytologist*, 207(2): 437–453.
65. Mahomoodally, M. F. (2013). Traditional medicines in Africa: An appraisal of ten potent African medicinal plants. *Evidence-Based Complementary and Alternative Medicine*, 2013; 617459.
66. Martin, G. J. (1995). *Ethnobotany: A Methods Manual*. Chapman & Hall.
67. Mukaila, Y. O., Koyejo, A. O., & Aremu, A. O. (2023). An ethnobotanical study of medicinal plants used to treat and manage diabetes mellitus in Ede, Osun State, Nigeria. *Ethnobotany Research and Applications*, 26: 1–22.
68. Mukaila, Y. O., Koyejo, A. O., & Aremu, A. O. (2021). A quantitative analysis of medicinal ethnobotany of Ile-Ife, Osun State, Nigeria. *Journal of Ethnobiology and Ethnomedicine*, 17: 1–20.
69. Mukaila, Y. O., Oladipo, O. T., & Ajao, A. A. (2022). Ethnobotanical documentation of indigenous medicinal plants in Ile-Ife, Osun State. *Asian Journal of Ethnobiology*.
70. Musa, M. S., Abdelrasool, F. E., Elsheikh, E. A., Ahmed, L. A., Mahmoud, A. L., & Yagi, S. M. (2011). Ethnobotanical study of medicinal plants in Sudan. *Journal of Ethnopharmacology*, 137(1): 82–92.
71. Nair, R., & Chanda, S. (2007). Antibacterial activities of medicinal plants of Western India. *Turkish Journal of Biology*, 31(4): 231–236.
72. Ncube, B., Afolayan, A. J., & Okoh, A. I. (2008). Assessment techniques of antimicrobial properties of natural compounds of plant origin: Current methods and future trends. *African Journal of Biotechnology*, 7(12): 1797–1806.
73. Newman, D. J., & Cragg, G. M. (2016). Natural products as sources of new drugs. *Journal of Natural Products*, 79(3): 629–661.
74. Odelade, E. T., Olaleye-Otunla, O. J., Alabi, D. M., Ogunlowo, I. I., & Folorunso, A. E. (2024). Ethnobotanical study of twenty species in the family Asteraceae in Ile-Ife, Southwestern Nigeria. *Ife Journal of Science*, 26(1): 69–90.
75. Odugbemi, T. (Ed.). (2008). *A Textbook of Medicinal Plants from Nigeria*. University of Lagos Press.
76. Oliver, B. (1960). *Medicinal Plants in Nigeria*. Nigerian College of Arts, Science and Technology.

77. Owolabi, M. S., Ogundajo, A. L., Lajide, L., Oladimeji, M. O., Setzer, W. N., & Palazzo, M. C. (2018). Chemical composition and antimicrobial activity of essential oils from selected Nigerian medicinal plants. *Natural Product Communications*, 13(3): 397–400.
78. Oyen, L. P. A. (2008). *Plant Resources of Tropical Africa 11: Medicinal Plants 1*. PROTA Foundation.
79. Pandey, M. M., Rastogi, S., & Rawat, A. K. S. (2013). Indian traditional Ayurvedic system of medicine and nutritional supplementation. *Evidence-Based Complementary and Alternative Medicine*, 2013; 376327.
80. Patil, R. H., Patil, M. P., & Maheshwari, V. L. (2023). Apocynaceae Plants: *Ethnobotany, Phytochemistry, Bioactivity and Biotechnological Advances*. Springer.
81. Phillipson, J. D. (2001). Phytochemistry and medicinal plants. *Phytochemistry*, 56(3): 237–243.
82. Pirker, H., Haselmair, R., Kuhn, E., Schunko, C., & Vogl, C. R. (2012). Transformation of traditional ethnobotanical knowledge. *Journal of Ethnobiology and Ethnomedicine*, 8: 7.
83. Quattrocchi, U. (2012). *CRC World Dictionary of Medicinal and Poisonous Plants*. CRC Press.
84. Ragasa, C. Y., & Cornelio, K. B. (2013). Triterpenes from Plumeria species and their biological activities. *Journal of Applied Pharmaceutical Science*, 3(11): 132–136.
85. Rahman, M. M., & Singhal, K. C. (2015). Pharmacological and phytochemical review of Rauvolfia serpentina. *International Journal of Pharmaceutical Sciences Review and Research*, 31(2): 185–192.
86. Rahman, A. H. M. M. (2009). Ethno-botanical knowledge and medicinal plant use. *Journal of Medicinal Plants Research*, 3(9): 597–604.
87. Rates, S. M. K. (2001). Plants as source of drugs. *Toxicon*, 39(5): 603–613.
88. Saranya, S., Ramasubbu, R., Prasannan, P., & Surendran, A. (2021). A comprehensive review on ethnobotany, phytochemistry and pharmacology of Rauvolfia L. (Apocynaceae). *The Botanical Review*, 87: 311–376.
89. Sarker, S. D., Latif, Z., & Gray, A. I. (2006). *Natural Products Isolation* (2nd ed.). Humana Press.
90. Schmelzer, G. H., & Gurib-Fakim, A. (Eds.). (2008). *Plant Resources of Tropical Africa 11(1): Medicinal Plants 1*. PROTA Foundation.
91. Schmelzer, G. H., & Gurib-Fakim, A. (Eds.). (2013). *Plant Resources of Tropical Africa 11(2): Medicinal Plants 2*. PROTA Foundation.

92. Simões, A. O., Endress, M. E., Conti, E., & Livshultz, T. (2007). Phylogeny and systematics of Apocynaceae. *Annals of the Missouri Botanical Garden*, 94(2): 324–359.
93. Simmonds, M. S. J. (2005). Importance of medicinal plants in drug discovery. *Journal of Ethnopharmacology*, 100(1–2): 72–79.
94. Sofidiya, M. O., Odukoya, O. A., Familoni, O. B., & Inya-Agha, S. I. (2007). Free radical scavenging activity of some Nigerian medicinal plant extracts. *Pakistan Journal of Biological Sciences*, 10(8): 1336–1339.
95. Sofowora, A. (2008). *Medicinal Plants and Traditional Medicine in Africa* (3rd ed.). Spectrum Books Limited.
96. Sonibare, M. A., & Gbile, Z. O. (2012). Ethnobotanical survey of anti-asthmatic medicinal plants in Southwestern Nigeria. *Nigerian Journal of Natural Products and Medicine*, 16: 56–63.
97. Steentoft, M. (1988). *Flowering Plants in West Africa*. Cambridge University Press.
98. Stevens, P. F. (2013). Indigenous knowledge and biodiversity conservation. *Plant Systematics and Evolution*, 299(4): 729–742.
99. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant Physiology and Development* (6th ed.). Sinauer Associates.
100. Tardío, J., & Pardo-de-Santayana, M. (2008). Cultural importance indices: A comparative analysis based on useful wild plants of Southern Cantabria. *Economic Botany*, 62(1): 24–39.
101. Taylor, D. A. H. (2005). *Medicinal Natural Products: A Biosynthetic Approach* (3rd ed.). John Wiley and Sons.
102. Taylor, L. (2005). *The Healing Power of Rainforest Herbs*. Square One Publishers.
103. Taylor, J. L. S., Rabe, T., McGaw, L. J., Jäger, A. K., & Van Staden, J. (2001). Towards the scientific validation of traditional medicinal plants. *Plant Growth Regulation*, 34(1): 23–37.
104. Udayan, P. S., & Balachandran, I. (2009). *Medicinal Plants of the World*. CBS Publishers.
105. Van der Heijden, R., Jacobs, D. I., Snoeijs, W., Hallard, D., & Verpoorte, R. (2004). The *Catharanthus* alkaloids: Pharmacognosy and Biotechnology. *Current Medicinal Chemistry*, 11(5): 607–628.
106. Van Wyk, B. E., Van Oudtshoorn, B., & Gericke, N. (2009). *Medicinal Plants of South Africa* (2nd ed.). Briza Publications.
107. Verdcourt, B. (2001). *Flora of Tropical East Africa: Apocynaceae*. A. A. Balkema.

108. Verpoorte, R. (1998). Exploration of nature's chemodiversity: The role of secondary metabolites as leads in drug development. *Drug Discovery Today*, 3(5): 232–238.
109. Verpoorte, R., Choi, Y. H., & Kim, H. K. (2005). Ethnopharmacology and System Biology: A perfect holistic match. *Journal of Ethnopharmacology*, 100(1–2): 53–56.
110. Wagner, H., & Bladt, S. (2009). *Plant Drug Analysis: A Thin Layer Chromatography Atlas* (2nd ed.). Springer.
111. Wink, M. (2015). Modes of action of herbal medicines and plant secondary metabolites. *Medicines*, 2(3), 251–286. World Health Organization. (1999). WHO Monographs on Selected Medicinal Plants (Vol. 1). World Health Organization.
112. World Health Organization. (2002). WHO Traditional Medicine Strategy 2002–2005. World Health Organization. World Health Organization. (2013). WHO Traditional Medicine Strategy 2014–2023. World Health Organization. World Health Organization. (2019). WHO Global Report on Traditional and Complementary Medicine 2019. World Health Organization.
113. World Health Organization. (2019). *WHO Global Report on Traditional and Complementary Medicine 2019*. World Health Organization.
114. Yineger, H., Kelbessa, E., Bekele, T., & Lulekal, E. (2008). Plants used in traditional medicine by the Oromo people. *Journal of Ethnopharmacology*, 116(2): 290–301.