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ETHNOBOTANICAL SURVEY AND PHYTOCHEMICAL PROPERTIES OF SOME MEDICINAL PLANTS USED IN TRADITIONAL HEALTHCARE IN ALKALERI, DARAZO AND TORO LOCAL GOVERNMENT AREAS OF BAUCHI STATE

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Abstract

This study presents an ethnobotanical survey of medicinal plants traditionally used in the Alkaleri, Darazo, and Toro Local Government Areas of Bauchi State, Nigeria. A total of 150 respondents, including herbalists, users, collectors, and vendors, were interviewed using structured questionnaires to document indigenous knowledge related to medicinal plant usage. Demographic analysis revealed a predominance of

Keywords:
Ethnobotanical survey, Medicinal plants, Traditional knowledge, Phytochemical

INTRODUCTION

Ethnobotanical surveys are crucial for documenting traditional uses of medicinal plants and identifying bioactive compounds (Naghavi et al., 2021). This approach can contribute to drug discovery and conservation of indigenous knowledge. Traditional medicine remains integral to healthcare in many African communities, particularly in regions with limited access to modern facilities (Mahomoodally, 2013). Ethnobotanical surveys in Bauchi State have documented numerous plants used in traditional medicine (Idu et al., 2007; Adamu et al., 2005). A survey in Bauchi State, Nigeria, identified 84 medicinal plants used locally to treat various diseases (Adamu et al., 2005). These plants serve as accessible and affordable health resources, often representing the only available therapy for local communities (Mahomoodally, 2013). The Waja people in Bauchi

male informants (78%) and a significant number of participants aged between 31 and 40 years. A total of 71 plant species, belonging to 34 families, were identified across the three areas, with *Boswellia dalzielii* (Ararabi) emerging as the most frequently cited plant (FL 39.33%). Other highly valued species included *Pterocarpus erinaceus, Securidaca longepedunculata,* and *Moringa oleifera,* reflecting their wide therapeutic applications. Leaves and barks were the most commonly utilized plant parts, prepared primarily through decoction and administered orally. The majority of informants acquired their knowledge through family lineage and community tutelage, indicating strong cultural transmission of ethnomedicinal practices. Market and wild collection were the predominant sources of plant materials. This study underscores the rich ethnobotanical heritage of the region and highlights the need for further pharmacological validation and conservation of indigenous plant resources to support sustainable healthcare and biodiversity preservation. Qualitative phytochemical analysis of the plant extracts was conducted according to the standard techniques. Qualitative phytochemical screening revealed the presence and absences of phytochemicals, such as alkaloids, saponins, tannins, phenols, terpenoids, glycosides, steroids and flavonoids, in the methanolic extracts of *Boswellia dalzielli* (Bark and Leaves), *Pterocarpus erinaceus* (stem bark and leaves), *Securidaca longepedunculata root,* and *Moringa oleifera Lam* leaves. The medicinal effects of the documented plants could be attributable to these associated bioactive phytocompounds, which are synthesized by the studied plants and transferred to humans when consumed or applied. Further empirical investigations to characterize the bioactive phytochemicals and their safety should be done.

State utilize plants such as *Adansonia digitata, Anacardium occidentale,* and *Azadirachta indica* in their traditional healing practices (Idu et al., 2007). Additionally, an ethnobotanical survey specifically focused on maternal healthcare in Katsina State, Nigeria, highlights the significance of medicinal plants for women's health (Kankara et al., 2015).

Many factors threaten traditional medicinal knowledge and plant biodiversity. Conservation strategies are needed to protect medicinal plants (Mesfin and Merara, 2022). Environmental degradation and deforestation pose risks to indigenous knowledge of medicinal plants (Mesfin and Merara, 2022).

Phytochemicals are non-nutritive, chemical compounds and occur naturally on plants during metabolic processes having diverse defensive actions or disease preventive properties. Plants are known to produce these chemicals to protect them (Minakshi, et al., 2016). The secondary metabolites are naturally occurring in leaves, vegetables and roots that have defense mechanism and protect from various disease (Sanjib et al., 2018). Phytochemicals appear to neutralize free radicals, inhibit enzymes that activate carcinogens, and activate enzymes that detoxify carcinogens (Saxena, 2013). Phytochemicals like alkaloids, flavonoid terpenoids, carotenoid, etc have antidiuretic, anti-inflammatory, antianalgesic, anticancer, anti-viral, antimalarial, anti-bacterial and anti-fungal activities playing a vital role in preventing various diseases. Research evidence has revealed the presence of various phytochemicals with medicinal properties, which present a viable alternative source of accessible, safe, and efficacious therapies for illnesses, especially in rural settings. Moreover, plant-derived extracts successfully inhibit and reverse inflammation, haemorrhage, myotoxicity, and neurotoxicity (Mokua et al., 2021).

This study investigates medicinal plants used in traditional healthcare in Alkaleri, Darazo, and Toro Local Government Areas of Bauchi State, Nigeria. Despite the availability of modern medicine, many rural communities still rely heavily on traditional remedies. However, there is a significant lack of scientific documentation on the plants used, which hinders drug discovery and integration into formal healthcare systems.

Traditional knowledge is mostly passed down orally and is now threatened by factors such as urbanization, habitat loss, overharvesting, and environmental degradation. While studies exist, most are limited in scope and do not focus on shared or localized use in healthcare delivery. Therefore, there is a pressing need to document and validate this indigenous knowledge for cultural preservation and public health improvement.

The study is justified as it supports the conservation and sustainable use of medicinal plants, aids in identifying potential new drugs, and promotes affordable healthcare solutions. It also offers economic opportunities for rural communities and contributes to biodiversity protection. Ethnobotanical survey documentation could bridge critical gaps and support evidence-based use of traditional medicine across Nigeria. The aim of this study is to carryout ethnobotanical survey of some medicinal plants used in traditional health care delivery in Alkaleri, Darazo, and Toro Local Government areas of Bauchi state. This article examines the use of medicinal plants in traditional healthcare practices within the Alkaleri, Darazo, and Toro Local Government Areas of Bauchi State, Nigeria.

Study Design

This research comprised of a field-based ethnobotanical survey focused on traditional medicine custodians in Bauchi State and qualitative phytochemical properties of medicinal plants. It explored how medicinal plants are used to treat diseases across three Local Government Areas (LGAs): Alkaleri (Southern Zone), Darazo (Central Zone), and Toro (Northern Zone).

Study Area

The study was carried out in selected communities within the chosen LGAs, where the Hausa-Fulani are the dominant ethnic group, followed by other tribes like Badawa, Kanuri, Kare-Kare, Gerawa, Jarawa, and Sayawa. These communities are largely agrarian, with a long-standing presence of herbal medicine practitioners.

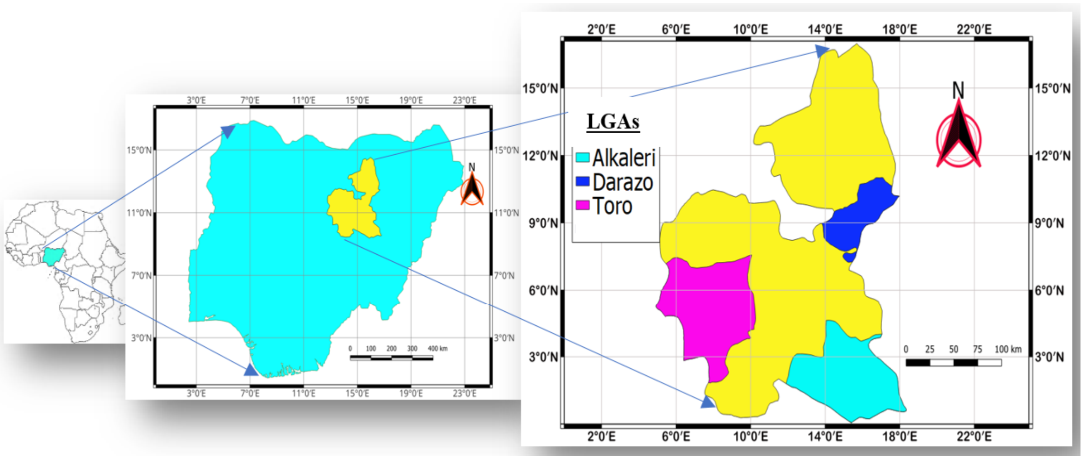

Figure 1. Map of Bauchi State showing Toro (Northern Zone), Latitude 10.4465 and longitude 9.2206, Darazo (Central Zone), Latitude 10.9992 and longitude 10.4106, and Alkaleri (Google Maps)

Data Collection

Before any interview, verbal informed consent was obtained. Semi-structured questionnaires guided interviews conducted in Hausa or other local languages with help from interpreters. The data collection method adapts Martin's (1995) approach, using purposive sampling to select ten communities known for their traditional medicine practices. Rapid Rural Appraisal (RRA) with village leader's help to identify these communities. Snowball sampling (De Caluwé, 2010) was used to reach 150 informants, including herbalists, vendors, and collectors. Data collected cover plant species, usage methods, and availability. Field walks with the informants allowed for plant collection and voucher specimen preparation.

Preference Ranking

Informants ranked 30 frequently used medicinal plants based on usage frequency and effectiveness in treating specific ailments, as outlined by Martin (1995). Scores from all informants was totaled to produce a final preference ranking.

Plant Identification and Voucher Specimen Processing

For the identification of medicinal plants, voucher specimens were collected and prepared for herbarium deposition. Taxonomic identification was carried out using identification keys and relevant botanical literature, including Flora of West Tropical Africa by Hutchinson and Dalzel. Additional resources, such as botanical instructions and peer-reviewed literature were consulted.

Some specimens were verified and authenticated by comparison with herbarium specimens housed at the Abubakar Tafawa Balewa University (ATBU) Herbarium in Bauchi. Others were cross-verified using online databases such as JSTOR Global Plants and Plants of the World Online (POWO). Final confirmation of plant identities was provided by the herbarium curator at ATBU.

Determination of Fidelity Level (FL)

The Fidelity Level (FL) was calculated to determine the reliability of each species in treating particular ailments: FL = (Ip/Iu) x 100, where Ip is the number of informants citing a plant for a specific ailment and Iu is the number citing it for any use (Friedman et al., 1986).

Qualitative Phytochemical Screening of the Selected Plants.

Qualitative phytochemical screening of the methanolic extract of *Boswellia dalzielli* (Bark and Leaves), *Pterocarpus erinaceus* (stem bark and leaves), *Securidaca longepedunculata root,* and *Moringa oleifera Lam* leaves was performed using the methods described by Trease and Evans (2009), Harborne et al. (1998), and Moriasi et al. (2020) with slight modifications to detect the presence or absence of various bioactive compounds. The phytochemicals tested include alkaloids, saponins, tannins, phenols, terpenoids, glycosides, steroids and flavonoids. Direct visual observations of the reactions' colouration profile or the formation of precipitates were done and used to appraise the presence or absence of respective phytochemicals in the study samples.

Data analysis

Descriptive statistics using frequencies and percentages was used to summarize data using appropriate software.

Results and Discussion

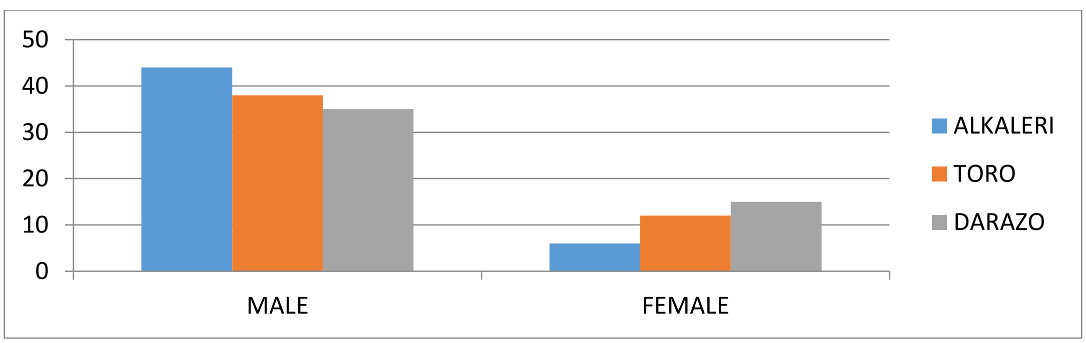

Figure 2: The distribution of respondents by gender.

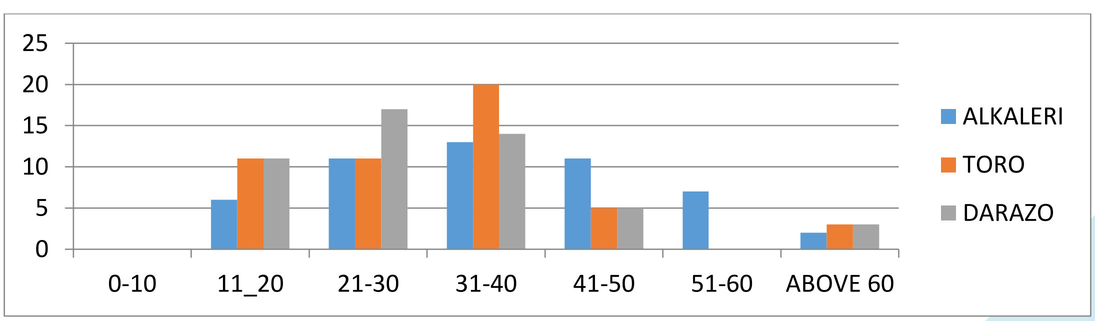

Figure 3: The distribution of respondents according to age.

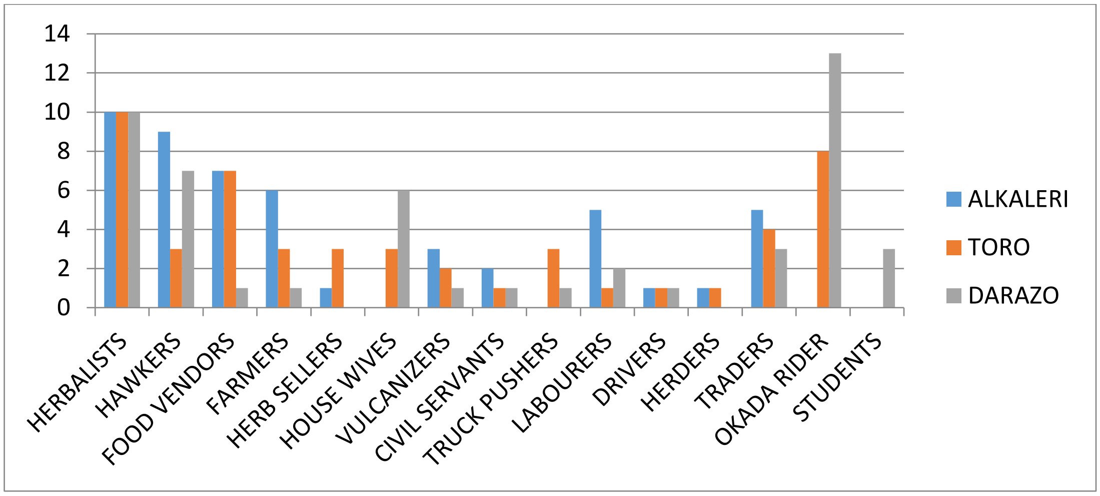

Figure 4: The distribution of responses according to occupation across all the three local government areas

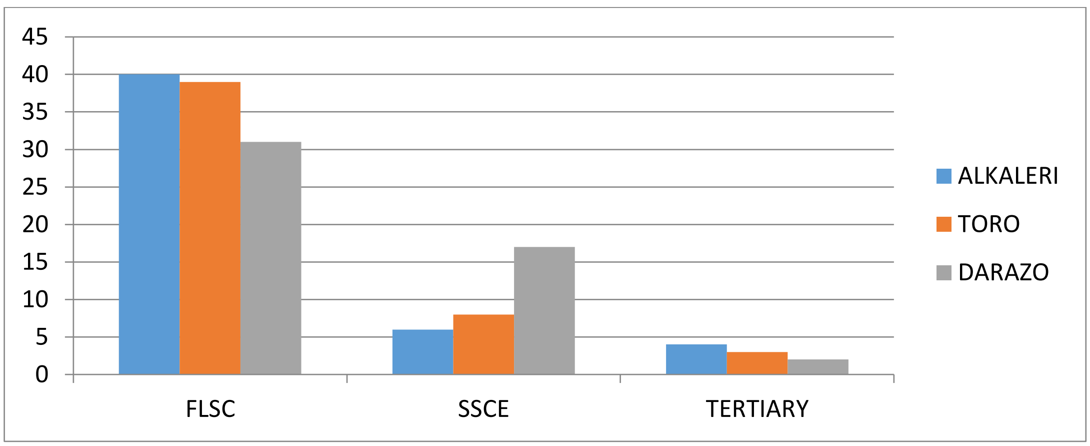

Figure 5: Distribution of respondents by educational level

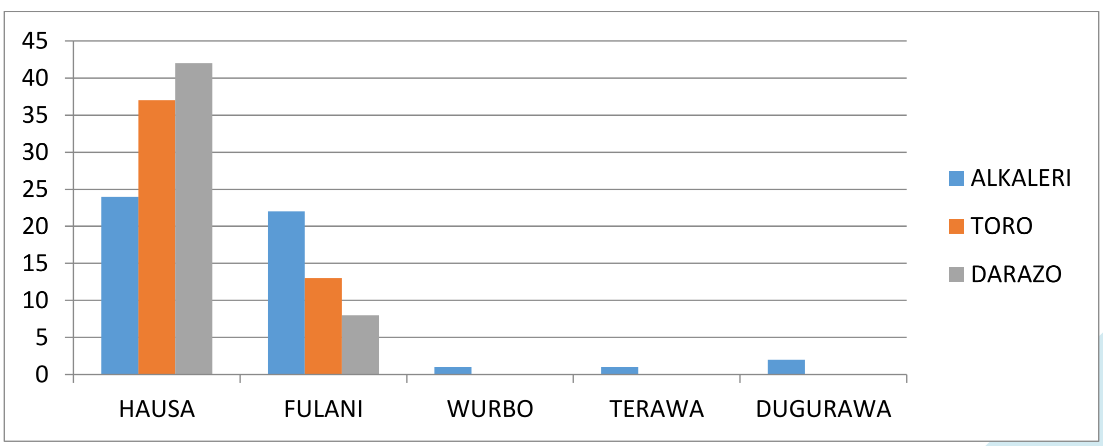

Figure 6: Distribution of respondents by tribe

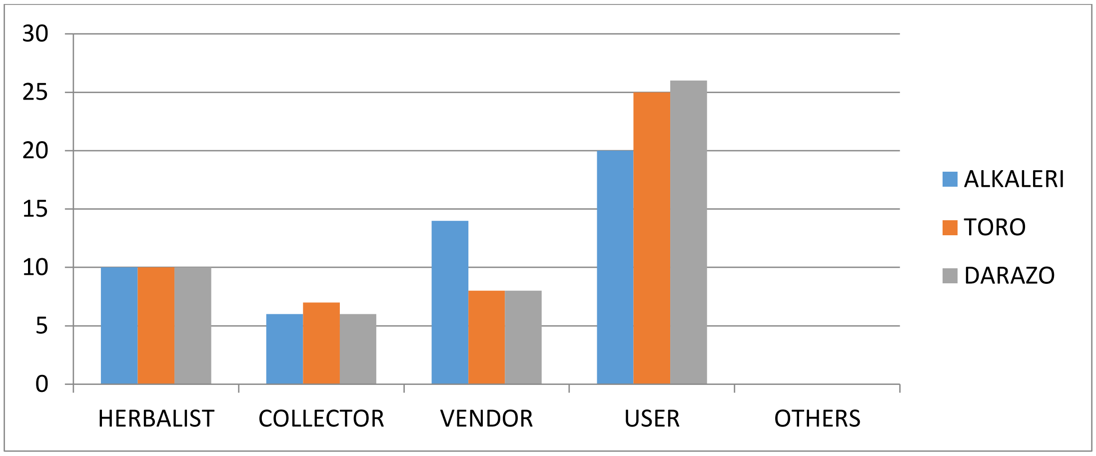

Figure 7: Distribution according to the roles each person carries out in handling medicinal plants.

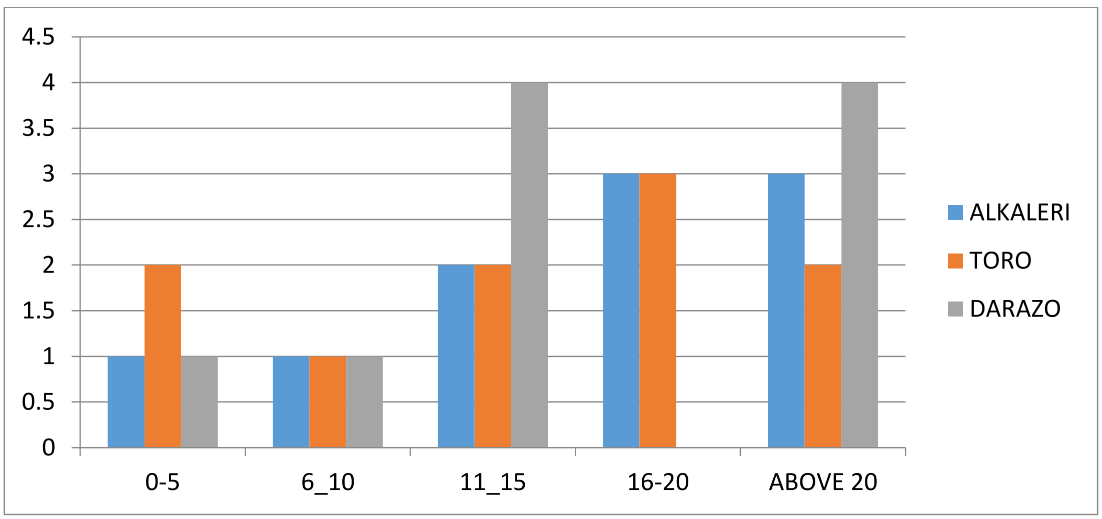

Figure 8: Distribution of respondents by length of time on the job.

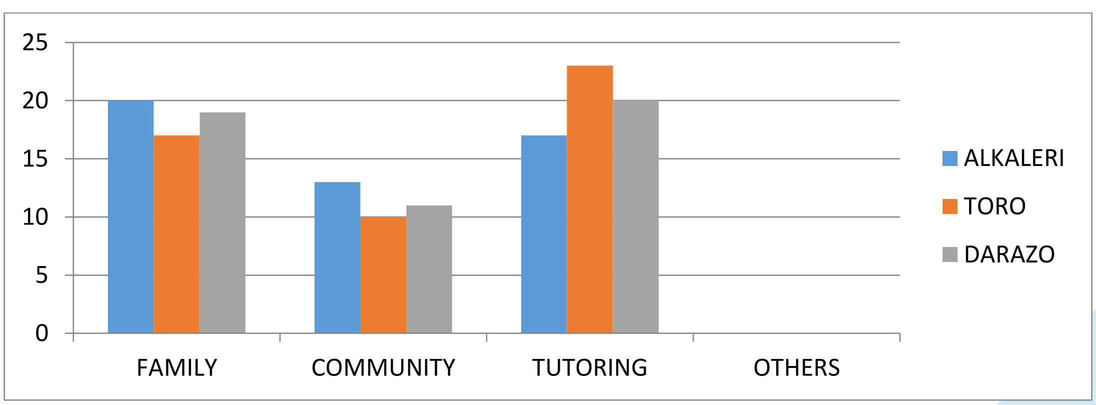

Figure 9: Distribution of respondents by how they learned medicinal use of plants

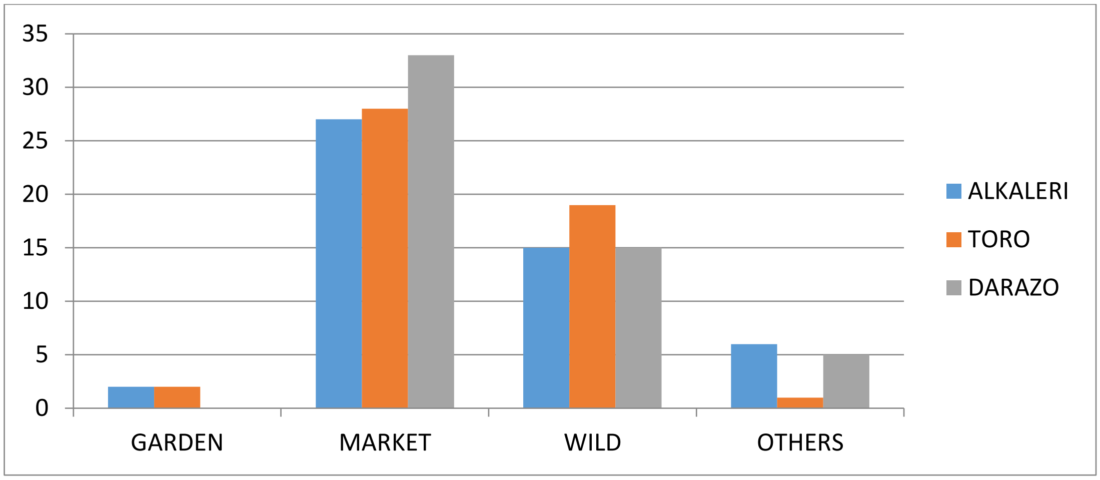

Figure 10: Distribution of respondents by how the sourced the plants.

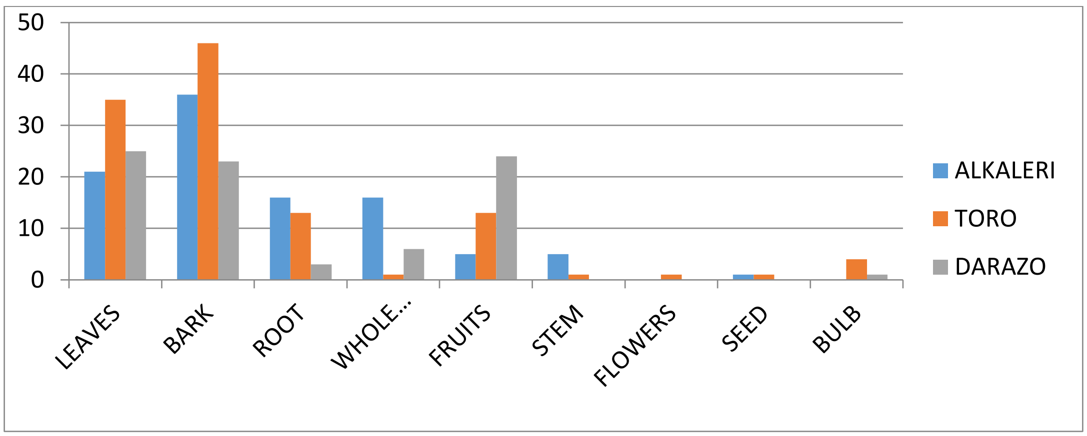

Figure 11: Distribution of respondents by plants parts mentioned

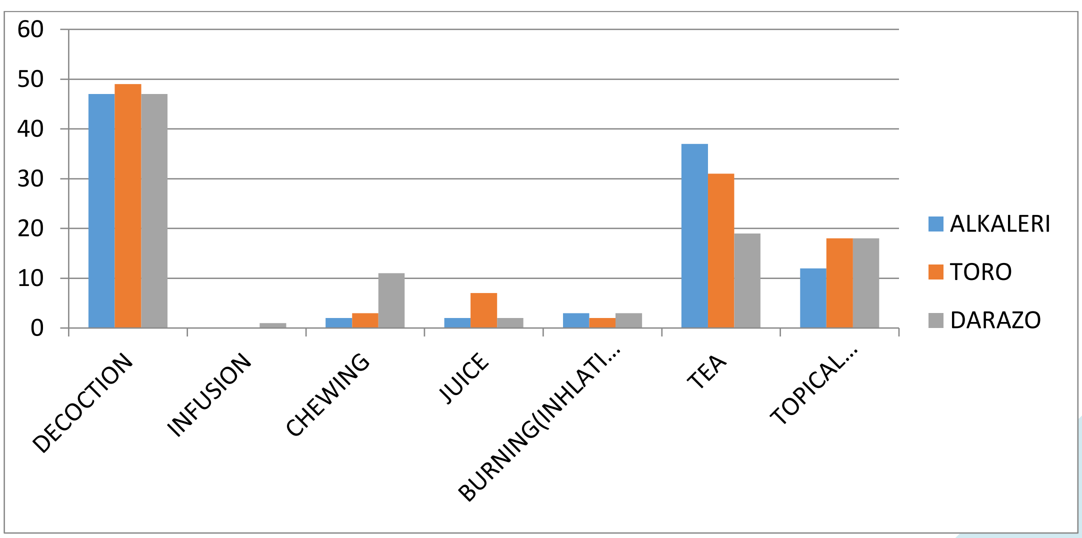

Figure 12: Distribution of respondents according to method of remedy preparation

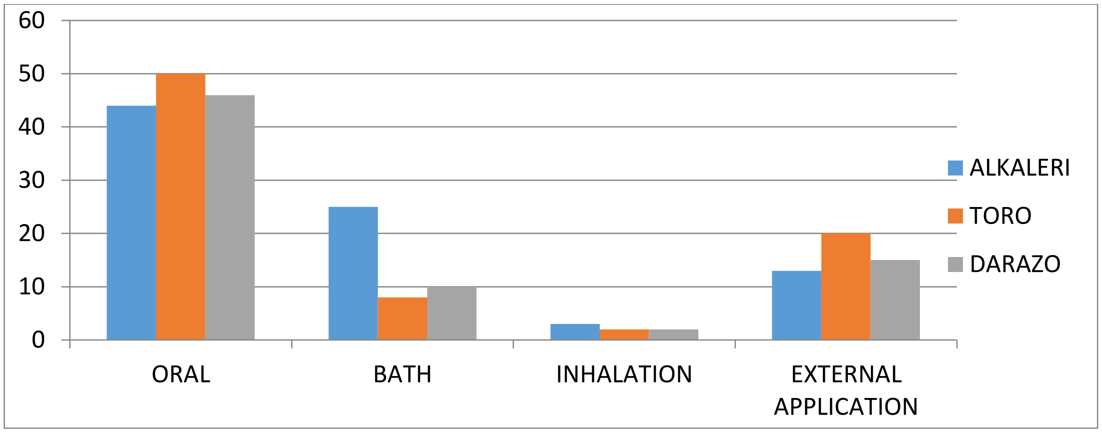

Figure 13: Distribution of respondents by how remedy preparation was administered

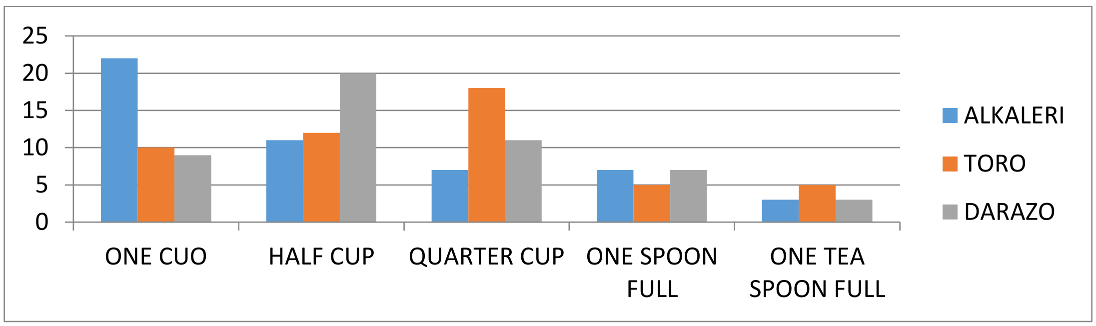

Figure 14: Distribution of respondents according to dosage used

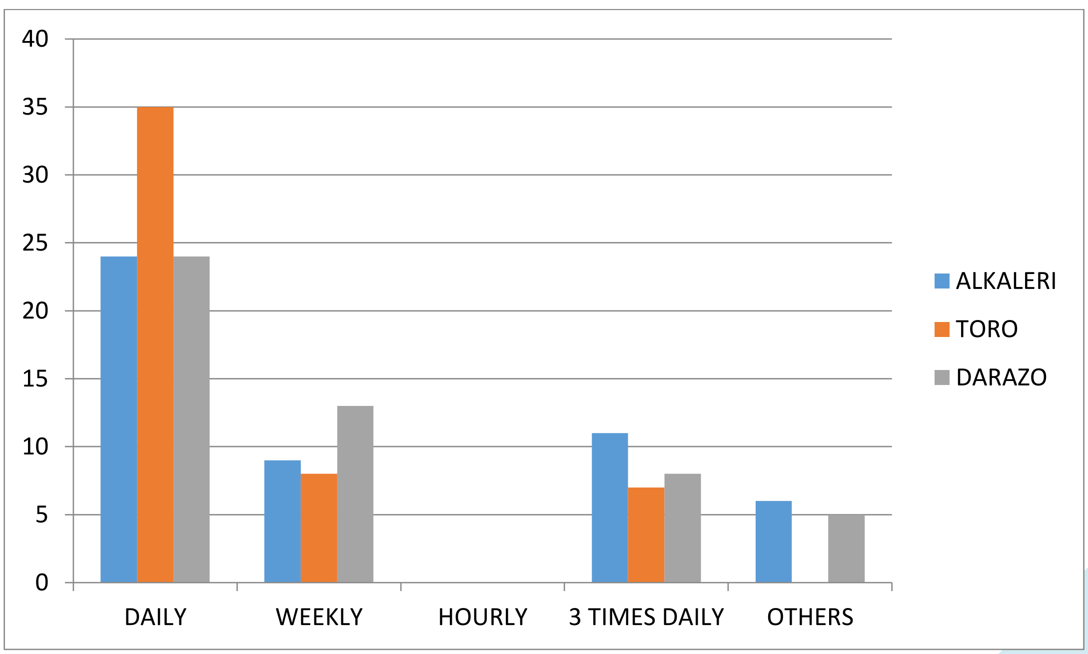

Figure 15: Distribution of respondents according to the number of times used for treatment

Table 1: Plants Identified in The Study Areas

S/N	Medicinal Plants	Local Names	Family	No of Citation (Ip)
1	Boswellia delzieii Hutch	Ararabi	Burseraceae	59
2	Indigofera pulchra Willd	Bakin Dunu	Fabaceae	2
3	Ipomoea asarifolia (Deser) Roem and Schult	Duman rafii	Convolvunlaceae	1
4	Cantinoa americana (Aubl.) Harley andJ.F.B. Pastore	Bagaruwa	Lamiaceae	1
5	Croton gratissimus Burch	Mubangwa	Eurphorbiaceae	1
6	Leucas martinicensis R. Br	Kanbarawo	Lamiaceae	1
7	Abrus precatorius L.	Idan zakara	Fabaceae	5
8	Sterculia setigera Delile	Kukkuki	Malvaceae	3
9	Prosopis africana (Guill, Perrott and Rich.) (Taub)	Kirya	Fabaceae	5
10	Ficus polita Vahl	Durumii	Moraceae	3
11	Erythrina senegalensis DC.	Minjiriya	Fabaceae	14
12	Cochlospermum tinctorum Perr. Ex A. Rich	Rawaya	Bixaceae	8
13	Ficus abutifolia (Miq) Miq	Ganyi	Moraceae	4
14	Securidaca longepudunculata Fresen.	Sanya	Polygalaceae	15
15	Crotalaria naragutensis Hutch	Wutawuta	Orobanchaceae	1
16	Vachellia nilotica (L). P.J.H Hurter andMabb	Birana	Fabaceae	1
17	Anisopus Manii N.E.Br	Gabaruwa	Fabaceae	6
18	Biophytum abyssinicum Steud. Ex A. Rich	Sakayau	Apocynceae	5
19	Parkia biglobosa (Jacq) R.Br. Ex G.Don	Dan kunya	Oxalidaceae	1
20	Striga hermontheca (Delile) Benth	Dorawa	Fabaceae	2
21	Termarindus indica L.	Tsaniya	Fabaceae	11
22	Thelepogon elegans Roth	Datanniya	Poaceae	1
23	Gymnosporia senegalensis (lam.) Loes	Namijin tsaada	Celastraceae	1
24	Ziziphus mucronata Willd	Magaryar kara	Rhamnaceae	1
25	Chrozophora senegalensis (L) A.Juss . ex. Spreng	Damagii	Euphorbiaceae	1
26	Moringa oleifera Lamk	Zogale	Moringaceae	22
27	Indigofera hirsuta Linn.	Kaikayi	Fabaceae	1
28	Ricinus communis L.	Zurman	Euphorbiaceae	1
29	Azadirachta indica A. Juss	Dar bejiya	Meliaceae	9
30	Terminalia leiocarpa (DC) Baill	Markee	Combretaceae	8
31	Mangifera indica L.	Mangworo	Anarcardiaceae	2
32	Gmelina arborea Roxb	Malaina	Lamiaceae	1
33	Balanites aegyptiaca (L) Delile	Dubagiraa	Zygophyllaceae	3
34	Diospyros mespiliformis Hochst. ex A.D.C	Mowar birii	Ebenaceae	4
35	Melia azedarach L.	Zaiti	Meliaceae	1
36	Ziziphus mauritiana Lam.	Magarya	Rhamnaceae	6
37	Ansellia africana Lindil	Manta uwaa	Orobanchaceae	2
38	Aeollanthus pubescens Benth.	Shashatou	Onagraceae	1
39	Guiera senegalensis J.F. Gmel	Sabara	Combretaceae	7
40	Cassia singuena Delile	Rumfu	Fabaceae	4

S/N	Medicinal Plants	Local Names	Family	No of Citation (Ip)
41	Nauclea latifolia SM.	Tuwon birii	Rubiaceae	3
42	Pennisetum glaucum (L) R.Br	Geroo	Poaceae	4
43	Sclerocarya birrea (A.Rich) Hochst	Danya	Anarcardiaceae	4
44	Senna italica Mill.	Filasko	Fabaceae	1
45	Pterocarpus erinaceus Poir	Madobiya	Fabaceae	16
46	Albuca nigritana (Baker) Troupin	Farin gadali	Hycinthaceae	4
47	Indigofera astragalina DC	Kakayi kamar	Fabaceae	1
48	Calotropis procera (Aiton) W.T Aiton	Tunfafiya	Apocynceae	1
49	Piliostigma reticulatum (DC) Hochst	Kalgo	Fabaceae	3
50	Englerina gabonensis (Engl.) Balle	Kauchin bin da zugu	Loranthaceae	1
51	Parinari curatellifolia Planch. Ex Benth	Rura	Chrysobalanaceae	1
52	Nauclea diderrichii (DC Wild) Merr.	Tafashiya	Rubiaceae	1
53	Pseudocedrela kotschyii (Schweinf.) Harms	Sassake tuna	Meliaceae	1
54	Garcinia kola Heckel	Namiji Gworo	Clusiaceae	1
55	Allium cepa L.	Albasa	Amaryllidaceae	4
56	Citrus sinensis (L) Osbeck	Lemu mai zakki	Rutaceae	2
57	Cymbopogon schoenanthus (L) Spreng	Nobe	Poaceae	1
58	Senna tora (L) Roxb	tabasa	Fabaceae	1
59	Adansonia digitata L	Kuka	Malvaceae	6
60	Detarium microcarpum Guill. and Perr.	Tauro	Fabaceae	6
61	Psidium guajava L.	Gwaiba	Myrtaceae	2
62	Vitex doniana Sweet	Dinya	Lamiaceae	2
63	Ficus thonningii Blume	Cediya	Moraceae	2
64	Raphionacine brownii Scott-Elliot	Laujiya	Apocynceae	1
65	Dichrostrachys cinerea Wight et Arn	Dundu	Fabaceae	1
66	Baccharoides adoensis (Sch.Bip. Ex Walp) H.Rob	Kumbra fage	Asteraceae	1
67	Cyperus articulatus L.	Kafin amarya	Asteraceae	3
68	Cyanthillium cinereum (L) H.Rob	Kajiiji	Cyperaceae	2
69	Fadherbia albida (Delile) A.Chev .	Gawo	Fabaceae	1
70	Solanium aethiopicum L.	Gauta	Solanaceae	8
71	Hyphaene thebaica (L) Mart	Gooriba	Arecaceae	4

Table 2: Phytochemical Components of the Four Medicinal Plants

Phytochemical	Boswellia dalzielli		Pterocarpus erinaceus		Securidaca longepedunculata	Moringa oleifera Lam.
	Bark	leaves	Stem bark	Leaves	Root	Leaves
Alkaloids	+	+ +	+	++	+	+++
Tannins	+	+ +	+	++	+	++
Saponin	+ +	+ +	+	-	+	+++
Flavonoids	+	+	++	++	+	+++
Glycosides	+ +	+	-	+	-	+

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Phytochemical	Boswellia dalzielli		Pterocarpus erinaceus		Securidaca longepedunculata	Moringa oleifera Lam.
	Bark	leaves	Stem bark	Leaves	Root	Leaves
Phenol	-	+	+	++	+	-
Steroids	+	-	+	+	-	+++
Terpenoids	+	+ +	+	-	++	-

Key:

- Absent

+ Present

++ Moderately present

+++ Strongly present

Figure 2 above shows the distribution of respondents by gender. The result shows that the majority of the respondents are male in all the local governments under study, with a small proportion of female respondents. Across the three LGAs, respondents were mostly male. Alkaleri recorded 44 males (88%) and 6 females (12%); Toro had 38 males (76%) and 12 females (24%); Darazo included 35 males (70%) and 15 females (30%). Overall, 117 of 150 respondents were male (78%), while 33 (22%) were female. These patterns indicate a male-dominated sample, with the proportion of male participants decreasing from Alkaleri >Toro >Darazo. The overall male preponderance likely reflects access, roles, or availability in ethnobotanical knowledge networks and community engagement. The dominance of male informants (78%) aligns with earlier observations by Erinoso and Aworinde (2012), who reported traditional medical practitioners and herbalists to be mainly males. This is to say that men are more often the public custodians of indigenous knowledge in Northern Nigeria.

Respondents were distributed across several age brackets, but none were younger than 11 years. The modal group across the study population was 31-40 years, accounting for 47 respondents (31%). This was followed by 21-30 years (39 respondents, 26%) and 11-20 years (28 respondents, 19%). Smaller proportions were recorded among 41-50 years (21 respondents, 14%), above 60 years (8 respondents, 5%), and 51-60 years (7 respondents, 5%). The age distribution of respondents, with the highest representation in the 31-40 age group, suggests that traditional knowledge is actively being practiced by a younger generation. The findings of Arowosegbe et al. (2015), however, align with those of the present investigation. They reported that the age bracket of 61 years and above had the least number of traditional medicine practitioners in Ekiti State, Nigeria. This could be ascribed to the fact that locality can be a determining factor in the integration of new healers in traditional medicine practices.

Respondents were drawn from a diverse range of occupations, reflecting the widespread involvement of different social groups in medicinal plant knowledge. The three largest categories overall were: Okada riders (motorcycle transporters): 21 respondents (14%): disproportionately concentrated in Darazo (13 respondents, 26%). Herbalists: 30 respondents (20%): evenly distributed across LGAs (10 in each). Traders: 12 respondents (8%), spread across all LGAs. Other notable groups included hawkers (19 respondents, 13%), food vendors (15, 10%), and farmers (10, 7%). Less represented occupations were housewives (9, 6%), labourers (8, 5%), vulcanizers (6, 4%), civil servants (4, 3%), truck pushers (4, 3%), students (3, 2%), herders (2, 1%), and drivers (3, 2%). This occupational heterogeneity highlights that medicinal plant knowledge is not restricted to full-time herbalists but permeates many sectors of society. Occupational diversity among informants, including herbalists, vendors, farmers, and collectors, indicates that the practice of traditional medicine transcends professional boundaries. Similar findings have been documented by Ukwuani-Kwaja et al. (2024), reinforcing the communal nature of ethnomedicinal knowledge and use.

Majority of respondents had only a primary-level education (First School Leaving Certificate, FSLC). Specifically, 110 respondents (73%) fell into this category. The secondary school group (SSCE) accounted for 31 respondents (21%), while only 9 respondents (6%) had tertiary-level education. This suggests that ethnomedicinal knowledge in the study areas is mainly held by individuals with low formal education, though Darazo shows slightly higher secondary-level representation. The predominance of FSLC holders aligns with the rural and semi-urban nature of the study areas, where access to higher education is limited. Despite lower formal education, respondents demonstrated substantial ethnomedicinal knowledge, reinforcing previous findings that indigenous health knowledge is transmitted primarily through oral traditions and apprenticeship rather than formal schooling. A similar trend was reported by Ukwuani-Kwaja et al. (2024), who recorded 98.08 % of respondents being illiterate in their study.

The majority of respondents across all LGAs identified as Hausa (103 respondents, 69%). Fulani respondents made up 43 (29%), while minority groups (Wurbo, Terawa, Dugurawa) together accounted for only 3 respondents (2%). Thus, Hausa respondents clearly dominate, followed by Fulani, with smaller ethnic groups represented only in Alkaleri. The dominance of Hausa respondents is unsurprising, given that Hausa is the majority ethnic group in Bauchi State and across northern Nigeria. The substantial Fulani representation, particularly in Alkaleri (44%), reflects the group's pastoral heritage and its reliance on ethnobotany. The presence of minority tribes (Wurbo, Terawa, Dugurawa) only in Alkaleri indicates greater ethnic diversity in the southern zone, possibly due to historical settlement patterns or intermarriage.

Respondents were classified according to the role they play in the use and circulation of medicinal plants. The largest category was users (71 respondents, 47%), followed by vendors (30, 20%) and herbalists (30, 20%). A smaller group were collectors (19, 13%). The predominance of users suggests that medicinal plant knowledge and application are not confined to specialists but are embedded in community health practices. Vendors and collectors serve as intermediaries in the ethnomedicinal economy, ensuring plant materials circulate from harvest sites to users. Herbalists, although fewer in number, play a crucial role in preserving specialized preparation knowledge. The uniformity across LGAs underscores that traditional medicine systems in Bauchi State are socially distributed rather than confined to specific localities.

Across LGAs, the dominant groups were those with 11-20 years and 21-30 years of experience, while very few had under 5 years' practice. Only a handful reported more than 40 years, indicating that while elder custodians exist, the bulk of healers are mid-career practitioners.

The depth of practitioner experience, with many respondents reporting more than 20 years of involvement in traditional medicine, suggests that these informants possess not only practical experience but also potentially undocumented knowledge. Their insights provide a valuable foundation for future pharmacological validation and may inform the development of novel therapeutic agents.

Respondents reported various pathways through which they acquired knowledge of medicinal plants. The major sources were: Tutoring/apprenticeship (the most common, with around 40% of respondents overall), Family inheritance/parental transfer (close behind at 37%, showing the role of intergenerational knowledge transmission), Self-discovery/experience (a smaller but notable proportion, approximately 15%), and peers and community elders (contributed the remaining share, under 10%). This distribution reflects the dual structure of ethnomedicinal knowledge transmission: vertical transfer through families and horizontal/community transfer through apprenticeship systems. The prominence of tutoring/apprenticeship confirms earlier findings by Anokbonggo (1992), who highlighted structured mentorship as critical in sustaining traditional medical practice.

Respondents identified four main ways by which they obtained medicinal plants: markets, wild collection, personal gardens, and other sources. Overall: Market was the dominant source (88 respondents, 59%), with the highest proportion in Darazo (33 respondents, 66%). Wild collection followed (49 respondents, 33%), most common in Alkaleri (21 respondents, 42%) and Toro (20 respondents, 40%). Garden cultivation was rare (4 respondents, 3%), mentioned only in Alkaleri and Toro. Other sources (friends, neighbours, mobile herbalists) accounted for 9 respondents (6%). This distribution shows that while markets are the primary avenue for medicinal plant access, wild collection remains important, particularly in Alkaleri and Toro, while home-based cultivation is minimal. The dominance of markets highlights the growing commercialization of medicinal plants, echoing observations by Erinoso and Aworinde (2012) that herbal markets are central to ethnomedicinal economies in Nigeria. However, the persistence of wild harvesting in Alkaleri and Toro demonstrates continued dependence on natural habitats. The very low level of garden cultivation suggests that conservation through domestic planting is not yet widely adopted, raising concerns about sustainability, especially given risks of overharvesting and habitat degradation

The result shows that respondents identified different parts of plants that they use medicinally. Leaves were overwhelmingly the most cited plant part (85 respondents, 57%), roots followed at 24% (36 respondents), stem bark accounted for 13% (20 respondents), and fruits (5 respondents, 3%) and seeds (4 respondents, 3%) were minimally mentioned. It was reported that the predominance in the use of leaves and barks could also be due to their fast regeneration, effectiveness, easier collection, the photosynthetic and biosynthetic activities which lead to the production of most bioactive substances Adia et al. 2014; Brahimi et al. (2022) and avoiding the extinction of the plant species as in the case of plant root collection (Asiimwe et al., 2021).

The result shows that decoction (boiling plant material in water) was the most common method, accounting for nearly half of all responses (47%). Infusion (soaking in hot or cold water) was the second most cited (25%). Pounding (crushing plant material for topical or oral application) was used by 15% of respondents. Chewing was mentioned by 8%. Concoction (mixing several plants or plant parts) was the least common (5%). Decoction and infusion dominate because they are culturally established, easy to prepare, and effective for extracting water-soluble phytochemicals such as tannins, saponins, and flavonoids. Decoction was found to be the widely adopted method, as corroborated by similar findings (Afolayan et al. 2014; Keo et al. 2018; Tugume et al. 2016; Umair et al. 2017). Conversely, Tumoro and Maryo (2016) and Habtamu et al. (2014) reported crushing, whilst Faruque et al. (2018) indicated paste as the most popular mode of herbal medicine preparation.

The result shows that Oral administration was by far the most common, accounting for about two-thirds (65%) of all responses. External application represented around 20% of responses. Inhalation (steam, smoke, or sniffing): used by about 10%. Others (e.g., rectal insertion, bathing with herbal water): very rarely mentioned (5%). In Alkaleri, oral administration was dominant, with some use of topical and inhalation. Toro showed a similar pattern, though inhalation was slightly more common than in Alkaleri. Darazo also emphasized oral administration, but had the highest proportion of topical applications compared to the other LGAs. The predominance of oral administration reflects the common belief that systemic ailments (malaria, gastrointestinal disorders, fever) are best treated internally. Topical applications are usually linked to wounds, skin infections, and rheumatic pains, while inhalation is often associated with respiratory complaints. The consistency across LGAs underscores the shared ethnomedicinal culture in Bauchi State.

Across all LGAs, the one-cupful measure was the predominant dosage, cited by 68 respondents (45.3%). This was followed by half-cupful (40 respondents, 26.7%) and spoonful (29 respondents, 19.3%). Less common were capful (8 respondents, 5.3%) and others (5 respondents, 3.4%). Overall, the findings highlight the tension between cultural accessibility and scientific standardization: while household measures democratize access to remedies and preserve indigenous practice, they also underscore the urgent need for pharmacological validation and metric standardization of dosages for high-fidelity plants such as *Azadirachta indica* and *Vernonia amygdalina.*

Among the 71 species identified, Boswellia dalzielii Hutch. was the most frequently cited (n = 59), also exhibiting the highest fidelity level (39.3%). Other frequently mentioned species included *Moringa oleifera Lam., Pterocarpus erinaceus, Tamarindus indica,* and *Securidaca longepedunculata*. These results are in concordance with findings from Olowokudejo et al. (2008) and Sule et al. (2019), underscoring the therapeutic versatility and cultural importance of these plants.

Phytochemical components of the four identified plants with the highest fidelity values.

The use of medicinal plants to treat and manage various forms of diseases and dysfunctions is becoming increasingly popular and has received wide acceptance. Nigeria, an important nation of biodiversity, is enriched with herbal resources. Reports on the effects of these medicinal plants on animal and human health are diverse. The chemical evaluation of medicinal plants and their isolates has transformed traditional medicine from an almost invisible trade into a modern industrial enterprise, capable of making a significant contribution to both health care delivery and economic growth of most developing countries (Adeleke and Ndah, 2022)

The result of phytochemical screening of the leaves of *Boswellia dalzielli* (Bark and Leaves), *Pterocarpus erinaceus* (stem bark and leaves), *Securidaca longepedunculata root,* and *Moringa oleifera Lam* leaves are summarized in Table 2.

The phytochemicals in the methanolic extract of four medicinal plants were evaluated qualitatively for eight parameters, like Alkaloids, Flavonoids, Phenols, tannins, Saponins, terpenoids, Steroids, and glycosides. The results indicated that medicinal plants showed the presence of Alkaloids, Flavonoids, Phenols, tannins, Saponins, terpenoids, Steroids, and glycosides (Table 2). The degree of phytochemicals, however, varied among different plants.

Phenolic compounds were moderately present in *Pterocarpus erinaceus* leaves (2+). The phenol was Present in *Boswellia dalzielli* leaves, *Pterocarpus erinaceus* stem bark, and *Securidaca longepedunculata* root (+). Phenol was absent (-) in *Boswellia dalzielli* leaves and *Moringa oleifera Lam*. Leaves. *Pterocarpus erinaceus* leaves displayed the highest presence of phenol, the result is in line with the findings of Vandi et al. (2024), who stated that *Pterocarpus erinaceus* leaves have been found to contain chemical compounds such as phenols and reported phenols to be strongly present (3+) in *Pterocarpus erinaceus* leaves. Phenolic compounds have anti-oxidative, antidiabetic, anticarcinogenic, antimutagenic, and anti-inflammatory properties (Fawehinmi et al., 2020)

Saponins were strongly present in *Moringa oleifera Lam.* leaves (3+), *Boswellia dalzielli* bark and leaves contained moderate levels of saponins (2+), *Pterocarpus erinaceus* stem bark and *Securidaca longepedunculata* root contained low level of saponins (+) while saponin was absent (-) in *Pterocarpus erinaceus* leaves. This result is an indication that the Moringa leaves contained saponins in high amounts. Similarly, Adekanmi et al. (2020) reported high levels of saponins in ethanoic extract of *Moringa oleifera Lam.* leaves and moderate levels of saponin in Aqueous extracts of *Moringa oleifera Lam.* Leaves. Saponins are essential in the treatment of hypercholesterolemia by preventing cholesterol reabsorption and result in low serum cholesterol by binding to cholesterol to form insoluble complexes excreted via the bile (Olaleye, 2007). Saponin reduces the cholesterol in the blood and blood pressure. Thus, saponins reduce the risk of cardiovascular diseases such as hypertension (Adekanmi *et al.,* 2020).

Flavonoid was strongly present in *Moringa oleifera Lam.* leaves (3+), *Pterocarpus erinaceus* stem bark and leaves contained moderate levels of saponins (2+), *Boswellia dalzielli* bark and leaves, and *Securidaca longepedunculata* root contained low levels of saponins (+). This is an indication that the Moringa leaves contain a high quantity of flavonoids. The presence of flavonoids in Moringa leaves is responsible for its use in the acceleration of labour in southwestern Nigeria during birth, and this might be linked to the high content of flavonoids and phenolic compounds (Okwu et al., 2009). Flavonoids are good antioxidants and free radical scavengers, which help in inhibiting cancer cell activity. In traditional medicine, it is reported that the presence of these phytochemical constituents in these plant extracts is responsible for their medicinal uses to cure ailments like malaria, diabetes, constipation, stomach pain, and other ailments (Isah *et al.,* 2021). Flavonoids have been shown to have the ability to modify the body's reaction to allergens, carcinogens, and viruses. They also show antimicrobial and anticancer activity (Fawehinmi *et al.,* 2022).

Alkaloid was present in high concentration in *Moringa oleifera Lam* leaves, present in moderate concentration on *Boswellia dalzielli* and *Pterocarpus erinaceus* leaves, while present in low concentration in *Boswellia dalzielli* bark and *Pterocarpus erinaceus* stem bark. Alkaloids and their synthetic derivatives exhibit antispasmodic, antibacterial, and analgesic properties (Ahmed *et al.,* 2017). This result corresponds with that of Pinal et al. (2014), who also reported the presence of alkaloid, flavonoid, steroid, saponin, tannin, but absence of glycoside in the aqueous extract of M. oleifera. Alkaloids are a vast and structurally diverse collection of chemicals that have been used as scaffolding for antibacterial medications like metronidazole and quinolones. Alkaloids help to regulate hypoglycemic activity also (Rajkumar *et al.,* 2022). The results of this study show that the total alkaloid content was highest in *Moringa oleifera Lam* leaves.

Steroids are strongly present in *Moringa oleifera Lam*. Leaves, slightly present in *Boswellia dalzielli* bark, Pterocarpus *erinaceus* stem bark and leaves, and absent in *Boswellia dalzielli* leaves and *Securidaca longepedunculata* root. Plant steroids are vital for their cardiotonic properties and are employed in nutrition, herbal medicine, and cosmetics manufacturing. Steroids are used to stimulate bone marrow and promote growth. It promotes lean body mass and aids in preventing bone loss in older men (Rajkumar *et al.,* 2022). As a result of this study, steroids were found to be highest in *Moringa oleifera Lam* leaves. Steroids and triterpenoids also exhibit analgesic properties. This may justify its use in the treatment of fever.

Terpenoids were moderately present in *Boswellia dalzielli* leaves and *Securidaca longepedunculata* root, slightly present in *Boswellia dalzielli* bark and *Pterocarpus erinaceus* stem bark, but absent in *Pterocarpus erinaceus* and *Moringa oleifera Lam*. Leaves. This result disagrees with the findings of Ariwaodo et al (2024), who reported Terpenoids in *Pterocarpus erinaceus* leaves, and Pareek et al. (2023), who reported the presence of Terpenoids in *Moringa oleifera Lam*. Leaves. Terpenoids are known to possess activity against bacteria and viruses. It has also been used as an anti-malaria, anti-inflammatory, and to treat cardiovascular diseases (Fawehinmi *et al.,* 2022).

Tannins were found to be moderately present in *Boswellia dalzielli* leaves, *Pterocarpus erinaceus* leaves, and *Moringa oleifera Lam*. Leaves, slightly present in *Boswellia dalzielli* bark, *Pterocarpus erinaceus* stem bark, and *Securidaca longepedunculata* roots. Tannins have been reported to possess an astringent property in the gastrointestinal tract, reducing peristaltic movement and intestinal secretion. The result of the study, therefore, suggests that the extract has the potential of being developed as an anti-motility agent as a remedy for gastrointestinal tract system-related problems (Mamza *et al.,* 2020). The qualitative analysis indicated an abundance of tannins in the ethanol extract as compared to the aqueous extract.

Glycosides were moderately present in *Boswellia dalzielli* bark, slightly present in *Boswellia dalzielli* leaves, *Pterocarpus erinaceus* leaves, and *Moringa oleifera Lam*.

Leaves, absent in the *Pterocarpus erinaceus* stem bark and the *Securidaca longepedunculata* root. Glycosides have been shown to possess antibacterial activity (Mamza et al., 2015b; Mamza et al., 2017).

Conclusion

This study reveals a vibrant and deeply embedded tradition of medicinal plant use in the rural communities of Bauchi State. Despite the availability of modern healthcare facilities, local populations continue to rely heavily on traditional remedies, which are perceived as accessible, affordable, and culturally congruent. The ethnobotanical data collected demonstrate that knowledge transmission remains active, particularly among middle-aged groups, although it still largely depends on oral traditions.

The findings also raise important concerns regarding sustainability. The extensive use of wild plant resources, especially bark and root harvesting, threatens local biodiversity and underscores the need for urgent conservation measures. Additionally, while several medicinal plants have been well-documented in literature, others identified in this study remain under-researched and require further scientific exploration.

Given the high fidelity levels of some species, and their widespread use across multiple ailments, the phytochemical evaluation of these plants presents a significant opportunity for drug discovery and public health advancement as the possess rich phytochemical properties. Moreover, integrating validated traditional practices into formal healthcare systems may help bridge existing gaps in primary care delivery, particularly in underserved rural areas.

In conclusion, this study contributes valuable data to the ethnobotanical literature of Northern Nigeria and provides a roadmap for harnessing traditional medicine in a manner that is scientifically validated, culturally respectful, and ecologically sustainable.

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