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Ethnobotanical Assessment of Medicinal Plants for Snakebite Management in Kebbi State, Nigeria

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ABSTRACT

Background and Objective: Snakebite envenoming causes essential mortality and morbidity and is among the leading health problems in Nigeria, especially in rural areas. Aim: This research work was aimed at conducting an ethnobotanical survey of medicinal plants used for the management of snakebite in Kebbi State, Nigeria. **Materials and Methods:** The study was conducted within Kebbi State, Nigeria. Respondents with knowledge of medicinal plants for snakebites were accessed via informants and acquaintance. Data were also retrieved from hunters, herbalist and snake charmers. Demographic characteristics, personal information of respondents, information on plants used, mode of preparation and administration were also collected via oral interview. **Results:** Twenty six individuals all male consented to disclose information and knowledge regarding plants and formulations used in the treatment or management of snakebite injuries within Kebbi State, all the respondents were male (100%), with 3.85% under 30 years, 38.46% aged 31-50, and 57.69% over 50 years. Respondent practicing both herbalism and snake charming were (19.23%), while respondents practicing only snake charming (57.69%) and hunters only (23.08%). Information on the occupation of respondents who agreed to disclose information about antisnake-venom medicinal plants was also recorded. Twenty seven medicinal plants from 12 different families were document in this study.The plants mode of preparation, administration and part used which are majorly roots, are disclosed by respondents within Kebbi State for the treatment of snakebite envenoming. The fidelity level of plants ranges between 22.22-88.88, and high informants consensus factor (ICF) between (0.85-1) for all the disease categories. **Conclusion:** The present study documented twenty seven medicinal plants used by herbalist, snake-charmers and hunters for snakebites treatment in Kebbi State, the cited plant also revealed high informant consensus factor and Fidelity level.

KEYWORDS

Ethnobotanical survey, medicinal plants, snakebite, Kebbi State, Nigeria

INTRODUCTION

Snakebite envenoming causes morbidity and mortality and is among the leading health issues in Nigeria, especially in rural areas[1]. It was estimated that around 435,000 to 580,000 snakebites incidences occur in Africa annually with an urgent need for treatment[2]. According to Odin *et al.*[3], over 497/100,000 incidences

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of snakebite occur annually with over 12.2% estimated death in Savannah Region of Northern Nigeria. Envenoming often occurs in rural communities, low- and middle-income countries with more prevalence in women, children and farmers. Countries with poor health system and limited medical resources have the highest burden of snakebite envenomation[4]. Snakebite envenoming leads to complications like local tissue damage, necrosis, hemorrhage, cytotoxicity, nephrotoxicity which are not tackled by conventional antivenins. Hence, it's essential to search for medicinal plants with antivenom properties[5].

Although no available plant-derived antivenom in Nigerian markets presently, it is a usual phenomenon to witness snake charmers regularly playing with different types of dangerous snakes in gatherings and during festivities[6]. These snake charmers claim to have effective cure of snakebites envenomation using plant remedies. Therefore these claims gives positive expectation for high possibilities of documenting effective and wider-spectrum plant antivenom for the management of common poisonous snakes found in the Northern parts of Nigeria[7].

Medicinal plants have played vital role as alternative to modern medicine mainly due to their affordability, accessibility and acceptability as well as efficacies in managing several illnesses such as microbes related, cancer, and hyperglycemia and snake envenoming and several others[8]. Indeed, recent ethno-botanical data have pinpoint numerous plants used for treating diseases in several regions of Nigeria[9].

Kebbi State is located in Northwestern Nigeria, with an ancient history bestowed with abundant medicinal plants[10]. It has over three million eight hundred people across four emirates comprising of Argungu Gwandu, Yauri and Zuru[11]. Since ancient time these emirates are violent free and there is peaceful co-existence between them. Majority of these people especially rural dwellers depend on folklore medicines for acute and chronic diseases and have been evidently effective for long period of time[12].

This research was designed to identify plants and herbal formulations used to treat snakebite envenoming by herbalist in Kebbi State. Furthermore, the expectation from this study is to reveal limited documented plants that could serve as potential sources of novel venom neutralizing agent from natural sources.

MATERIALS AND METHODS

Study area: The ethno-botanical study was conducted within the four emirates of Kebbi State consisting of Argungu, Zuru, Yauri, and Gwandu Emirates (Fig. 1). The emirates consist mainly of the Hausa-Fulani tribe (Argungu and Gwandu Emirates), Gungawa (Yauri Emirates) and Dakarkari (Zuru Emirates). The majority of the people are farmers, traders and practice the Islamic religion. The location (latitude and longitude) of Kebbi State, Nigeria, is 12.4376°N, 4.2078°E. It shares common borders with Niger State to the Southwest and to the East is Sokoto State. The North West is by Niger Republic[13].

The landscape is predominantly flat with slight undulations, featuring compact, stony brown soil. In Kebbi State, the vegetation is classified as Savannah. There are two primary seasons: The dry season, which extends from November to April, and the rainy season, occurring from May to October. The harmattan period spans from November to January, marked by significant fog, dust, and cooler temperatures. Notably, March and April are the warmest months, with minimum temperatures ranging from 38 to 42°C in November. During the harmattan months (December to February), temperatures decrease, averaging between 20 and 23°C, with humidity levels fluctuating between 17% and 80%[14].

Survey sampling technique: A convenience sampling technique and a strategized method which involved disclosing previous cited plants to subsequent respondent and observed their judgments was adopted in this study[15]. Ethical approval was obtained from the local authorities and was conducted

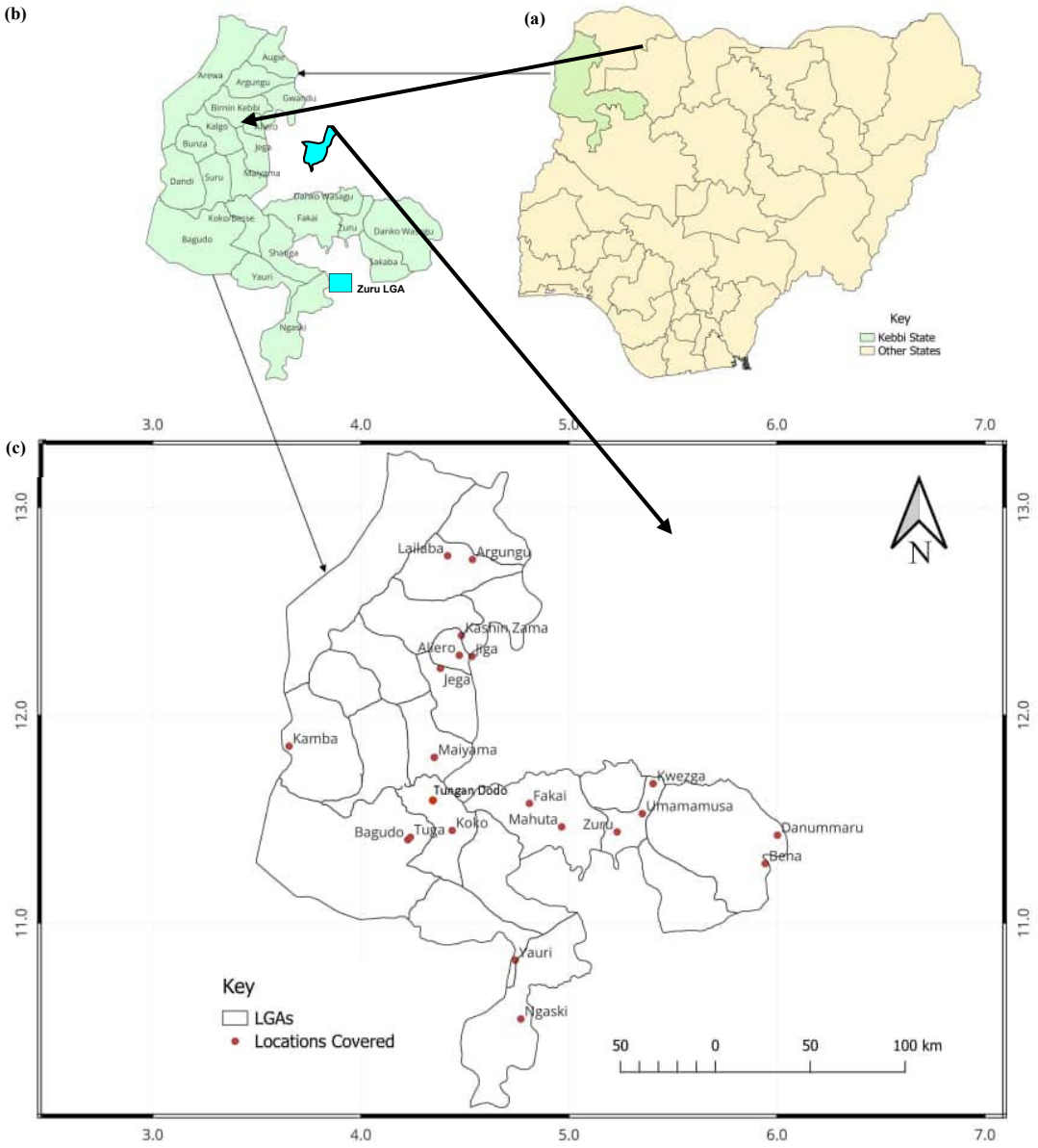

Fig.1(a-b): Geographical map of the survey study area, (a) Kebbi State location in Nigeria, (b) Kebbi State Local Governments and (c) Location of LGA and specific surveyed areas covered

according to International Society for Ethnobiology's code of ethics. The importance of the study was disclosed to the respondents and only respondents who agreed to give their consent voluntarily were interviewed. The survey was conducted in Kebbi State, Nigeria and was structured within four emirates kingdoms comprising of Gwandu, Zuru, Argungu, and Yauri Emirates.

Data collection: The participants employed for this study were approached with the help of informants and acquaintances. Demographic data and a survey on suitable plants were identified through herbalists, snake charmers, and hunters in Kebbi State, Nigeria. The data collection process spanned a duration of eight months (February 2023-September 2023). Consenting herbal medicine and snake-charming practitioners, and hunters were orally interviewed after obtaining consent. Information on the plant's local name, parts of the plant used, procedure of preparation, dosage, and mode of administration was documented. Analysis of the collected data was done according to the protocol previously described by Malami *et al.*[16]. Online literature via PubMed, Google Scholar and Scopus was consulted for anti-venom activities of the cited plants with the view of obtaining reports on their anti-snake venom activities.

Plant collection and identification: All the plants documented from the ethno-botanical survey were collected and identified by a taxonomist. Afterwards, voucher numbers were assigned and placed in the herbarium of Abdullahi Fodio University of Science and Technology, Aliero, and Federal University Birnin Kebbi, Kebbi State, Nigeria. The identification of the plant names was verified using the World Flora Online.

Criteria for selection

Inclusion criteria: Only areas or locations with prior information of the presence of herbalist snake-charmers and hunters were visited. The plants selected for antivenom screening were selected based on limited validity, frequency of citation, and low toxicity profile.

Exclusion criteria: Places or locations with records of insecurity were excluded. Herbalists, snake-charmers, and hunters who were not willing to participate were also excluded.

Data analysis: Data collected on the medicinal plants and plant formulations used in treating snakebite envenoming, information on demography were tabulated, categorized and analysed using descriptive statistics via Microsoft word. The frequency of citation (%) was calculated as previously described by Segun *et al.*[17] (a) While fidelity level (FL) was calculated as described by Ugulu[18] and (b) Similarly, informant consensus factor (ICF) was as described by Trotter and Logan[19].

$$\text{Frequency (\%)} = \frac{\text{Number of informant tha cited the species}}{\text{Total number of informants}} \times 100 \quad (1)$$

$$\text{Fidelity level} = \frac{\text{No of informant tha claimed use of particular species for a particular disseases}}{\text{Total no of informan citing the species for any disease}} \times 100 \quad (2)$$

$$\text{Informant consensus factor} = \frac{N_{ur} - N_t}{N_{ur} - 1} \quad (3)$$

where, N_{ur} number of use-reports in each disease category, N_t number of species used for that use category. ICF values range between 0 and 1, where 1 indicates the highest level of respondents' consensus on the species to be used in the treatment within a category of illness.

RESULTS AND DISCUSSION

Demographic data of respondents: Twenty six individuals agreed to disclose information and knowledge regarding plants and formulations used in treating or managing snakebites within Kebbi State. All the respondents were males (100%) among whom one person was less than thirty years of age (3.85%), while ten respondents were between the age of 31-50 years (38.46%). The majority, fifteen respondents were above fifty years (57.69%) (Table 1).

Table 1: Demographic data of respondents

Biodata	Frequency	Percentage (%)
Gender		
Male	26	100
Female	0	0
Total	26	100
Age distribution (Years)		
≤30	1	3.85
31-50	10	38.46
≥51	15	57.69

Occupational status of respondents: The occupational data of the respondents who agreed to disclose information on anti-venom medicinal plants is as follows: A total of five respondents practice both herbalism and snake charming (19.23), while fifteen respondents practice only snake charming (57.69), and six respondents were hunters (23.08%).

Medicinal plants used for the treatment of snakebite injuries in Kebbi State: Twenty seven plants which include *Mitragyna inermis* (Wild.) Kuntze, *Mimosa pudica* L, *Hyphaene thebaica* (Del.) Mart, *Borassus aethiopum* Mart., *Annona senegalensis* Pers., *Combretum geitonophyllum* (Hutch. and Dalziel)., *Combretum lamprocarpum* Diels., *Thaumatococcus daniellii* (Benn.) Benth. ex Eichler, Sclerocarya birrea (A.Rich.) Hochst, *Parkia biglobosa* (Jacq.) R.Br. ex G.Don, *Crinum ornatum* (Aiton) Herb., *Pleurotus tuber-regium* (Fr.) Singer, *Cuscuta campestris* Yunck., *Sterculia setigera* Delile, *Galinsoga parviflora* Cav., *anne microcarpa* Engl. and K. Krause, *Strychnos spinosa* Lam., *Diospyros mespiliformis* Hochst. ex A.DC., *Faidherbia albida* (Delile) A.Chev, Terminalia avicenoides Guill. and Perr., *Bauhinia rufescens* Lam., *Newbouldia laevis* (P.Beauv.) Seem. ex Bureau, *Indigofera astragalina* DC., *Ficus platyphylla* Delile, Azadirachta indica A. Juss, Catunaregam nilotica (Stapf) Tirveng and *Blighia sapida* K.D.Koenig were disclosed by the respondents within Kebbi State for the treatment of snakebite envenoming. The voucher specimen, number of citation, part of plant used, Local Government were the plant was cited, the ethnic group of respondents, citation frequency and ranking are presented in Table 2.

The mode of preparation of the cited plants, mode of administration, part used and reports of published research on anti-snake venom are presented in Table 3. All the plant parts mentioned are majorly roots, followed by leaves and then stem-barks.

The fidelity level of plants used for treating snakebite envenoming in Kebbi State, Nigeria is presented in (Table 4). *Annona senegalensis* Pers., *Thaumatococcus daniellii* (Benn.) Benth. ex Eichler, *Crinum ornatum* (Aiton) Herb., and *Galinsoga parviflora* Cav. Has the highest fidelity level of 88.88, 77.77, 77.77 and 75 respectively. Apart from there usage in managing snakebite envenoming these plants also have other medicinal applications which include; diabetes and hypertension, wounds, sores and vomiting as well as skin diseases management.

Table 5 presents the informants consensus factor (ICF) of medicinal plants used for the treatment of snakebite envenoming in Kebbi State, Nigeria. The result shows high informants consensus factor (ICF) (0.85-1) for all the disease categories outlined in this study including neglected tropical parasitic diseases, blood and cardiovascular disorders. brain disorders, gastro-intestinal tract (GIT) disorders, general health conditions (GHC), skeletomuscular disorders, skin and hair disease, throat and respiratory diseases, poison infection due to stings/bites, metabolic disorders and urogenital disorders implying strong consensus between respondents who mentioned specific plant species used in the treatment of those ailments.

Globally, there are prominent herbal practices for curing snakebite envenoming by traditionalist. The effective use of plants in folklore for treating snakebites is primarily due to their low toxicity profile, cultural preferences, effectiveness, and affordability[34]. Many people of Kebbi State are mostly farmers and hunters with quality knowledge and a history of folkloric medicine[35].

In the present study, analysis disclosed that over thirty-eight percent (38%) of the respondents were between 31-50 years of age, while the majority of the respondent, fifty-seven percent (57%) were above 50 years. Also, the source of knowledge of anti-snake medicinal plants is majorly inherited. The present findings is in-line with the report of Maga *et al*.[36] who also found that, the traditional healers in Kebbi State are majorly aged between 50 years and above and the mode by which they obtain the knowledge is mostly inheritance.

Table 2: Medicinal plants used for the treatment of snakebite envenoming in Kebbi State, Nigeria

S/N	Local names (Hausa)	Common names	Botanical names	Family	NC	PU	VN	EG	LG	RFC	R
1	Giyya		*Mitragyna inermis* (Wild.) Kuntze	Rubiaceae	6	R	Ksusta/psb/h/ voucher no:s.n	H	G	23.08	8
2	Kama walkin ka	Touch-me-not	*Mimosa pudica* L	Fabaceae	11	WP	Ksusta/psb/h/ voucher no:s.n	H	G	42.31	4
3	Kaba/goruba	Doum palm	*Hyphaene thebaica* (Del.) Mart	Arecaceae	4	L	Ksusta/psb/h/ voucher no:s.n	H/D	G/Z	15.38	10
4	Giginya	African fan palm	*Borassus aethiopum* Mart.	Arecaceae	6	R	Ksusta/psb/h/ voucher no:s.n	H/D	G/Z	23.08	8
5	Gwandar daji	Wild custard apple	*Annona senegalensis* Pers.	Annonaceae	16	R	Ksusta/psb/ h/504A	H/G/D	A/G/Y/Z	61.54	1
6	Farar tarabniya	Banyun kignat bagid white	*Combretum geitonophyllum* (Hutch. and Dalziel).	Combretaceae	6	R	Ksusta/psb/ h/311A	D	Z	23.08	8
7	Jar tarbniya	Banyun kignat bagid red	*Combretum lamprocarpum* Diels.	Combretaceae	4	R	FUBK/H/155	D	Z	15.38	10
8	Dan dawon mashaya	Miracle Berry	*Thaumatococcus daniellii* (Benn.) Benth. ex Eichler	Marantaceae	7	R	Ksusta/psb/h/ voucher no:s.n	D/H	Z/G	26.92	7
9	Doruwa	African locust bean	*Parkia biglobosa* (Jacq.) R.Br. ex G.Don	Leguminosae	5	SB	Ksusta/psb/h/281	D/H/G	A/G/Y/Z	19.23	9
10	Loda	Marula	Sclerocarya birrea (A.Rich.) Hochst	Anacardiaceae	8	L/R	Ksusta/psb/h/114A	H/D	A/G/Z	30.77	6
11	Albasan-Kura	Crimum	*Crinum ornatum* (Aiton) Herb.	Amaryllidaceae	7	B	Ksusta/psb/h/ voucher no:s.n	D/H	G/Z	26.92	7
12	Katala		*Pleurotus tuber-regium* (Fr.) Singer	Pleurotaceae	9	R	Ksusta/psb/h/ voucher no:s.n	D	Z	34.62	5
13	A'a kayi ka fita	Dodder	*Cuscuta campestris* Yunck.	Convolvulaceae	6	WP	Ksusta/psb/h/ voucher no:s.n	D/H/G	A/G/Y/Z	23.08	8

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Table 2: Continue

S/N	Local names (Hausa)	Common names	Botanical names	Family	NC	PU	VN	EG	LG	RFC	R
14	Kukkuki	Karaya gum Tree	*Sterculia setigera* Delile	Malvaceae	15	SB	Ksusta/psb/h/83B	D/H/G	A/G/Y/Z	57.69	2
15	Gwafta	gallant soldier	*Galinsoga parviflora* Cav. Ta	Asteraceae	6	SB	Ksusta/psb/h/ voucher no:s.n	D/H/G	G/Y/Z	23.08	8
16	Farun kura	African grape	*Strychnos spinosa* Lam.	Loganiaceae	3	L/SB	Ksusta/PSB/H/ Voucher No: S.N	D	Z	11.54	11
17	Kokiya	Natal orange	*Diospyros mespiliformis* Hochst. ex A.DC.	Ebenaceae	3	SB	Ksusta/PSB/H/ Voucher No: S.N	D/G	Z/Y	11.54	11
18	Kaiwa / Kanya	Jackalberry	*Faidherbia albida* (Delile) A.Chev.	Fabaceae	12	SB	Ksusta/PSB/H/182	D/H/G	A/G/Y/Z	46.15	3
19	Gawo	Winter thorn	*Terminalia avicennioides* Guill. & Perr.	Combretaceae	11	R	Ksusta/PSB/H/319	D/H/G	A/G/Z	42.31	4
20	Bawa / Baushe	Bambara tree	*Bauhinia rufescens* Lam.	Fabaceae	4	R/L	Ksusta/PSB/H/ Voucher No: S.N	D/G	Z/Y	15.38	10
21	Jirga	Silver butterfly tree	*Newbouldia laevis* (P. Beauv.) Seem. ex Bureau	Bignoniaceae	9	R	Ksusta/PSB/H/253	D/H/G	A/G/Y/Z	34.61	5
22	Aduruku	Boundary tree	*Strychnos spinosa* Lam.	Loganiaceae	3	L	Ksusta/PSB/H/ Voucher No: S.N	D/G	Z/Y	11.54	11
23	Masahi	Silky indigo	*Indigofera astragalina* DC.	Fabaceae	4	WP	Ksusta/PSB/H/SN	D/G	Z/Y	15.38	10
24	Gamji	Broad-leaf fig	*Ficus platyphylla* Delile	Moraceae	5	SB	Ksusta/PSB/H/2691	H/D/G	G/Z/Y	19.23	9
25	Dogon yaro	Neem tree	*Azadirachta indica* A. Juss	Meliaceae	11	L	Ksusta/PSB/H/61	D/H/G	A/G/Y/Z	42.31	4
26	Tsibra	Catunaregam	*Catunaregam nilotica* (Stapf) Tirveng.	Rubiaceae	4	R	Ksusta/PSB/H/SN	D/G	Z/Y	15.38	10
27	Gwanja kusa	Akee apple	*Blighia sapida* K.D. Koenig	Sapindaceae	3	R	Ksusta/PSB/H/ Voucher No: S.N	D	Z	11.54	11

Local name: Hausa language, VN: Voucher number, LG: Local government (A: Argungu, G: Gwandu, Y: Yauri and Z: Zuru), EG: Ethnic group (H: Hausa, G: Gungawa and D: Dakarkari), PU: Parts Used (R: root, SB: Stembark, L: Leaves, HP: Whole plant, B-Bud), NC: Number of citation, FC: Frequency of citation and R: Ranking

Table 3: Herbal formulations and preparation used for treating snakebite envenoming in Kebbi State, Nigeria

S/N	Botanical names	Part of the plant used	Mode of preparation	Mode of administration	RPRAV
1	*Mitragyna inermis* (Wild.) Kuntze	Root	Boiled in water and drink the juice	A cup Orally administered three times daily	No report
2	*Mimosa pudica* L.	Whole plant	Grand into powder and mixed either with milk or pap	Orally administered once	Meenatchisundaram and Michael[20], and Sia *et al.*[21]
3	*Hyphaene thebaica* (Del.) Mart	Leaf	Grand into powder and mixed either with milk or pap	Orally administered once	No report
4	*Borassus aethiopum* Mart.	Root	Grand into powder and mixed either with milk or pap	Orally administered once daily, until fully recovered	Sarkiyayi *et al.*[22]
5	*Annona senegalensis* Pers.	Root	Ground into powder and mixed with water	Orally administered once daily until recovery.	Emmanuel *et al.*[23]
6	*Combretum geitonophyllum* (Hutch. and Dalziel).	Root	Ground into powder and mixed either with milk or pap	Orally administered once	No report
7	*Combretum lamprocarpum* Diels.	Root	Ground into powder and mixed either with milk or pap	Orally administered once	No report
8	*Thaumatococcus daniellii* (Benn.) Benth. ex Eichler	Root	Ground into powder and mixed water	Orally administered once daily until recovery	No report
9	*Parkia biglobosa* (Jacq.) R.Br. ex G.Don	Stem bark	Boiled in hot water	Drink the juice frequently until recovered	Asuzu and Harvey[24] and Hassan *et al.*[25]
10	*Sclerocarya birrea* (A.Rich.) Hochst	Leaf, Root	Squeeze and extract the juice	Drink half a cup daily until recovered	No report
11	*Crinum ornatum* (Aiton) Herb.	Bud	Extract the bud	Drink the juice once daily until fully recovered	No report
12	*Pleurotus tuber-regium* (Fr.) Singer	Root	boiled the root with potash	And drink the juice 2 cups daily until fully recovered	No report

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Table 3: Continue

S/N	Botanical names	Part of the plant used	Mode of preparation	Mode of administration	RPRAV
13	*Cuscuta campestris* Yunck.	Whole plant	Extract the whole plant	Filter and drink the Juice	No report
14	*Sterculia setigera* Delile	Stem bark	Powdered stem bark mixed with milk	Administered orally	Liaqat *et al.*[26] and Sani *et al.*[27]
15	*Galinsoga parviflora* Cav. Tab	Stem bark	Powdered stem bark mixed in milk	Administered orally	No report
16	*Lannea microcarpa* Engl. and K. Krause	Leaf/stembark	Soaked in water and drink the juice	Administered orally	No report
17	*Strychnos spinosa* Lam.	Stem bark	Powdered stem bark soaked in hot water	Administered orally	No report
18	*Diospyros mespiliformis* Hochst. ex A.DC.	Stem bark	Powdered stem bark soaked in hot water	Administered orally	Sani *et al.*[28]
19	*Faidherbia albida* (Delile) A.Chev	Root	Powdered root soaked in hot water	Administered orally	No report
20	Terminalia avicenoides Guill. and Perr.	Root/leaves	Powdered	Apply to the wound area	Zanna *et al.*[29]
21	*Bauhinia rufescens* Lam.	Root	Powdered root soaked in hot water	Administered orally	Sani *et al.*[30]
22	*Newbouldia laevis* (P. Beauv.) Seem. ex Bureau	Leaves	Powdered leaves soaked in hot water	Administered orally	Gbolade *et al.*[31]
23	*Indigofera astragalina* DC.	Whole plant	Boiled in water (decoction)	Administered orally	No report
24	*Ficus platyphylla* Delile	Stem bark	Powdered and mixed with water, pap, or milk	Administered orally	No report
25	*Azadirachta indica* A. Juss	Leaves	Leaves squeezed or pounded to extract juice	Juice administered orally and applied to wound area	Mukherjee *et al.*[32]
26	*Catunaregam nilotica* (Stapf) Tirveng.	Root	Powdered root mixed with pap	Administered orally	Salihu *et al.*[33]
27	*Blighia sapida* K.D. Koenig	Root	Boiled in water; prepared as decoction	Administered orally	No report

RPRAV: Reports of Published Research on anti-snake venom

Table 4: Fidelity level of the cited plants

Plant species	Others medicinal uses	N_p	N	FL (%)
Mitragyna inermis (Wild.) Kuntze	Diarrhea, dysentery, cholera and malaria	6	11	54.54
Mimosa pudica L.	Urogenital disorders, Piles, Dysentery	11	18	61.11
Hyphaene thebaica (Del.) Mart	Hypertension	4	7	57.14
Borassus aethiopum Mart.	Bronchitis, Sore throats and Asthma	6	12	50
Annona senegalensis Pers.	Skin diseases.	16	18	88.88
Combretum geitonophyllum (Hutch. and Dalziel).	Analgesic and diuretic	6	15	40
Combretum lamprocarpum Diels.	Urinary tract infections	4	13	30.77
Thaumatococcus daniellii (Benn.) Benth. ex Eichler	Stomach ache and diarrhea	7	9	77.77
Parkia biglobosa (Jacq.) R.Br. ex G.Don	Hypertension	5	18	27.77
Sclerocarya birrea (A.Rich.) Hochst	Diarrhea and antidiabetic	8	16	50
Crinum ornatum (Aiton) Herb.	Wounds, sores and vomiting	7	9	77.77
Pleurotus tuber-regium (Fr.) Singer	Headache and stomach pain	9	13	69.23
Cuscuta campestris Yunck.	Strengthen sexual power	6	11	54.54
Sterculia setigera Delile	Diarrhea and epilepsy, anemia	15	23	65.22
Galinsoga parviflora Cav.	Malaria, and flu	6	8	75
Lannea microcarpa Engl. and K. Krause	Hypertension	3	7	42.86
Strychnos spinosa Lam.	Hypertension and diabetes	3	8	37.5
Diospyros mespiliformis Hochst. ex A.DC.	Malaria and headaches	12	17	70.59
Faidherbia albida (Delile) A.Chev	Diarrhea	11	23	47.82
Terminalia avicennoides Guill. and Perr.	Inflammation	4	18	22.22
Bauhinia rufescens Lam.	Gout and diarrhea	9	15	60
Newbouldia laevis (P.Beauv.) Seem. ex Bureau	Convulsion and epilepsy	3	8	37.5
Indigofera astragalina DC.	Wounds and digestive disorders	4	7	57.14
Ficus platyphylla Delile	Epilepsy	5	19	26.32
Azadirachta indica A. Juss	Leprosy and malaria	11	22	50
Catunaregam nilotica (Stapf) Tirveng	Inflammation and Leprosy	4	10	40
Blighia sapida K.D.Koenig	Diabetes and hypertension	3	7	42.85

N_p= no of informant that claimed use of particular species for a particular diseases, N= total no of informant citing the species for any disease

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Table 5: Informants consensus factor (ICF) of medicinal plants used for the treatment of snakebite envenoming in Kebbi State, Nigeria

Disease categories	Some recorded ailments	No. of Species (N_t)	No. of Use-Report (N_{ut})	ICF
Neglected tropical parasitic diseases	Human African Trypanosomiasis, Malaria, Onchocerciasis	4	25	0.88
Blood and cardiovascular disorders	Anemia Bleeding, Heart burns, Stroke, High Blood Pressure	5	30	0.86
Brain disorders	Migraine, Psychotic disorders, Epilepsy, Convulsions etc	3	23	0.91
Gastro-intestinal tract (GIT) disorders	Diarrhoea, Liver Infections, Pancreas Problems, Dysentery, Dyspepsia, Gallbladder, Stomach Pains, Typhoid, Oedema, Cholera, Ulcer etc	6	61	0.92
General health conditions (GHC)	Headache, Pains, Sun Burns, Allergies, Fevers, Flu, Colds, Vomiting, Cough, weakness and Appetite lost	7	60	0.89
Skeletomuscular disorders	Muscle, Joint, Bones pain, Rheumatism	1	6	1.00
Skin and hair diseases	Eczema, Acne, Ringworm, allergies	2	15	0.93
Throat and respiratory diseases	Asthma and Pneumonia, Ear, Lungs, Eyes Nose and oral Infections,	1	6	1.00
Poison infection due to stings/bites	Scorpion and snake envenoming	27	185	0.86
Metabolic disorders	Diabetes, Gaucher's Diseases etc	3	14	0.85
Urogenital disorders	Reproductive and Urinary Tract track infections	2	15	0.93

N_t: Number of species used for that category, N_{ur}: Number of use-reports in each disease category and ICF: Informant consensus factor

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The utilization of medicinal plants in indigenous systems of medicine for snakebite treatment and the present ethno-botanical study revealed huge repository of plants reported in the management of snakebite envenoming by herbal practitioners and hunters in Kebbi State. Researchers reported that therapeutic potential of plants used for managing snakebites is attributed to the presence of different phytochemicals[37]. In the present survey, roots, leaves, and bark are the most commonly used plant parts for the management of snakebite envenoming, with roots being particularly predominantly used, this is in agreement with the findings of Giovannini and Howes[38] who also reported that root are the most frequently used part of plants used to manage snakebite envenoming. Additionally, plants used for antivenom treatment in the present study are often prepared through powders, infusions, decoctions, and juices, and were orally administered with only one plant mentioned to be applied topically in addition to oral administration. Hence this study documented that majority of the herbal preparations used for treating snakebite envenoming are administered orally. This is in-line with the report of Okot *et al.*[39] who stated that most of the herbal medicines (62.5%) were prepared for oral administration.

Fidelity level (FL) in ethno-botanical studies measures the preference of a plant species for treating a specific ailment[40]. A high fidelity level close to (100%) is an indication of strong preference for that plant species for a particular ailment. However, a low fidelity level signifies the use of a particular specie for several illnesses[41]. In the present study, all the cited plant species revealed Fidelity levels between 88.88-22.22%, revealing that all the cited plant species were not only used to manage snakebite envenoming, but are also used to manage several illness.

The Informant Consensus Factor (ICF) is used to assess the level of agreement or homogeneity among informants regarding the use of plants for specific ailments, it has value that ranges from 0 to 1[42]. A high ICF value close to 1 reveals a strong agreement among informants regarding the use of specific plants for a particular ailment. While a lower value suggests fewer consensuses[43]. The high ICF values observed in this study were an indication of significant agreement between the informants and the uses of these plants for the specific ailments.

CONCLUSION

This study documented several medicinal plants used by herbalists, snake-charmers and hunters for snakebite treatment in Kebbi State, Nigeria. Acknowledging Kebbi State as a Region with abundant medicinal plants with vast pharmacological applications. These medicinal plants play a crucial role in snakebite management, particularly in rural and underserved areas where conventional antivenom is often unavailable and expensive. Therefore further studies on scientific validation and pharmacological exploration of these plants are recommended.

SIGNIFICANCE STATEMENT

This study provides important ethnobotanical documentation of medicinal plants used in the management of snakebite envenoming in Kebbi State, Nigeria. It highlights indigenous knowledge held by herbalists, hunters, and snake charmers, which remains largely undocumented and at risk of loss. The findings reveal a rich diversity of plant species with high informant consensus, indicating strong traditional agreement on their therapeutic relevance. This work contributes to the preservation of traditional knowledge and provides a scientific basis for further pharmacological investigation of potential plant-derived antivenom agents, particularly in resource-limited rural settings where conventional antivenom is often inaccessible.

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