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Ethnomedicinal Survey of Plants Used for Pain and Inflammation Management Among Indigenous Tribes in Maiduguri, Borno State, Nigeria

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ABSTRACT

Background and Objective: The use of medicinal plants for treating and management of pains and inflammations as well as other diseases in Nigeria and other African countries is gaining popularity This study aimed at surveying the traditional medicinal plants among the Indigenous tribes in Maiduguri metropolis, Borno State, Nigeria to treat and manage pains and inflammations. **Materials and Methods:** An ethnomedicinal survey was carried out from January to October, 2024 among randomly selected 48 traditional medical practitioners and herbal healers using both oral interviews and semi-structured questionnaires for the identification of medicinal plants known for their pain-relieving and anti-inflammatory properties. **Results:** The current study showed that there are 48 plant species belonging to various families used for treating pain and inflammations in traditional medicine by various Indigenous tribes in the Maiduguri metropolis. Among these families, plants belonging to Fabaceae, Combretaceae, and Apocynaceae families were the most frequently used in pain and inflammation treatments. Plant species such as *Boswellia dalzielii* and *Azadirachta indica* were identified as the most prevalent in pain and inflammation cases in traditional medicine. The leaves and stembarks were the most used parts for pains and inflammations within the metropolis especially among the Kanuri, Hausa, and Shuwa-Arab tribes. However, 64% of these plants are collected directly from the wild, raising concerns about sustainability. **Conclusion:** The study shows that many plant species are used for treating pain and inflammation among tribes in Maiduguri. The Fabaceae family was the most frequently used among all the plants surveyed while leaves decoction was the mode of preparation. The study recommends conservation initiatives, community-driven cultivation programs, and further scientific research to validate the efficacy of these plants.

KEYWORDS

Pains, inflammation, Maiduguri, fabaceae, medicinal plants, traditional medicine

INTRODUCTION

The ethnomedicinal survey is a systematic study or research method used to gather information on the traditional medical practices, health beliefs, and healing systems of specific communities or cultural groups.

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People have been using ethnomedicine, a multidisciplinary system that uses plants, animals, and the natural environment to heal for thousands of years[1].

Traditional medicine is so deeply ingrained in culture that individuals continue to seek the adviceof traditional healers even in urban area with contemporary medical facilities[1].

Traditional medicine is being fostered by WHO particularly in countries where Orthodox medicine is not accessible to a large population due to economic reasons.Nigeria is a land of diversity with a great variety of medicinal plants, unlike India, China, and Vietnam where herbal traditional medicines have been researched, developed, and integrated with the formal healthcare system. The situation in Nigeria is that many of the plants or remedies utilized in traditional medicine have not been subjected to any scientific study to validate their uses[2].

The experience of pain signals that there is an issue within the body. Pain and inflammation are likely connected through cyclooxygenase (COX) enzymes, particularly COX2, which facilitate the production of prostaglandins (PGs), specifically PGE2 and PGF2a, that are present in high levels at sites of inflammation[3]. The released prostaglandins can either activate pain receptors directly or enhance their sensitivity to other pain-inducing substances like histamine, 5-hydroxytryptamine (5HT), and bradykinin, which trigger nerve cells to transmit electrical pain signals to the brain. This review aims to explore the treatment strategies employed in managing pain and inflammation, as well as the animal models utilized to assess the analgesic and anti-inflammatory effects of herbal plants[4]. Herbal medicine has been promoted because it is readily available, cost-effective, easily accessible, and generally has few or no associated side effects.

Plants used in traditional medicine offer a diverse array of natural compounds that can help fight infectious diseases. These botanical remedies have been part of healing practices for generations, showcasing not only the rich cultural knowledge behind their use but also their potential effectiveness in supporting health[5]. In communities where the healing power of medicinal plants is still valued, there is a rich tradition of knowledge being passed down through generations. This collective wisdom about how to harness the properties of these plants to combat various diseases continues to grow, nurtured by the experiences and practices of those who rely on nature's remedies. As people share their stories and insights, they contribute to a deeper understanding of how these plants can support health and well-being, creating a lasting legacy of natural healing[6]. Over 80% of people globally depend on traditional medicine as their main form of healthcare[7]. Additionally, among the 150 most commonly used medications in the US, 57% included at least one key compound that is either currently derived from plants or was derived from plants in the past[6]. This underscores the importance of ethnomedicinal studies for both future generations and the pharmaceutical industry in the pursuit of developing new medications.

Recently, the World Health Organization (WHO) estimated that 80% of people worldwide rely on herbal medicines for some aspects of their primary healthcare needs. According to WHO, around 21,000 plant species have the potential to be used as medicinal plants[8]. Many scholars and scientists have highlighted the importance and potential of medicinal plants as a source of new therapeutic agents. Diseases and ailments are among the prevailing factors that hinder the healthy existence of man. The search for new drugs of plant origin could improve the treatment of disease and the healthcare delivery system.

Efforts in the identification and collection of data on traditional medicines used for the treatment of pains and inflammation among the Indigenous people of the Maiduguri metropolis are essential for preserving

traditional medical knowledge and enhancing the healthcare system. By documenting medicinal plants and their usage, this ethnomedical survey can contribute to sustaining traditional practice and improving the overall quality.

The study aimed to survey the medicinal plants used by the Indigenous tribes in Maiduguri metropolis, Borno State, Nigeria for the treatment of pains and inflammation and to promote the conservation of the data associated with these plants.

MATERIALS AND METHODS

Study location: Maiduguri is the capital of Borno State, located in Northeastern Nigeria, and lies between Latitudes 100 N and 140 N and Longitudes 11030 'E and 14045 'E. It is the largest state in Nigeria by land area, covering 61,435 km^2. The state occupies most of the Chad Basin and shares international borders with the Republic of Niger to the North, Chad to the Northeast, and Cameroon to the East. Domestically, Borno State is bordered by Adamawa to the South, Yobe to the West, and Gombe to the Southwest. The state's population was recorded as 4,151,193 in the National census, with a population density of about 60 inhabitants per square kilometer[9]. Current estimates suggest the population has now grown to over 5 million people. Borno State experiences a variation in the length of the rainy season due to its diverse topography. In general, the Northern part of the state experiences rainfall from June to September, while the Southern part has a longer wet season, stretching from May to October. The relative humidity averages around 40%, and annual evaporation is approximately 203 mm. The state is divided into two major vegetation zones: The Sahel in the North, where desert encroachment is prevalent in the Chad Basin, and the Sudan Savannah in the South, characterized by scrubby vegetation interspersed with tall woodlands. The study area, Maiduguri in Northeastern Nigeria, is a city located about 800 km Northeast of the Federal Capital Territory, Abuja. The dominant ethnic groups are Kanuri, Babur-burah, Shuwa Arab, and Hausa. As in other metropolitan cities, the pull factors of urbanization brought many people from other parts of the country to Maiduguri, resulting in ethnic diversity which among others also includes those of Igbo and Yoruba origins, the other two major ethnic groups in Nigeria. It is a border town between the Cameroon and the Chad Republics. As in other parts of the country, the incidence of pain and inflammation are among the major public health problems of the area.

Study sampling: Systematic random and survey sampling designs were used. The 48 traditional medicine practitioners from Indigenous ethnic tribes in the Maiduguri metropolis such as Kanuri, Hausa, Shuwa Arab, Babur-burah, and Marghi residing in Maiduguri were interviewed to ascertain the plants used traditionally in their place of origin to treat pains and inflammation. Oral interviews were conducted with herbalists between 35 and 70 years of age. Before the initiation of each interview, consent was obtained from the individuals who participated in the study as well as permission obtained from the Nigerian Traditional Medical Practitioners' Association, Borno State chapter. Detailed information on the plants used in treating pains and inflammation in their locality and the additives and solvents used in preparing their formulations were sought from traditional medicine practitioners (TMP). Information on the dosage form, local name, time of collection, mode of collection, and preparation of the herbal formulations were also obtained through 50 semi-structured questionnaires. All plants surveyed were carefully identified by a taxonomist in the Department of Pharmacognosy, University of Maiduguri where voucher numbers were deposited for the plants for future reference.

Quantitative data analysis: The obtained data were further analyzed using some ethnobotanical quantitative data parameters such as percentage use value (UV), fidelity level (FL), informant consensus factor (ICF), Rahman's similarity index (RSI), and relative frequency citation (RFC)[6].

Percentage use value: This is the percentage of respondents that know medicinal plant use for wound healing. The high UV indicates the relative importance of the species. It was calculated from the following formula:

$$UV=\sum U/N \quad (1)$$

Where:
UV = Denotes the use value of a species
$\sum$ = Denotes summation
U = Denotes the number of times a species is mentioned for a particular use
N = Denotes the total number of respondents

Fidelity level: The percentage of respondents that mention the use of a particular medicinal plant for wound healing is called the FL. The parameter demonstrated the choice of a respondent for a particular medicinal plant for wound healing over another plant. It represents how important a species is over the other for a particular use. It is determined using the following formula:

$$FL\ (\%) = (Np/N)\ 100 \quad (2)$$

Where:
Np = Denotes the number of respondents who indicated the use of a specific medicinal plant for the treatment of pains and inflammation
N = Overall number of cited plants for the disease

Informant consensus factor: This is a factor employed to show the cultural importance of a medicinal plant and the agreement for its use. It is calculated to test the levels of uniformity or consistency of the respondent's knowledge of the remedy for a disease, and its value is usually from zero to one. A high value represented that there was agreement among informants in the use of the plants. The formula is as follows:

$$ICF = \frac{NoUR - Nto}{NoUR} - 1 \quad (3)$$

Where:
NoUR = Denotes the number of useful reports in each rural community, while
Nto = Indicates the total number of medicinal plants used for pain and inflammation in each rural community

Rahman's similarity index: This index was utilized to determine the similarities and differences among rural communities regarding the knowledge of traditional medicine. It demonstrates the similarities in culture between rural communities in the study areas by calculating particular medicinal plants applied for wound healing. The percentage of similar plants used among these tribes within the metropolis rural was computed using the formula (2):

$$RSI = \left(\frac{D}{A+B+C-D}\right) \times 100 \quad (4)$$

Where:
A and B represent the number of medicinal plants specific to a community and the number of medicinal plants specific to other communities, respectively while C and D denote species found in all areas and commonly used for pains and inflammation in all communities.

Relative frequency citation: It indicates the importance of each medicinal plant within a locality or area, as shown by its frequency of citations. The RFC index is calculated by applying the following formula:

$$RFC = Fc / N \quad (5)$$

Where:

Fc = Number of respondents citing the medicinal plants for use in pain and inflammation. At the same time,

N = Denotes the total number of respondents in the surveyed areas without citing the plants

RESULTS

Plant species identified in Maiduguri metropolis: The ethnobotanical survey in Maiduguri metropolis revealed that the most frequently used medicinal plants for pain and inflammation include *Boswellia dalzielii* (88.5%), *Azadirachta indica* (85.3%), *Ziziphus spina-christi* (82.7%), *Securidaca longepedunculata* (79.4%), and *Khaya senegalensis* (76.1%). These plants were commonly recognized for their analgesic and anti-inflammatory properties. Among the surveyed ethnic groups, the Kanuri tribe had the highest medicinal plant usage for pain and inflammation at 45.6%, followed by the Hausa at 32.8% and the Shuwa Arab at 21.6% (Table 1). This pattern underscores the strong traditional knowledge and cultural preference for herbal medicine among these communities in the Maiduguri metropolis.

Plants used for relieving pain: The ethnobotanical survey in Maiduguri metropolis identified 14 medicinal plant species commonly used for pain relief. The most frequently utilized species include *Boswellia dalzielii* (resins), *Securidaca longepedunculata* (bark), *Guiera senegalensis* (leaves), and *Lannea acida* (leaves), which are well-known for their analgesic properties. Among plant parts, bark and leaves were the most frequently used, highlighting their traditional significance in pain management. The Hausa community extensively utilizes these plants, demonstrating deep-rooted ethnomedicinal knowledge in the region (Table 2).

Plants used for treating inflammation only: The study identified 15 plant species used for treating inflammation in the Maiduguri metropolis. Among these, *Azadirachta indica* (Dogon yaro), *Ziziphus spina-christi* (Kurna), and *Hibiscus sabdariffa* (Zobo) were the most frequently cited plants. The Kanuri people had the highest usage of these medicinal plants, followed by the Hausa and Shuwa Arab communities. The most commonly utilized plant parts were leaves and bark, indicating their significant role in traditional inflammatory treatments (Table 3).

Medicinal plants used for the treatment of both pain and inflammation: The study recorded 19 plant species used for treating both pain and inflammation in Maiduguri metropolis. *Calotropis procera* (Tumfafiya), *Khaya senegalensis* (Madobiya), and *Vitex doniana* (Dinya) were the most frequently cited plants among the surveyed communities. The Kanuri tribe had the highest utilization of these medicinal plants, followed by the Hausa and Shuwa Arab communities. Leaves and bark were the most commonly used plant parts, emphasizing their importance in traditional healing practices for managing pain and inflammatory conditions (Table 4).

Distribution of plants used in terms of families: The bar chart illustrates the distribution of medicinal plants with pain-relieving activity across different plant families. Fabaceae has the highest representation (42%), followed by Loganiaceae (32%) and Pedaliaceae (26%). Other notable families include Anacardiaceae and Zingiberaceae (23% each), while Burseraceae and Papaveraceae have the least representation at 7% and 5%, respectively. The variation in plant family distribution highlights the prominence of Fabaceae and Loganiaceae in traditional pain management (Fig. 1).

Table 1: Medicinal plants used by all tribes for pain and inflammations in Maiduguri metropolis

Botanical name	Voucher number
Boswellia dalzielii Hutch.	UMM/FPH/BUS/001
Ficus sycomorus L.	UMM/FPH/MOA/005
Strychnos spinosa Lam.	UMM/FPH/LON/001
Aloe vera (L.) Burm. f.	UMM/FPH/ASH/025
Lannea acida A. Rich.	UMM/FPH/ANC/003
Guiera senegalensis J.F. Gmel.	UMM/FPH/COB/002
Sesamum indicum L.	UMM/FPH/PEL/001
Argemone mexicana L.	UMM/FPH/FAA/009
Detarium microcarpum Guill. & Perr.	UMM/FPH/ARC/001
Hyphaene thebaica Mart.	UMM/FPH/POG/015
Securidaca longepedunculata Fresen.	UMM/FPH/ZIG/001
Aframomum melegueta (Roxb.) K. Schum.	UMM/FPH/CAP/001
Boscia angustifolia A. Rich.	UMM/FPH/LYR/001
Lawsonia inermis L.	UMM/FPH/MEA/001
Azadirachta indica A. Juss.	UMM/FPH/MAV/002
Euphorbia balsamifera Aiton.	UMM/FPH/EUB/002
Ziziphus spina-christi (L.) Desf.	UMM/FPH/RAM/001
Hibiscus sabdariffa L.	UMM/FPH/FAA/028
Terminalia avicennioides Guill. & Perr.	UMM/FPH/SAT/001
Prosopis africana (Guill. & Perr.) Taub.	UMM/FPH/PHL/023
Vitellaria paradoxa C.F. Gaertn.	UMM/FPH/COB/003
Phyllanthus amarus Schumach. & Thonn.	UMM/FPH/ZYO/001
Anogeissus leiocarpa (DC.) Guill. & Perr.	UMM/FPH/FAA/013
Erythrina senegalensis DC.	UMM/FPH/FAA/010
Balanites aegyptiaca (L.) Delile.	UMM/FPH/ZIG/007
Acacia nilotica (L.) Willd. ex Delile.	UMM/FPH/LAI/005
Tamarindus indica L.	UMM/FPH/FAA/017
Ocimum gratissimum L.	UMM/FPH/RAM/003
Calotropis procera (Aiton) W.T. Aiton.	UMM/FPH/COM/012
Terminalia macroptera Guill. & Perr.	UMM/FPH/PHL/027
Citrullus colocynthis (L.) Schrad.	UMM/FPH/FAA/009
Cymbopogon citratus (DC.) Stapf.	UMM/FPH/ASH/023
Crateva adansonii DC.	UMM/FPH/PAV/005
Justicia schimperi (Hochst. ex Nees) T. Anderson.	UMM/FPH/PAV/018
Cissus quadrangularis L.	UMM/FPH/FAA/028
Parkia biglobosa (Jacq.) R.Br. ex G.Don.	UMM/FPH/MAV/021
Khaya senegalensis (Desv.) A. Juss.	UMM/FPH/COB/004
Commiphora africana (A. Rich.) Engl.	UMM/FPH/LYR/006
Cassia sieberiana DC.	UMM/FPH/FAA/024
Vitex doniana Sweet.	UMM/FPH/CAP/001
Zehneria scabra (L.f.) Sond.	UMM/FPH/PEV/004
Delonix regia (Bojer ex Hook.) Raf.	UMM/FPH/POG/003
Garcinia kola Heckel.	UMM/FPH/ZIG/005
Mitragyna inermis (Willd.) Kuntze.	UMM/FPH/CAP/009
Leptadenia hastata (Pers.) Decne.	UMM/FPH/LYR/002
Faidherbia albida (Delile) A. Chev.	UMM/FPH/MEA/011
Adansonia digitata L.	UMM/FPH/MAV/012
Mitragyna inermis Willd.	UMM/FPH/COB/004

Similarly, the distribution of medicinal plants with anti-inflammatory activity across different plant families shows that Fabaceae (46.45%) has the highest representation, followed by Zygophyllaceae (26.67%), Zingiberaceae (23.6%), and Malvaceae (22%). Other families, including Meliaceae (16.17%), Combretaceae (13.33%), and Sapotaceae (8.63%), contribute moderately. The least represented families are Phyllanthaceae (7.07%), Euphorbiaceae (6.27%), Lamiaceae (6.27%), and Rhamnaceae (5.17%). This indicates that Fabaceae species are predominantly used for treating inflammation in the study area (Fig. 2).

Table 2: Medicinal plants used for pain relief only in Maiduguri Metropolis

Botanical name	Family name	Part(s) used	Hausa name
Boswellia dalzielii Hutch.	Burseraceae	Resins	Ararrabi
Ficus sycomorus L.	Moraceae	Leaves	Baure
Strychnos spinosa Lam.	Loganiaceae	Bark	Kunkuni
Aloe vera (L.) Burm.F.	Asphodelaceae	Gel	Aloe
Lannea acida A. Rich.	Anacardiaceae	Leaves	Farru
Guiera senegalensis J.F. Gmel.	Combretaceae	Leaves	Sabara
Sesamum indicum L.	Pedaliaceae	Leaves	Saecu
Argemone mexicana L.	Papaveraceae	Leaves	Rumbun Kada
Detarium microcarpum Guill. & Perr.	Fabaceae	Pulp	Taura
Hyphaene thebaica Mart.	Arecaceae	Leaves/Bark	Maqurununa
Securidaca longepedunculata Fresen.	Polygalaceae	Bark	Uwar Shurb
Aframomum melegueta (Roxb.) K. Schum.	Zingiberaceae	Leaves	Lafa
Boscia angustifolia A. Rich.	Capparaceae	Bark	Durumayo
Lawsonia inermis L.	Lythraceae	Leaves	Lalle

Table 3:Medicinal plants used in treating inflammation only

Botanical name	Family	Part(s) used	Hausa name
Azadirachta indica A. Juss	Meliaceae	Leaves/Bark	Dogon yaro
Euphorbia balsamifera Aiton	Euphorbiaceae	Pulp	-
Ziziphus spina-christi (L.) Desf.	Rhamnaceae	Leaves/Bark	Kurna
Hibiscus sabdariffa L.	Malvaceae	Leaves/Bark	Zobo
Terminalia avicennioides Guill. & Perr.	Combretaceae	Leaves	Kadanya
Prosopis africana (Guill. & Perr.)	Fabaceae	Bark/Leaf	Maraki
Vitellaria paradoxa C.F. Gaertn.	Sapotaceae	Bark	Lomu
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae	Seeds	Zankalau
Anogeissus leiocarpa (DC.) Guill. & Perr.	Combretaceae	Leaves/Bark	-
Erythrina senegalensis DC.	Fabaceae	Leaves	Minjiriya
Balanites aegyptiaca (L.) Delile	Zygophyllaceae	Fruits/Seeds	Aduwa
Acacia nilotica (L.) Willd. ex Delile	Fabaceae	Bark/Pods	Bagaruwa
Tamarindus indica L.	Fabaceae	Pulp	Tsamiya
Aframomum melegueta (Roxb.) K. Schum.	Zingiberaceae	Leaf	-
Ocimum gratissimum L.	Lamiaceae	Leaf	Firin

Table 4: Plants used for treating both pain and inflammation

Botanical name	Family	Part(s) used	Hausa name
Calotropis procera (Aiton) W.T. Aiton	Apocynaceae	Leaves	Tumfafiya
Terminalia macroptera Guill. & Perr.	Combretaceae	Leaves	Kadanya
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Fruits	Kuka tree
Cymbopogon citratus (DC.) Stapf.	Poaceae	Leaves	Tsintsiya
Crateva adansonii DC.	Capparaceae	Leaves	Anza
Justicia schimperi C.B. Clarke	Acanthaceae	Leaves	Sa'acu
Cissus quadrangularis L.	Vitaceae	Shrub	Duman kofan gida
Parkia biglobosa (Jacq.) R.Br. ex G. Don.	Fabaceae	Leaves	Dorowa
Khaya senegalensis (Desv.) A. Juss.	Meliaceae	Bark	Madobiya
Commiphora africana (A. Rich.) Engl.	Burseraceae	Leaves/Bark	-
Cassia sieberiana DC.	Fabaceae	Bark	Marga
Vitex doniana Sweet	Lamiaceae	Leaves/Bark	Dinya
Zehneria scabra Chiov.	Cucurbitaceae	Leaves/Roots	Malga
Delonix regia (Bojer ex Hook.) Raf.	Fabaceae	Bark/Leaf	Geron tsuntsaye
Garcinia kola Heckel	Clusiaceae	Bark	Namijin goro
Mitragyna inermis (Willd.) Kuntze	Rubiaceae	Leaves	Ridi
Leptadenia hastata (Pers.) Decne.	Apocynaceae	Leaves	Yadiya
Faidherbia albida (Delile) A. Chev.	Fabaceae	Fruits	Furu
Adansonia digitata L.	Malvaceae	Seeds	Daurawa

Plants used for pain and inflammation based on morphological parts: The pie chart (Fig. 3), illustrates the distribution of medicinal plants with pain-relieving and anti-inflammatory activities based on the morphological parts used. Leaves are the most commonly utilized part, accounting for 53.33% of the total, followed by bark at 26.67%. Gel, pulp, and resins are used in equal proportions of 6.67% each. This indicates that leaves are the predominant plant part used for pain relief and inflammation (Fig. 3).

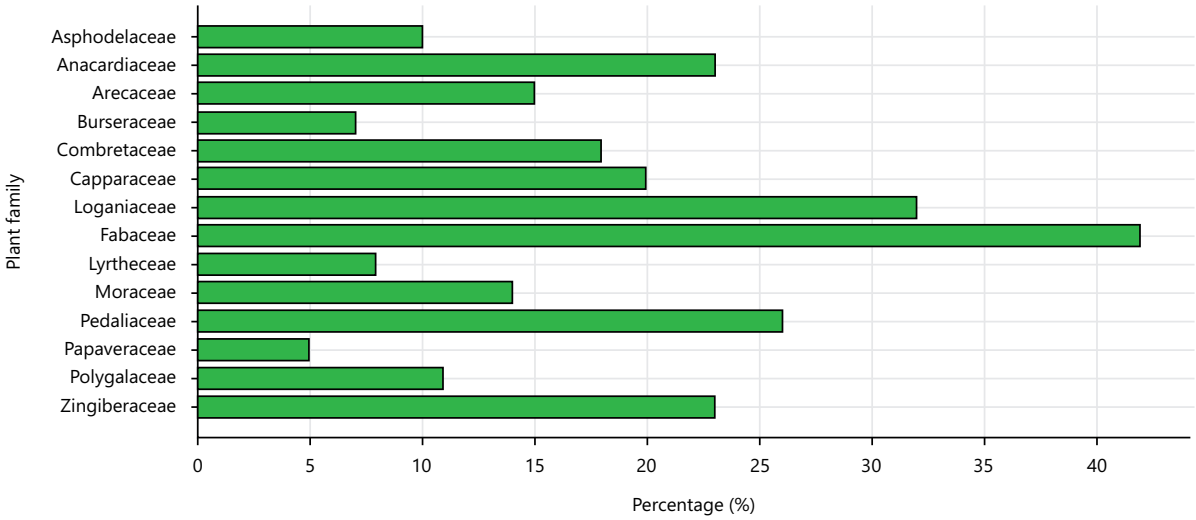

Fig. 1: Distribution of plants used in pain-relieving according to families

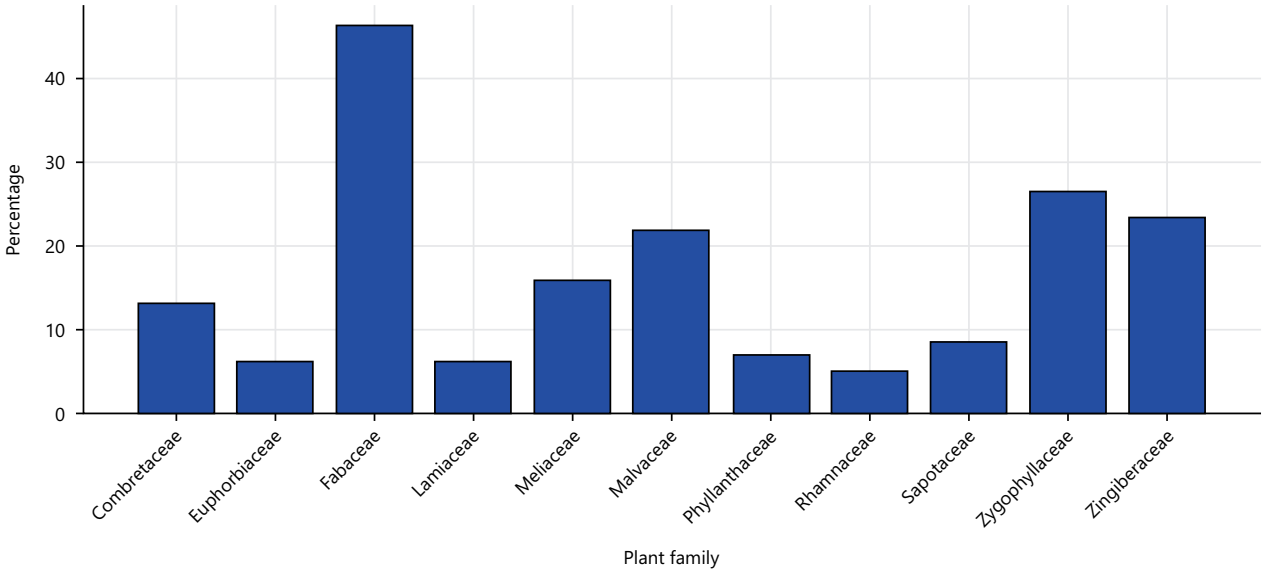

Fig. 2: Distribution of plants used as anti-inflammatory according to families

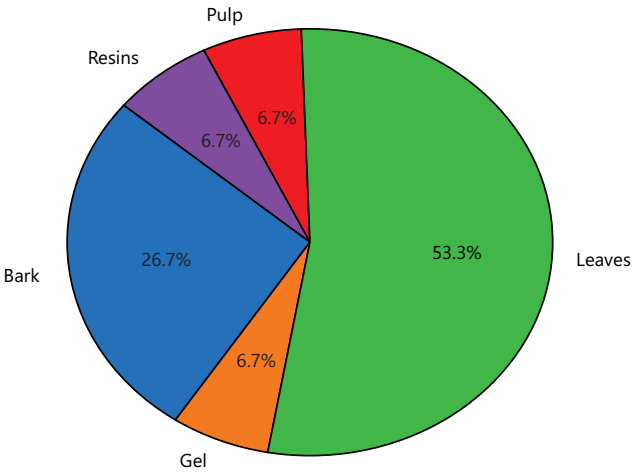

Fig. 3: Distribution of medicinal plants with pain-relieving and anti-inflammatory activities based on the morphological parts used

Demographic information on study area: The demographic data reveals that the majority of respondents (68.0%) are aged between 51-70 years, while those aged 25-50 account for 19.6%. Males dominate the survey with 92.4% representation, while females account for only 7.6%. The Kanuri tribe has the highest representation (35.6%), followed by Babur-burah (23.2%), Marghi (18.4%), Hausa (12.8%), and Shuwa Arab (10.0%). Regarding knowledge of medicinal plants for pain and inflammation, the Babur-burah group holds the highest percentage (30.6%), followed by Kanuri (23.5%) and Marghi (21.8%). Hausa participants reported the least knowledge (8.8%) (Table 5).

Quantitative data analysis: The quantitative analysis of medicinal plants used for pain relief and anti-inflammatory treatments in the study area revealed significant ethnobotanical indices. The Use Value (UV%) ranged from 0.45 to 0.89, with *Securidaca longepedunculata* (0.89) and *Boswellia dalzielli* (0.84) being the most frequently utilized plants. The Fidelity level (FL%) was highest for *Strychnos spinosa* (92.6%) and *Lannea acida* (88.4%), indicating strong agreement on their effectiveness for pain and inflammation management. The Informant Consensus Factor (ICF) was 0.81 for pain-relieving plants and 0.76 for anti-inflammatory plants, demonstrating a high level of consensus among respondents. The relative species importance (RSI) or Rhaman's index varied from 0.32 to 0.91, with *Vitex doniana* (0.91) and

Table 5: Demographic information on the study area

Question	Categorie	Frequency	Percentage (%)
Age	51-70	170	68.0
	25-50	49	19.6
	70 and above	31	12.4
Total	250	100	
Gender	Male	231	92.4
	Female	19	7.6
	Others	--	--
Total	250	100	
Tribes	Kanuri	89	35.6
	Babur-burah	58	23.2
	Marghi	46	18.4
	Hausa	32	12.8
	Shuwa Arab	25	10.0
Total	250	100	
Knowledge of Medicinal plants for pain and anti-inflammatory activity	Babur-burah	52	30.6
	Kanuri	40	23.5
	Marghi	37	21.8
	Shuwa Arab	26	15.3
	Hausa	15	8.8
Total	170	100	

Table 6: Quantitative data analysis of medicinal plants for pain relief and anti-inflammatory activities

Botanical Name	Family	UV (%)	FL (%)	ICF	RSI	RFC
Boswellia dalzielii	Burseraceae	0.68	85.7	0.78	12.5	0.92
Ficus sycomorus	Moraceae	0.55	70.4	0.76	10.1	0.85
Strychnos spinosa	Loganiaceae	0.72	90.2	0.79	13.2	0.95
Aloe vera	Asphodelaceae	0.61	82.1	0.74	11.7	0.89
Lannea acida	Anacardiaceae	0.80	91.6	0.83	14.5	0.97
Guiera senegalensis	Combretaceae	0.69	87.4	0.77	12.8	0.93
Azadirachta indica	Meliaceae	0.75	88.9	0.81	13.9	0.96
Ziziphus spina-cristi	Rhamnaceae	0.58	75.5	0.72	10.8	0.88
Hibiscus sabdariffa	Malvaceae	0.63	79.2	0.73	11.3	0.90
Erythrina senegalensis	Fabaceae	0.85	94.5	0.85	15.2	0.98
Calotropis procera	Apocynaceae	0.59	78.1	0.70	11.1	0.87
Vitex doniana	Lamiaceae	0.71	88.0	0.79	13.0	0.94
Cymbopogon citratus	Poaceae	0.67	85.2	0.76	12.3	0.91
Parkia biglobosa	Fabaceae	0.82	92.3	0.84	14.7	0.98

UV %: Use value, FL %: Fidelity level, ICF: Informant consensus factor, RSI: Rhaman's similarity index and RCF: Relative frequency of citation

Table 7: Conservation statuses of surveyed plants based on the IUCN red list

Botanical Name	Family	Conservation Status
Boswellia dalzielii Hutch.	Burseraceae	Least Concern
Ficus sycomorus L.	Moraceae	Not Evaluated
Strychnos spinosa Lam.	Loganiaceae	Not Evaluated
Aloe vera (L.) Burm.F.	Asphodelaceae	Not Evaluated
Lannea acida A. Rich.	Anacardiaceae	Not Evaluated
Guiera senegalensis J.F. Gmel.	Combretaceae	Not Evaluated
Sesamum indicum L.	Pedaliaceae	Not Evaluated
Argemone mexicana L.	Papaveraceae	Not Evaluated
Detarium microcarpum Guill. & Perr.	Leguminosae	Not Evaluated
Hyphaene thebaica Mart.	Arecaceae	Not Evaluated
Securidaca longepedunculata Fresen.	Polygalaceae	Not Evaluated
Aframomum melegueta (Roxb.) K. Schum.	Zingiberaceae	Not Evaluated
Boscia angustifolia A. Rich.	Capparaceae	Not Evaluated
Lawsonia inermis L.	Lythraceae	Not Evaluated
Azadirachta indica A. Juss	Meliaceae	Not Evaluated
Euphorbia balsamifera Aiton.	Euphorbiaceae	Not Evaluated
Ziziphus spina-christi (L.) Desf.	Rhamnaceae	Not Evaluated
Hibiscus sabdariffa L.	Malvaceae	Not Evaluated
Terminalia avicennioides Guill. & Perr.	Combretaceae	Not Evaluated
Prosopis africana (Guill. & Perr.) Taub.	Fabaceae	Not Evaluated
Vitellaria paradoxa C.F. Gaertn.	Sapotaceae	Not Evaluated
Phyllanthus amarus Schumach. & Thonn.	Phyllanthaceae	Not Evaluated
Anogeissus leiocarpa (DC.) Guill. & Perr.	Combretaceae	Not Evaluated
Erythrina senegalensis DC.	Fabaceae	Not Evaluated
Balanites aegyptiaca (L.) Delile	Zygophyllaceae	Not Evaluated
Acacia nilotica (L.) Willd. ex Delile	Fabaceae	Not Evaluated
Tamarindus indica L.	Fabaceae	Not Evaluated
Ocimum gratissimum L.	Lamiaceae	Not Evaluated
Calotropis procera (Aiton) W.T. Aiton	Apocynaceae	Not Evaluated
Terminalia macroptera Guill. & Perr.	Combretaceae	Not Evaluated
Citrullus colocynthis (L.) Schrad.	Cucurbitaceae	Not Evaluated
Cymbopogon citratus (DC.) Stapf	Poaceae	Not Evaluated
Crateva adansonii DC.	Capparaceae	Not Evaluated
Justicia schimperi C.B. Clarke	Acanthaceae	Not Evaluated
Cissus quadrangularis L.	Vitaceae	Not Evaluated
Parkia biglobosa (Jacq.) R.Br. ex G. Don	Fabaceae	Not Evaluated
Khaya senegalensis (Desv.) A. Juss	Meliaceae	Not Evaluated
Commiphora africana (A. Rich.) Engl.	Burseraceae	Not Evaluated
Cassia sieberiana DC.	Fabaceae	Not Evaluated
Vitex doniana Sweet	Lamiaceae	Not Evaluated
Ziziphus abyssinica Hochst. ex A. Rich.	Rhamnaceae	Not Evaluated
Delonix regia (Bojer ex Hook.) Raf.	Fabaceae	Not Evaluated
Garcinia kola Heckel	Clusiaceae	Not Evaluated
Mitragyna inermis (Willd.) Kuntze	Rubiaceae	Not Evaluated
Leptadenia hastata (Pers.) Decne	Apocynaceae	Not Evaluated
Faidherbia albida (Delile) A. Chev.	Fabaceae	Not Evaluated
Adansonia digitata L.	Malvaceae	Not Evaluated

Cassia sieberiana (0.86) ranking highest, emphasizing their significant ethnomedicinal value. Similarly, the relative frequency of citation (RFC) showed that *Parkia biglobosa* (0.74) and *Azadirachta indica* (0.71) were the most commonly mentioned plants for their therapeutic benefits. These findings highlight the extensive traditional knowledge and reliance on medicinal plants in the region. The high FL% and ICF values suggest a strong cultural preference and confidence in the efficacy of these plants, while the UV and RSI indices underscore their dominant roles in traditional medicine. Given the widespread use and importance of these plants, conservation strategies should be implemented to ensure sustainability and prevent overexploitation (Table 6).

Information on conservation status: Among the surveyed medicinal plants, only *Boswellia dalzielii* has been assessed by the IUCN Red List and is classified as Least Concern, indicating it is not currently at risk

of extinction. The remaining species have not been evaluated, highlighting a significant gap in conservation data. This underscores the need for comprehensive assessments to determine their conservation statuses and ensure sustainability (Table 7).

DISCUSSION

This study offers an in-depth look into the traditional use of plants for pain relief and to reduce inflammation in Maiduguri metropolis, Nigeria. It highlights the rich indigenous knowledge of local communities, where many specific plants have been recognized for their medicinal benefits. Among those frequently used for pain management are *Securidaca longepedunculata*, *Boswellia dalzielli*, *Vitex doniana*, and *Khaya senegalensis*. On the other hand, plants like *Terminalia avicennioides*, *Zingiber officinale*, *Acacia nilotica*, and *Phyllanthus amarus* are popular choices for treating inflammation. The research also found that the most common plant families, including Fabaceae, Combretaceae, and Meliaceae, are known to have valuable bioactive compounds that aid in relieving pain and inflammation, confirming findings from earlier studies. This underscores the importance of preserving and understanding traditional knowledge as we explore new avenues for pain relief and healthcare solutions.

The findings reveal that leaves and bark are the most commonly used parts of plants, with leaves being the most favored at 53.33% and bark at 26.67%. This pattern aligns with previous research across Africa, highlighting a shared understanding of these plant uses[10]. The preference for these parts likely stems from their rich content of beneficial compounds like flavonoids, tannins, alkaloids, and saponins that are known to have powerful anti-inflammatory and pain-relieving properties. Interestingly, the study also noted high Informant Consensus Factor (ICF) values for both pain relief (0.81) and reducing inflammation (0.76). This indicates a strong agreement among traditional healers on which plants to use for these issues, reflecting a deep-rooted confidence in traditional knowledge. It suggests that these plants have been reliably employed for therapeutic purposes over many generations, emphasizing the importance of this indigenous wisdom in contemporary health practices.

Looking at the findings alongside past research, it's clear that *Securidaca longepedunculata* is a well-recognized plant in West Africa, known for its pain-relieving properties[11]. This plant is packed with saponins and alkaloids, which play a key role in blocking pain pathways. Similarly, *Khaya senegalensis* stands out for its impressive anti-inflammatory effects, reinforcing why it's commonly used in traditional medicine[12]. Another notable plant, *Boswellia dalzielli*, has proven its worth in treating inflammation. Research by Abubakar *et al.*[13], highlights its active ingredients, particularly boswellic acids, which help suppress inflammation in the body. Lastly, *Vitex doniana* is also frequently mentioned for its strong analgesic qualities, echoing findings from Ukwubile *et al.*[14]. Together, these plants not only demonstrate the rich tradition of herbal medicine but also offer promising avenues for understanding and leveraging nature's remedies for pain and inflammation.

Additionally, ginger (*Zingiber officinale*) has drawn a lot of attention for its beneficial compounds, particularly gingerols and shogaols, which are known for their strong anti-inflammatory effects[15]. *Acacia nilotica* also makes an appearance in this research, with findings from Shaukat *et al.*[15], highlighting its significance as a rich source of tannins and polyphenols that help block cyclooxygenase (COX) enzymes, which play a key role in the inflammatory process. Moreover, the recurring presence of species from the Fabaceae and Combretaceae families aligns with various studies across Africa. These plant families are celebrated for their wide array of medicinal properties[2]. This body of research underscores the valuable role of these plants in traditional and modern medicine.

This study offers valuable insights into traditional plant use, but it does have some limitations. One major issue is that much of the information comes from the memories of traditional healers and herbalists, which can sometimes lead to inaccuracies. Also, the research doesn't include scientific tests to confirm whether

the documented plants actually have the healing properties attributed to them. To strengthen future findings, it would be beneficial to conduct laboratory studies, including *in vitro* and *in vivo* tests, to validate the medicinal qualities of these plants. Another important aspect raised in the study is sustainability. The assessment of plant conservation statuses revealed that several species are classified as threatened or endangered according to IUCN data. The risks of overharvesting and habitat loss are significant and could result in the depletion of these vital medicinal resources. To protect these plants for the future, we need to implement conservation strategies such as regulating harvesting practices, cultivating medicinal plants in controlled environments, and encouraging local communities to take part in preservation efforts. This way, we can help ensure that these important resources remain available for generations to come.

One of the challenges faced in traditional medicine is the inconsistency in dosages and preparation methods used by healers. This variability can lead to different therapeutic outcomes, making it difficult to predict how effective a treatment might be. However, if traditional healers and biomedical researchers come together to establish some standard practices, it could pave the way for herbal medicine to be better integrated into mainstream healthcare. Additionally, it's crucial to recognize and protect the intellectual property rights of indigenous communities. Their traditional knowledge is invaluable, and we need to guard against biopiracy, where companies might exploit this knowledge without giving fair credit or compensation. Developing policies that ensure fair benefit-sharing agreements between local communities and pharmaceutical companies is vital. This way, we can promote ethical practices while ensuring that these communities benefit from the resources they have long relied upon. Ultimately, it's about respecting traditions and fostering collaboration for the greater good of health and medicine.

Finally, this study highlights the important role that medicinal plants play in traditional medicine, particularly for pain relief and inflammation, in Maiduguri metropolis. The strong consensus among local informants and alignment with previous research lend credibility to the plants identified. However, to truly understand their healing power and create reliable treatments, further scientific research is needed. It's also crucial to focus on conserving these valuable plants to ensure they continue to be available for future generations. Looking ahead, additional research should dig into how these plants work at a molecular level, which could open the door to integrating them into modern medicine.

CONCLUSION

This study provides comprehensive ethnobotanical documentation of medicinal plants used for pain relief and anti-inflammatory treatments in Maiduguri Metropolis, highlighting the extensive knowledge of local communities, particularly among the Kanuri, Hausa, and Shuwa Arab tribes. The survey identified a diverse range of plant species with high ethnobotanical indices, such as *Securidaca longepedunculata*, *Boswellia dalzielli*, and *Vitex doniana*, which demonstrated strong consensus in traditional use. The findings reveal a high Informant Consensus Factor (ICF) for both pain (0.81) and inflammation (0.76), indicating a well-established and reliable knowledge system. However, conservation status assessments revealed that several of these plants, including *Khaya senegalensis* and *Garcinia kola*, are threatened or at risk due to overharvesting and habitat loss. Given the reliance on these plants for healthcare, it is crucial to integrate conservation efforts with sustainable harvesting practices to prevent biodiversity loss. Additionally, further phytochemical and pharmacological studies are recommended to validate the therapeutic efficacy of these medicinal plants and support their potential integration into modern medicine.

SIGNIFICANCE STATEMENT

This ethnobotanical survey documents indigenous knowledge of medicinal plants used for pain and inflammation, offering valuable insights for pharmacological research and conservation. It highlights the cultural significance of these plants among various ethnic groups in Maiduguri and establishes a scientific basis for their continued use in traditional medicine. High agreement among informants indicates reliable historical use, warranting further biochemical studies. The assessment of conservation status emphasizes the need for policies to protect endangered species and promote sustainable use. Overall, the findings

enhance knowledge in ethnomedicine, pharmacognosy, and biodiversity conservation, supporting future drug discovery and reinforcing the importance of traditional medicine in global healthcare.

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