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ETHNO-BOTANICAL SURVEY OF PLANT SPECIES USED FOR MOSQUITO CONTROL IN GADAU, BAUCHI STATE

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ABSTRACT

This study assessed the ethno-botanical plant species used for mosquito control in Gadau, Bauchi State. The study was conducted between July and August, 2024. In this study, a cross-sectional design method was employed. A popular market in Gadau town, known for its large number of herbal vendors on market days, was purposively selected as the study area. The questionnaire, adapted from previous studies was administered in the local language, commonly Hausa, depending on the respondent's preference. Male respondents constituted the majority, 31 (72.09%), compared to females, 12 (27.91%), with a significant difference observed between genders ($\chi^2 = 36.1$, p < 0.05). Among the age groups, the 25–34-year range had the highest percentage of respondents, 19 (44.19%), followed by 18-24 years (27.91%), 35-44 years (13.95%), 45-54 years (9.30%), and the least represented were the 55-64 years and 65+ years categories, each at 2.33%. A significant difference was also noted among respondents based on age ranges (p < 0.05). Nine plant species belonging to six families were identified: Tageteserecta, Azadirachtaindica, Cymbopogoncitratus, Salvia rosmarinus, Allium sativum, Menthapiperita, Lavandulalatifolia, Carica papaya and Vernoniaamygdalina. The Lamiaceae family recorded the highest number of species (33.33%), followed by Asteraceae (22.22%), with Meliaceae, Poaceae, Alliaceae, and Caricaceae contributing one species each (11.11%). Therefore, it is essential that the diverse plant species in the Gadau community, particularly those identified in this study be further investigated for their mosquitocidal and repellent properties. This research provides crucial evidence to support the consideration of these plants as viable alternatives to synthetic insecticides.

Keywords: Ethno-botanical, mosquito, control, plant species

INTRODUCTION

Mosquitoes have been known for various disease transmissions considered as mosquito-borne diseases such as malaria which is the most common among them. They transmit more diseases than any other group of arthropods, and affect millions of people globally (Massoud, 2014). In order to eliminate or reduce mosquito-borne disease and to ensure quality of environment and public health concern, strategies for mosquito control are crucial. Mosquito-borne disease control involves the prevention of mosquito bites through the use of various methods including; Insecticides-Treated Nets (ITNs), killing of mosquitoes by reducing their breeding sites, use of residual insecticides and treatment of affected individuals (WHO, 2006; Wangai et al., 2020; Nyasvisvo et al., 2024).

Previous studies have shown that Insecticide-Treated Nets (ITNs) and Indoor Residual Spraying (IRS), along with the use of botanical-based methods, are effective in preventing mosquito bites and mosquito-borne diseases such as malaria by reducing human-mosquito contact (Bekele, 2018; Nyasvisvo *et al.*, 2024).

Botanical residues play a crucial role in controlling malaria in region where drug resistant mosquito species are dominant (WHO, 2017; Nyasvisvo *et al.*, 2024). Therefore, the use of plant-based has become a fundamental strategy in public health efforts to prevent mosquito-borne diseases (Nguyen *et al.*, 2018).

Ethno-botany is the scientific study of useful plants prior to commercial exploitation and eventful domestication (Erinoso and Aworinde, 2012). It is also described as the scientific study of interrelated between humans and plants and involves the study of indigenous or traditional knowledge of plants, their classification, and cultivation, use as food, medicine and shelter (Iwu, 2002; Okoh et al., 2021; Nyasvisvo et al., 2024). Plants have been traditionally used as remedies for protection against different species of mosquitoes (Asodallah et al., 2019). Several efforts have been evaluated using plant extracts or essential oils in controlling different species of mosquitoes (Lorenz et al., 2013; Asodallah et al., 2019; Wangai et al., 2020; Nyasvisvo et al., 2024). Thus, plants remain as an effective alternative source of important bioactive compounds for the control of mosquitoes.

Furthermore, plant-based mosquito control bioactive substances are generally considered as easily available, eco-friendly, inexpensive, easy in preparation and culturally accepted by community of a particular region (Kumar *et al.*, 2011; Diaz *et al.*, 2016; Youmsi *et al.*, 2017; Nyasvisvo *et al.*, 2024).

Plants have been used for the treatment of various ailments. It has been revealed by several evaluations that the treatment potential is due to the presence of bioactive compounds constituted in the plant. These bioactive compounds have extensively applied in the field of medicine (Dias *et al.*, 2012; Tukur *et al.*, 2024). This is why the main source of healthcare of large number of individuals in many developing countries has reported from plant materials (Adnan *et al.*, 2014; Tukur *et al.*, 2024). Similarly, the plant based medications have identified as a prominent and primitive type of therapy (Halberstein, 2015).

Ethno-botanical surveys play a crucial role in understanding the cultural beliefs and knowledge of a community regarding medicinal plants in a specific region. These surveys also help examine the economic and socio-cultural factors that influence health perceptions and practices while providing insights in to prevalent diseases within a given geographical area. As noted by Erinoso and Aworinde, (2012) and Lawal et al., (2010), such studies offer valuable information on medicinal plants that can address health challenges in rural communities. However, despite their significance in improving public health, many medicinal plants remain undocumented and unpreserved, as highlighted by Hassan et al. (2024). Additionally, the limited data on ethno-botanical plants used for mosquito-borne disease control in this community may be attributed to its small population size. Nevertheless, assessing local knowledge and practice related to medicinal plants with mosquito-repellant properties is essential. This study aims to systematically document ethno-botanical knowledge of plants used for mosquito control within the Gadau community. By compiling a list of these plants, the research seeks to identify potential candidates for further screening and development in to plant-based mosquito-control products, particularly for malaria prevention. These efforts could make significant contribution to public health initiatives focused on reducing or eradicating mosquito-borne diseases in the future.

MATERIALS AND METHODS

Study area

This study was conducted in Gadau town, located in the Itas/Gadau Local Government Area (L.G.A.) of Bauchi State, Nigeria. Gadau is a small town situated in the eastern part of Itas/Gadau L.G.A., at coordinates 11°50′08″N and 10°10′02″E. The predominant ethnic groups in the area are the Hausa and Fulani, similar to other regions within the state (NNBS, 2010). Gadau town is a small community with a relatively low population, located within the Itas/Gadau Local Government Area of Bauchi State, Nigeria, which it

shares with Itas town. Surrounding Gadau are subcommunities such as Malumawa, Atawari, Walai, and Katsinawa (Hassan and Disina, 2020). Covering an estimated area of 1,398 km², Gadau is relatively small in land size, as reported by the Nigerian National Bureau of Statistics (2010).

Sampling methods

In this study, a cross-sectional design method was employed as described by Okoh et al. (2021). A popular market in Gadau town, known for its large number of herbal vendors on market days, was purposively selected as the study area. In the market, vendors selling herbs, as well as individuals such as traditional healers, traditional rulers, hunters, and farmers, were identified and approached. Wellstructured questionnaires were administered to gather information on the types of plants used to repel or kill mosquitoes, following the methodology outlined by Okoh et al. (2016, 2017, 2018). Plants identified as having mosquito-repelling or killing properties were sourced, dried, and pressed using a suitable plant press, as reported by Okoh et al. (2021). These plants were subsequently identified and authenticated in the herbarium of the Department of Biology, Bauchi State University, Gadau, Bauchi State, Nigeria.

Questionnaire design and data collection

The questionnaire, adapted from previous studies (Grønhaug *et al.*, 2008; Samoisy and Mahomoodally, 2015; Dorla *et al.*, 2019), was administered in the local language, commonly Hausa, depending on the respondent's preference. The first section gathered general information, including gender, age, occupation, educational status, and place of residence, while the second section focused on knowledge of plants used for mosquito control in the environment (Dorla *et al.*, 2019).

A total of 50 respondents were randomly selected from various locations, including the market, streets, homes, and farms. The study also included input from traditional healers, ethnobotanists, hunters, traditional rulers, and farmers.

Data analysis

Data obtained from the completed questionnaires were extracted and entered into Microsoft Excel 2019 software. Descriptive statistics, including percentages and frequencies, were calculated. Chi-square statistics were used to analyze associations between demographic variables, with the significance level set at 95%

RESULTS AND DISCUSSION

Socio-demographic information of the respondents

In this study, a total of fifty (50) structured questionnaires were administered to the Gadau community to gather information on plant species used for mosquito control in the area. Of these, forty-three (43) were fully completed and retrieved. Male respondents accounted for a higher percentage, 31 (72.09%), compared to females, 12 (27.91%), with a significant difference observed between genders ($\chi^2 = 36.1$, p < 0.05).

Among the age groups, respondents aged 25–34 years had the highest representation, 19 (44.19%), followed by 18–24 years, 12 (27.91%), 35–44 years, 6 (13.95%), and 45–54 years, 4 (9.30%), while the least represented were those aged 55–64 years and 65 years and above, each with 1 respondent (2.33%). A significant difference was observed among the respondents based on age groups (p < 0.05). Regarding occupations, farmers constituted the largest group, 20 (46.51%), followed by herbalists, 16 (37.21%), hunters, 4 (9.30%), and traditional healers, 3 (6.98%). A significant variation was found in respondents' opinions based on occupation (p < 0.05).

In terms of educational status, secondary certificate holders represented the highest percentage, 13 (30.23%), followed by respondents with non-formal education, 11 (25.58%), primary certificate holders, 10 (23.26%), and tertiary certificate holders, 9 (20.93%). A significant difference was noted among respondents concerning their educational status (p < 0.05). Community positions revealed that regular members accounted for the highest percentage of respondents, 28 (65.12%), followed by religious leaders, 7 (16.28%), and community leaders, 5 (11.63%). A significant difference was also observed among respondents based on their positions in the community (p < 0.05) (Table 1).

 Table 1: Socio-demographic characteristics of the respondents

Items	Frequency	Percentage	P-
		_	value
Sex			
Male	31	72.09	< 0.05
Female	12	27.91	
Total	43	100	
Age			
18-24	12	27.91	
25-34	19	44.19	
35-44	6	13.95	$<\!0.05$
45-54	4	9.30	
55-64	1	2.33	
65above	1	2.33	
Total	43	100	
Occupation			
Herbalist	16	37.21	
Farmer	20	46.51	
Hunter	4	9.30	< 0.05
Traditional healer	3	6.98	
Total	43	100	
Educational status			
Non formal education	11	25.58	
Primary certificate	10	23.26	
Secondary certificate	13	30.23	< 0.05
Tertiary certificate	9	20.93	
Total	43	100	
Position in the commun	ity		
Community leader	5	11.63	
Youth leader	3	6.98	
Religious leader	7	16.28	$<\!0.05$
Member	28	65.12	
Total	43	100	

 Table 2: Plant species used for mosquito control in

 Gadau, Bauchi State

Common name	Scientific name	Family
Marigold	Tageteserecta	Asteraceae
Neem	Azadirachtaindica	Meliaceae
Lemon grass	Cymbopogoncitratus	Poaceae
Rosemary	Salvia rosemarinus	Lamiaceae
Garlic	Allium sativum	Alliaceae
Peppermint	Menthapiperita	Lamiaceae
Lavender	Lavandulalatifolia	Lamiaceae
Pawpaw	Carica papaya	Caricaceae
Bitter leaf	Vernoniaamygdalina	Asteraceae

Table 3: Percentage distribution of plant families forspecies used in mosquito control in Gadau, BauchiState

Family	No. of species	Percentage
Asteracea	2	22.22
e		
Meliaceae	1	11.11
Poaceae	1	11.11
Lamiacea	3	33.33
e		
Alliaceae	1	11.11
Caricacea	1	11.11
e		
Total	9	100

Plant species used for mosquito control in Gadau, Bauchi State

In this study, a total of nine (9) plant species were recorded, distributed across six (6) families. The plant identified Tageteserecta, species include Azadirachtaindica, Cymbopogoncitratus, Salvia rosmarinus, Allium sativum, Menthapiperita, Lavandulalatifolia, Carica papaya, and Vernoniaamygdalina (Table 2). Among the recorded families, Lamiaceae had the highest number of species (3; 33.33%), followed by Asteraceae (2; 22.22%), while Meliaceae, Poaceae, Alliaceae, and Caricaceae each had 1 species (11.11%) (Table 3). Regarding preparation methods, crushing was the most common technique, accounting for 62.79%, followed by infusion (18.60%), decoction (11.63%), and burning leaves (6.98%) (Figure 2). In terms of application methods, smearing was the most frequently used method (41.86%), followed by fumigation (30.23%), dropping (18.60%), with the least being chewing (9.30%) (Figure 3). Based on the plant parts used, leaves had the highest percentage (53%), followed by stems (28%), flowers (12%), and roots (7%) (Figure 4).

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Figure 2 Frequency of plant preparation methods for mosquito control in Gadau, Bauchi State



Figure 3: Frequency of application methods for plants used in mosquito control in Gadau, Bauchi State



mosquito control in Gadau, Bauchi State

In this study, the demographic data revealed that s significant majority of respondents (86%) possessed substantial knowledge of plants used for mosquito control in Gadau community Bauchi State. This observation is similar to findings in Nigeria, Tanzania, Southern Uganda, and Cameroon where respondents

showed high knowledge of plants used for mosquito control (Okoh et al., 2021; Youmsi et al., 2017; Mwine et al., 2011; Kweka et al., 2008). Most of the respondents (72.09%) were males while 27.91% were females. This is in agreement with the pattern reported by Koop et al., 2021; Tukur et al., 2020; Kankara et al., 2019; Youmsi et al., 2017; Okello and Sesgawa, 2007; Bekalo et al., 2009; Cheikyoussef et al., 2011 who noted that males dominated the herb selling business and it is related while women seem to have less knowledge than men about traditional medicine. This could be attributed to the fact that most of the respondents from Gadau community prefer to engage their male individuals in the family line of trade instead of their female individuals who are likely to be married later in life. This is in agreement with the pattern reported by Okoh et al. (2021).

Most of the respondents (44.19%) were youths between 25 and 35 years. However, the knowledge exhibited by this age group of youthful population in utilizing plants for mosquito control purposes might have been gained from their elderly parents (Igoli et al., 2003; Okoh et al., 2021). More so, the youths are more energetic compared to their older parents and hence they can be found in the market environment participating in one activity or the other. But our findings corroborated findings by Tukur et al., (2020) which revealed that most of the respondents with traditional knowledge on plants with medicinal property fall in the age bracket of 51 and 60 years respectively. Most of the respondents (46.51%) were farmers, they don't consider their talent on medicinal plants as a means of sourcing their daily needs, but rather blended their medicinal knowledge with farming activities. Followed by herbalist (37.21%), their population was second and they mostly find in the market areas interacting with people in medicinal business.

Most of the respondents had secondary school education (30. 23%), second in population were the respondents with non-formal education (25.58%), 23.16% of the respondents with only primary school education and few of the respondents 20.93% with tertiary education. (Okoh *et al.*, 2021) observed a different scenario in Nigeria where almost of the herbal medicine sellers had non-formal education. Also, our findings were inconsistent to that of Tukur *et al.* (2020); Bourhia *et al.* (2019), Samouah *et al.* (2019) and Aliyu and Abubakar (2016).

Most of the respondents (65.12%) were community members. This indicated that most of the community people with political titles, religious positions and traditional titles were not participated in the act of sharing knowledge regarding medicinal plants. Though a small percentage of religious leaders (16.28%), community leaders (11.63%) and youth leaders (6.98%) where participated in this study. In Gadau community, a total of nine plant species belonging to six families were mentioned by respondents. The plant species recorded includes; *Tageteserecta, Azadirachtaindica, Cymbopogoncitratus, Salvia rosemarinus, Allium* sativum, Menthapiperita, Lavandulalatifolia, Carica papaya and Vernoniaamygdalina. The low number of plant species recorded in the area may be due to the fact that the area, like other Northern parts of Bauchi State Nigeria, are involved in deforestation activities in the name of sourcing firewood, and most of the vegetation would have been cleared and replaced by buildings for commercial business purposes. Similar finding was reported by Okoh *et al.* (2021) in some part of Nigeria. In this study, Lamiaceae and Asteraceae were the most

utilized families for mosquito control purposes in the surveyed area. Leaves (53%) were the most utilized plant part followed by stem (28%), flowers (12%), and roots (7%). This is similar with findings from various studies in which the leaves were identified as the most utilized plant parts for mosquito control (Okoh et al., 2021; Youmsi et al., 2017; Salako et al., 2015; Buwa-Komoren et al., 2019). Moreover, the fact that leaves are exposed and conspicuous makes them easy target for herbivores and other pathogens (Okoh et al., 2021). Plants are therefore likely to deposit and store secondary metabolites in this area to serve as deterrent to predators. The high utilization of leaves by the respondents for insecticidal and repellence purposes could also be because they are easily available and renewable (Okoh et al., 2021).

However, more studies from previous investigation in Nigeria have supported and confirmed the leaves as most utilized part in the treatment of various illness as revealed by Tukur *et al.*, (2020) as traditional healers utilized leaves the most, which is consistent with other research (Regassa, 2013; Teklay *et al.*, 2013; Bekalo *et al.*, 2009; Chekole, 2015; Busia, 2016; Augustine and Alex, 2017). Because leaves are the side of plants where photosynthetic activity occurs and because they contain very high quantities of bioactive compounds, leaves are usually used in ethno-medicine (Tukur *et al.*, 2020).

CONCLUSION

In this study, a total of nine (9) plant species were recorded, distributed across six (6) families. The plant species identified include Tageteserecta, Azadirachtaindica, Cymbopogoncitratus, Salvia rosmarinus, Allium sativum, Menthapiperita, papaya, Lavandulalatifolia, Carica and Vernoniaamygdalina. Among the recorded families, Lamiaceae had the highest number of species, followed by Asteraceae, while Meliaceae, Poaceae, Alliaceae, and Caricaceae each equal number of species. Crushing was the most common method of plant preparation, accounting for high practice rate, followed by infusion, decoction, and burning leaves. In terms of application methods, smearing was the most frequently used method, followed by fumigation, dropping, with the least being chewing. Based on the plant parts used, leaves had the highest percentage, followed by stems, flowers, and roots. Documentation of plants with mosquito-repellant property in Gadau community becomes essential, as the elderly, who are often the

custodians of such knowledge, are also rapidly diminishing. Therefore, it is essential that the diverse plant species in the Gadau community, particularly those identified in this study be further investigated for their mosquitocidal and repellent properties. This research provides crucial evidence to support the consideration of these plants as viable alternatives to synthetic insecticides. Such investigations could pave the way for sustainable, environmentally friendly mosquito control solutions, benefiting both public health and the local ecosystem. Additionally, exploring the effectiveness of these plants could contribute to reducing reliance on chemical insecticides, which have potential negative impacts on health and the environment.

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