Journal of Applied Life Sciences and Environment
https://jurnalalse.iuls.ro

USV 1842

Article
https://doi.org/10.46909/alse-591207
Vol. 59, Issue 1 (205) / 2026: 105-133

ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED IN THE MANAGEMENT OF PEPTIC ULCER DISEASE IN IGABI LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

Oluyinka Christopher ARIYO

Department of Entrepreneurship and Innovative Agriculture, Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria [FRIN], P.M.B. 2273, Afaka, Kaduna State, Nigeria

*Correspondence: ask4ariyo@yahoo.com

Received: Mar. 25, 2026. Revised: May 13, 2026. Accepted: May 18, 2026. Published online: Jun. 12, 2026

ABSTRACT. Peptic ulcer disease (PUD) results from an imbalance between gastric mucosal defence mechanisms and aggressive factors. Although modern anti-ulcer drugs are available, many rural communities in Nigeria continue to rely on traditional medicinal plants for ulcer management. This study documented the diversity and ethnomedicinal relevance of plants used for the treatment of PUD in Igabi Local Government Area (LGA), Kaduna State, Nigeria. A cross-sectional survey was conducted among 110 respondents, comprising 36 traditional herbalists and 74 herb sellers selected through random sampling from 4 villages and major commercial centres within the LGA. Data were collected using semi-structured interviews and analysed using descriptive statistics, frequency of occurrence (FO), and fidelity level (FL) to determine the cultural significance of each species. A total of 22 plant species belonging to 17 families were recorded, with Fabaceae (subfamilies Mimosoideae and Papilionoideae) being the most represented family. *Ocimum gratissimum* (FO: 45; FL: 40.91%), *Bryophyllum pinnatum* (FO: 40; FL: 36.36%), and *Carica papaya* (FO: 39; FL: 35.45%) were the most frequently cited species. Leaves (40.91%) and seeds (22.73%) were the most commonly used plant parts, while grinding (33.33%) and decoction (20.83%) were the predominant preparation methods. Oral administration through drinking (54.55%) and eating (40.91%) was the most common route of administration. High FLs indicate strong traditional consensus regarding the therapeutic value of several species. These plants may serve as promising sources of novel gastroprotective compounds. Further pharmacological studies, including bioassay-guided fractionation,

Cite: Ariyo, O.C. Ethnobotanical study of medicinal plants used in the management of peptic ulcer disease in Igabi Local Government Area, Kaduna State, Nigeria. *Journal of Applied Life Sciences and Environment* **2026**, *59* (1), 105-133. https://doi.org/10.46909/alse-591207

metabolite characterisation, and in vivo validation, are recommended to substantiate their anti-ulcer potential and support future drug development.

Keywords: ethnobotany; herbalists; herb sellers; medicinal plants; peptic ulcer.

INTRODUCTION

Ulceration is defined as an open sore on the skin or mucous membrane, characterised by the localised shedding of inflamed, necrotic tissue (Chan and Graham, 2004). While these lesions can manifest on the skin of the lower extremities or elsewhere on the body, they are most clinically significant when occurring within the digestive tract (Tesfaye *et al*., 2022). Peptic ulcer disease (PUD), specifically, refers to sores that develop on the lining of the stomach, the upper small intestine (duodenum), or the oesophagus, a condition resulting from a fundamental breach in the mucosal barrier due to the erosive effects of acid-pepsin exposure (Abebaw *et al*., 2017; Debjit *et al*., 2010). The pathogenesis of PUD is typically rooted in a disruption of the delicate balance between aggressive gastrointestinal factors and mucosal defence mechanisms (Gadekar *et al*., 2010). Common triggers include *Helicobacter pylori* infection, chronic use of non-steroidal anti-inflammatory drugs such as aspirin and ibuprofen, psychological stress, excessive alcohol consumption, smoking, poor dietary habits, and age-related declines in prostaglandin synthesis (Stewart and Ackroyd, 2011).

The global biodiversity of plant species serves as a cornerstone of both ecological stability and human health. Botanical diversity is fundamental to ecosystem resilience, providing essential services that sustain life and livelihoods (Bita-Nicolae and Dhyani, 2025). This biological wealth is increasingly recognised not only for its environmental value but also for its untapped pharmacological potential. Recent research emphasises that the systematic study of plant diversity is essential for the discovery of novel lead compounds capable of addressing contemporary health challenges, particularly as climate change and habitat loss threaten these genetic reservoirs (Mykhailenko *et al*., 2025). Within this framework, medicinal plants have become a central focus of biomedical research. Evidence indicates that bioactive secondary metabolites, particularly flavonoids, tannins, and related phenolic compounds, play key roles in gastroprotection and may offer safer, plant-based alternatives to conventional synthetic pharmaceuticals (Julián-Flores *et al*., 2025; Sun and Shahrajabian, 2023).

Current conventional treatments for PUD, such as proton pump inhibitors (omeprazole, pantoprazole), histamine receptor blockers (ranitidine, cimetidine), and antibiotics, are effective in suppressing acid secretion but are often associated with adverse effects, including dizziness, headache, constipation, and sexual dysfunction (Gulmez *et al*., 2007; Sarkar *et al*., 2008). Furthermore, the rising cost of these medications makes them inaccessible to many people in developing nations, where traditional medicine remains a vital pillar of primary healthcare (WHO, 2019; Cameron *et al*., 2009). Nigeria, with its immense botanical heritage of more than 7,000 plant species, represents a vast resource

for drug discovery (Attahiru, 2025). Traditional healers have long utilised this flora to manage a range of infectious and degenerative diseases, with more than 50,000 plant species identified globally for medicinal use (Akinwumi and Sonibare, 2019; Dike *et al*., 2012; Beverly and Sudarsanam, 2011; Schippmann *et al*., 2002). Despite this, it is estimated that humans have explored less than 10% of plant species for their therapeutic properties (Romano *et al*., 2021).

There is an urgent need to document this ethnomedicinal knowledge because the oral transmission of indigenous practices is increasingly vulnerable to the erosion of cultural heritage and environmental degradation (Kaido *et al*., 1997; Mahomoodally, 2013). Given the significant morbidity and mortality associated with untreated or poorly managed peptic ulcers (Daniel *et al*., 2017), together with the continuing decline in indigenous knowledge, this study was designed to document the medicinal plant species utilised by traditional practitioners in Igabi Local Government Area (LGA), Kaduna State. By preserving this information and providing a scientific basis for the efficacy of these traditional remedies, this research contributes to the broader effort to identify safe, affordable, and accessible therapeutic solutions for gastrointestinal health.

MATERIALS AND METHODS

Study area

The study area for this research was Igabi LGA in Kaduna State, with its official headquarters in the town of Turunku. It is located at latitude 10°47′0″N and longitude 7°46′0″E. The LGA covers an area of approximately 3,727 km^2 and, according to the 2006 National Population Census (NPC, 2006), had a projected population of 636,400 people in 2022 (City Population, 2022).

Igabi LGA is the most populous local government area in Kaduna State. It is bordered by Giwa and Zaria LGAs to the north; Soba and Kauru LGAs to the east; Kajuru, Kaduna North, Kaduna South, and Chikun LGAs to the south; and Chikun and Birnin Gwari LGAs to the west. Igabi LGA comprises 16 districts: Amaza, Audi, Bargu, Dunki, Dusten Mai, Eadan Gayan, Faro Kwai, Garda, Gehehu, Igabi, Kerawa, Mangi, Pumbi Dutse, Turunku, Yelwa, and Zangon Aya. The inhabitants are predominantly Adara people and also speak Hausa and Gbagyi languages (NPC, 2010). The climate is characterised by two distinct seasons: a wet season and a prolonged dry season, typical of tropical regions. Recent climatological datasets indicate that Igabi LGA receives an estimated mean annual rainfall of approximately 881 mm, which is characteristic of the northern Guinea savanna zone. Mean air temperatures typically range from 22°C to 30°C, with marked seasonal variation. During the harmattan period, which is associated with dry north-easterly winds, minimum temperatures may decline to around 11°C, whereas peak temperatures approaching 40°C are experienced during the pre-rainy season months (Climate-Data.org, 2024; Copernicus Climate Change Service, 2024). The predominant ethnic group is the Gbagyi; other groups include the Hausa, Kataf, Igbo, Fulani, and Yoruba. Farming is the major

occupation, with crops such as rice, yam, maize, guinea corn, millet, and cassava cultivated, and livestock including goats, sheep, and cattle reared.

Method of data collection

Ethnobotanical data for this study were collected using open-ended, semi-structured questionnaires and oral interviews. Fieldwork was carried out over a 6-month period, from April to October 2024. During this time, the research team visited herbalists and herb sellers across the study area, including the communities of Mando, Sabo Birni, Rigasa, and Afaka (*Figure 1*), as well as markets, motor parks, and major bus stops within the LGA, following the approach of Angela *et al*. (2021). In total, 110 respondents participated in the study, comprising 36 herbalists and 74 herb sellers.

Herbalists and herb sellers were the target respondents because they are the primary custodians and providers of traditional remedies commonly used in the management of PUD. They possess extensive indigenous knowledge of medicinal plants, preparation techniques, and therapeutic practices relied upon by community members. Their influence on health-seeking behaviour, treatment choices, and the availability of herbal resources makes them an essential yet often understudied group within the local healthcare landscape. Including both groups ensured a comprehensive understanding of traditional ulcer management practices in the study area.

To ensure representativeness, random sampling was employed so that every practitioner had an equal chance of being selected. The estimated population of practitioners in the study area consisted of 50 herbalists and 102 herb sellers, giving a total population of 152 individuals. Using an error tolerance of 0.05, the sample size was determined using the Taro Yamane formula (*Equation* 1):

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

where n is the sample size, N is the population size, and e is the error tolerance. Based on this calculation, 36 herbalists and 74 herb sellers were selected for participation.

To construct a reliable sampling frame, a complete and up-to-date register of practitioners was obtained from their respective professional associations. The list was cleaned, verified, and cross-checked to eliminate coverage errors and ensure that no eligible individuals were omitted. Each practitioner was assigned a unique identification code, after which a probability-based randomisation procedure was used to select participants objectively. This validated sampling frame and transparent selection process strengthened the representativeness and overall validity of the study.

The study complied with established ethical standards for research involving human participants. According to institutional guidelines, this type of ethnobotanical research did not require formal ethical approval or institutional authorisation. Before each interview, the study objectives, the voluntary nature of participation, and the confidentiality of responses were explained. Informed consent was obtained from all participants: literate respondents signed the consent section of the questionnaire, while non-literate respondents provided thumbprints after the consent script had been read aloud in Hausa. No identifying

information was collected, and all data were treated confidentially. Documentation of indigenous medicinal plant knowledge respected cultural norms and posed no risk of harm or coercion.

The questionnaire was designed to align with the study objectives and to capture detailed ethnomedicinal knowledge. To ensure clarity and reliability, the instrument was pretested with 5 herbalists and 10 herb sellers within the study area. Feedback from the pretest was used to refine ambiguous items, improve question structure, and enhance overall comprehensibility, thereby increasing internal consistency.

To ensure the accuracy and reliability of the information obtained, several validation strategies were incorporated into the data collection process. First, responses from each participant were triangulated by comparing them with information provided by other respondents, which helped identify inconsistencies and confirm commonly reported ethnomedicinal practices. Interviewers also employed probing and follow-up questions whenever statements appeared unclear, allowing them to verify details such as plant uses, preparation techniques, and dosage descriptions. In addition, key responses were restated to participants using a repeat-back approach to confirm that the recorded information accurately reflected their intended meaning. The data were further subjected to consistency checks by comparing respondents' claims with existing ethnobotanical literature and previously documented practices within the region, thereby assessing the plausibility of the information provided. Conducting all interviews in Hausa, the predominant local language, also served as an important validation measure by reducing the risk of misinterpretation and enhancing the accuracy of responses. Collectively, these procedures ensured that the ethnobotanical data generated were credible, internally consistent, and reflective of actual community practices.

To reduce bias, questionnaires were administered directly to literate respondents, while non-literate participants were interviewed orally. Interview responses were recorded verbatim on the questionnaire forms to minimise interviewer interpretation and reduce interviewer influence. All oral interviews were conducted in Hausa, the predominant local language, to ensure accurate communication and support more reliable recall, thereby minimising recall bias. The interviews followed a flexible, open-ended format that encouraged two-way interaction and allowed respondents to elaborate freely, consistent with Kayode *et al*. (2009). Interviewers adhered to a standardised guide and used neutral, non-leading prompts to ensure consistency across sessions and further reduce interviewer influence.

The ethnomedicinal data collected included the local names of plants used in the treatment of ulcers, the plant parts used, methods of preparation, modes of administration/application, and dosages of herbal remedies. The information collected was properly documented. Local plant names provided by respondents were matched with scientific names using the Hausa and Yoruba editions of Gbile and Soladoye (2002). Taxonomic nomenclature was further validated using reputable online botanical databases, including *The Plant List*

(http://www.theplantlist.org/) and the *Encyclopaedia of Life* (https://eol.org/), to ensure accuracy and standardisation of species identification.

Although this study provides valuable insights into the ethnobotanical management of PUD, several limitations should be acknowledged.

The data relied on self-reported information, which may have been affected by recall bias or subjective interpretation. The study did not include pharmacological or toxicological analyses, limiting the ability to verify the safety or efficacy of the documented species.

In addition, the research was confined to a single geographical area; therefore, the findings may not fully represent practices in other cultural or ecological contexts. Information on dosage and frequency of administration was collected as reported by participants; however, these practices varied widely and could not be standardised. The duration of treatment was not recorded, which further limits the assessment of consistency in traditional practices. Variations in preparation methods and plant combinations also contributed to this lack of uniformity.

Despite these constraints, the study provides a strong foundation for future scientific investigations aimed at validating the medicinal plants used for ulcer management and facilitating their integration into evidence-based healthcare frameworks.

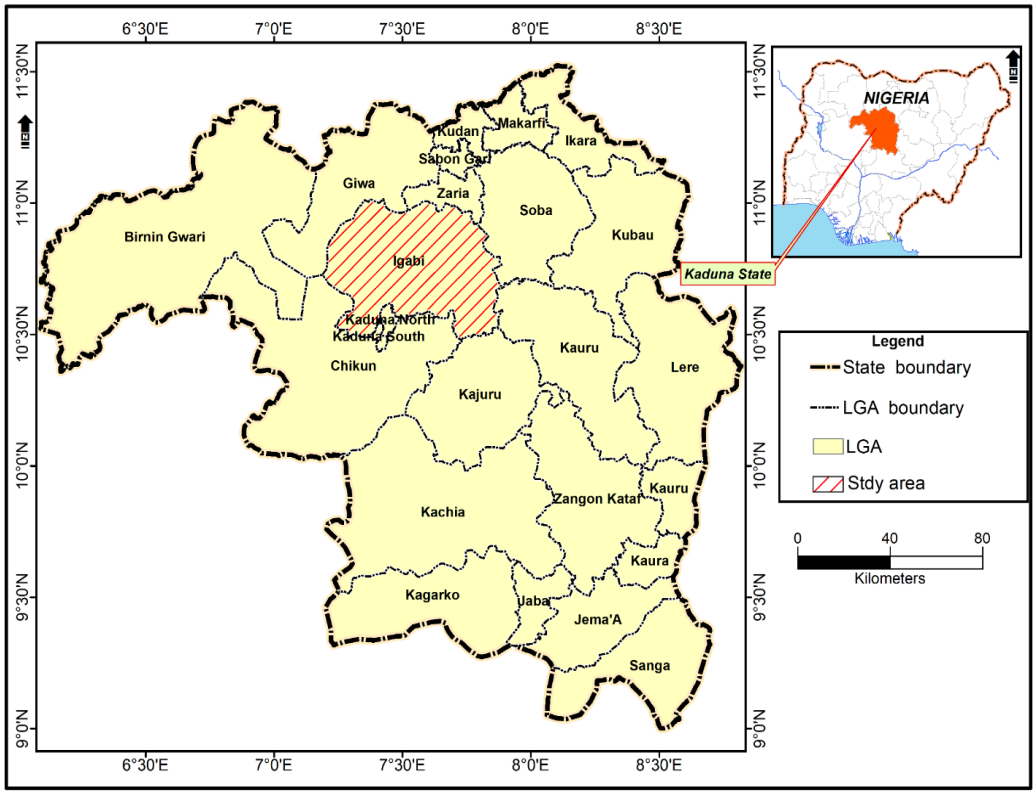

Figure 1 – Map of Kaduna State Showing the Study Area (Igabi LGA)

Data analysis

The following statistical analyses were used: descriptive statistics, frequency of occurrence (FO), and fidelity level (FL).

Descriptive statistics

Descriptive statistics were employed to summarise the distribution of medicinal plant species used for peptic ulcer management. Data were presented using frequency counts, percentages, tables, bar charts, and pie charts, providing a clear overview of species abundance, usage patterns, and respondent preferences. This approach is widely used in ethnobotanical studies to present large datasets in an interpretable form and to highlight general trends in traditional knowledge systems (Albuquerque *et al*., 2014).

Frequency of occurrence (FO)

FO was calculated to determine how often each plant species was cited by respondents. FO served as an indicator of the popularity, cultural prominence, and commonality of each species in ulcer treatment. This metric is important in ethnobotany because it reflects the extent to which a plant is embedded in local medicinal practices (Tardío and Pardo de Santayana, 2008). It was used to determine how frequently each plant species was mentioned or used, thereby indicating its popularity and widespread use in the treatment of PUD.

Fidelity level (FL)

FL was used to identify the most preferred plant species for ulcer treatment, following the methods of Friedman *et al*. (1986) and Akinwumi and Sonibare (2019). It highlights the relative importance of a species in the treatment of a specific disease compared with other medicinal plants. FL measures the consistency of a plant's use among different respondents and represents the proportion of respondents who use a particular plant species for a specific ailment (ulcer). It was calculated as (*Equation* 2):

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

where N_P = number of respondents who reported using a species for a specific illness (ulcer) and N = total number of respondents using the species for any medicinal purpose.

RESULTS AND DISCUSSION

Plants have long served as an important reservoir of bioactive secondary metabolites, providing a multifaceted therapeutic approach to the management of gastroduodenal ulcers (Schmeda-Hirschmann and Yesilada, 2005). Because of their long history of traditional use, medicinal plants employed in the treatment of PUD warrant scientific investigation as potential sources of anti-ulcer lead compounds. In many rural communities, several plant species used in folk medicine have demonstrated notable effectiveness against ulcer symptoms. In the present study, the medicinal plants used for ulcer treatment in Igabi LGA are presented in *Table 1*. The table provides comprehensive information on each species, including scientific and family names, vernacular names in Yoruba and Hausa, English names, life forms, plant parts used, preparation methods, modes of administration, FO, and FL. In total, 22 plant species belonging to 17 families were documented. These species,

including *Mangifera indica*, *Ageratum conyzoides*, *Vernonia amygdalina*, *Carica papaya*, *Bryophyllum pinnatum*, *Acacia nilotica*, *Parkia biglobosa*, *Ocimum gratissimum*, *Moringa oleifera*, *Musa sapientum*, *Musa paradisiaca*, and *Psidium guajava*, are sourced from home gardens, farmlands, forests, markets, and roadside areas, reflecting their accessibility and cultural significance.

The number of species recorded in this study is consistent with findings from other ethnobotanical surveys in northern Nigeria. For example, Musa *et al*. (2021) reported 25 species from 13 families among Hausa-Fulani communities in Katsina State, while Agbatutu *et al*. (2022) documented 24 species from 20 families in Wukari Metropolis, Taraba State. Similarly, Angela *et al*. (2021) identified 16 species from 15 families in the Gwandu Emirate of Kebbi State. Many of the species identified in Igabi LGA, such as *Mangifera indica*, *Carica papaya*, *Acacia nilotica*, *Hibiscus sabdariffa*, *Moringa oleifera*, *Psidium guajava*, *Bryophyllum pinnatum*, and *Ocimum gratissimum*, were also reported in these studies, demonstrating strong regional consensus regarding their therapeutic value.

The findings further align with those of Kadiri *et al*. (2013) in Abeokuta, who documented *Aframomum melegueta*, *Ageratum conyzoides*, *Bryophyllum pinnatum*, *Carica papaya*, *Ocimum gratissimum*, *Musa paradisiaca*, and *Zea mays* as remedies for ulcer treatment. This consistency across different regions of Nigeria reinforces the reliability and cultural relevance of these species in ulcer management.

Beyond Nigeria, the ethnomedicinal patterns observed in Igabi LGA mirror findings from other parts of Africa and the world. In Ethiopia, species such as *Vernonia amygdalina*, *Ocimum* spp., and *Carica papaya* are widely used for gastrointestinal disorders (Lulekal *et al*., 2014; Teklay *et al*., 2013). In India, *Musa paradisiaca*, *Psidium guajava*, *Ageratum conyzoides*, and *Bryophyllum pinnatum* are common anti-ulcer plants supported by pharmacological evidence (Goel and Sairam, 2002; Singh *et al*., 2011). In Latin America, *Mangifera indica* and *Bryophyllum pinnatum* are prominent gastroprotective species, with studies confirming the ulcer-healing effects of their flavonoid-rich extracts (Schmeda-Hirschmann and Yesilada, 2005). These cross-continental similarities suggest that the therapeutic properties of these plants are rooted in shared phytochemical mechanisms rather than cultural coincidence.

Respondents in this study attributed the effectiveness of these plants to their inherent bioactive compounds, a view supported by scientific literature. Kadiri *et al*. (2013) identified tannins, saponins, alkaloids, and flavonoids in related species, compounds known for their anti-ulcer, anti-inflammatory, antioxidant, and antimicrobial activities. For example, *Musa paradisiaca*, *Azadirachta indica*, and *Macrospyrum longistyla* contain these metabolites, which contribute to their therapeutic potential.

Additional studies have shown that saponins, flavonoids, and phenolic compounds possess anti-ulcer, hypotensive, anti-inflammatory, and antimicrobial properties (Akah and Okafor, 1992; Aqib and Mohib, 2014; Pukraj and Tabassumyaseen, 2013), further supporting the pharmacological

plausibility of the species documented in this study.

Several species exhibited high FO and FL, including *Ocimum gratissimum* (FO = 45; FL = 40.91%), *Bryophyllum pinnatum* (FO = 40; FL = 36.36%), *Carica papaya* (FO = 39; FL = 35.45%), *Ageratum conyzoides* (FO = 35; FL = 31.82%), *Musa sapientum* (FO = 30; FL = 27.27%), *Parkia biglobosa* (FO = 28; FL = 25.45%), and *Musa paradisiaca* (FO = 27; FL = 24.55%). High FO and FL values indicate strong cultural consensus and widespread recognition of these plants as effective ulcer remedies. This pattern is consistent with ethnobotanical principles, which emphasise that plant species with high cultural consensus are more likely to exhibit significant pharmacological activity (Tardío and Pardo de Santayana, 2008). The convergence of local knowledge and scientific evidence underscores the therapeutic relevance of these species and highlights their potential for future phytochemical and pharmacological investigation.

Pharmacological discussion and mechanistic basis of the anti-ulcer activity of the documented medicinal plants

The ethnobotanical data collected from Igabi LGA revealed a strong pattern of community consensus regarding the medicinal plants used in the management of PUD. Several species, particularly *Ocimum gratissimum*, *Bryophyllum pinnatum*, *Carica papaya*, and *Ageratum conyzoides*, were consistently cited by respondents as highly effective, reflecting their cultural importance and widespread therapeutic use. Species with high levels of consensus are often associated with pharmacologically active plants, a trend that is well established in ethnobotanical research (Ankli *et al*., 1999; Heinrich *et al*., 1998). Their prominence in the study area aligns with broader African ethnopharmacological evidence showing that plants traditionally used for ulcer treatment commonly possess antioxidant, anti-inflammatory, antimicrobial, and cytoprotective properties mediated by compounds such as flavonoids, tannins, alkaloids, terpenoids, and saponins (Adebayo and Krettli, 2011; Borrelli and Izzo, 2000).

The therapeutic relevance of these widely cited species is further supported by extensive scientific literature. *Ocimum gratissimum*, *Bryophyllum pinnatum*, *Carica papaya*, and *Ageratum conyzoides* are all known to contain abundant flavonoids, phenolic compounds, and other bioactive metabolites that help suppress gastric acid secretion, neutralise reactive oxygen species, and strengthen mucosal defences. These pharmacological properties reinforce the strong traditional consensus surrounding their effectiveness in ulcer management. Oxidative stress is a major driver of mucosal injury in ethanol-induced and non-steroidal anti-inflammatory drug-induced ulcers, and flavonoid-rich extracts have demonstrated significant gastroprotective effects in experimental models (Borrelli and Izzo, 2000). For example, mangiferin from *Mangifera indica* exhibits potent antioxidant and anti-inflammatory activity, enhancing prostaglandin synthesis and reducing lipid peroxidation (Garrido *et al*., 2004). Similarly, *Vernonia amygdalina* and *Ageratum conyzoides* have shown anti-ulcer activity through acid suppression and reinforcement of

mucosal defence factors (Ijeh and Ejike, 2011).

Plants with moderate FO and FL values, such as *Musa sapientum*, *Musa paradisiaca*, and *Parkia biglobosa*, also play important roles in ulcer therapy. Banana species contain leucocyanidin, a flavonoid that increases mucus secretion and strengthens the mucosal barrier, thereby accelerating ulcer healing (Goel and Sairam, 2002). Tannin-rich species, including *Acacia nilotica*, *Psidium guajava*, and *Parkia biglobosa*, exert astringent effects that form a protective protein layer over the gastric mucosa and inhibit *Helicobacter pylori*, a major aetiological agent of PUD (Al-Rajhi *et al*., 2023; Fowora *et al*., 2021). These findings are consistent with broader African natural-product research demonstrating that tannin-containing plants exhibit significant anti-ulcer and anti-*H. pylori* activity (Adebayo and Krettli, 2011; Borrelli and Izzo, 2000). Essential-oil-producing species such as *Ocimum gratissimum* and *Aframomum melegueta* contribute additional antimicrobial effects through bioactive constituents including eugenol, thymol, and gingerols, which have demonstrated broad-spectrum antibacterial activity, including activity against *H. pylori* (Ezeorba *et al*., 2024; Ojewumi *et al*., 2024; Owokotomo *et al*., 2015). Anti-inflammatory mechanisms have also been reported in species such as *Hibiscus sabdariffa*, *Moringa oleifera*, and *Sorghum bicolor*, which contain anthocyanins and phenolic compounds that inhibit pro-inflammatory mediators, including TNF-α, IL-6, and COX-2 (Ali *et al*., 2005). *Carica papaya* may further support mucosal healing through proteolytic enzymes such as papain and chymopapain, which modulate inflammation and promote tissue repair (Oloyede, 2005).

Although some species exhibited lower FO and FL values, such as *Aframomum melegueta*, *Arachis hypogaea*, *Sorghum bicolor*, and *Zea mays*, their documented pharmacological activities suggest that they may serve specialised or complementary roles within traditional ulcer therapy. Species with lower citation frequencies may reflect restricted knowledge, limited availability, or niche therapeutic applications rather than reduced efficacy.

Overall, the convergence of high ethnobotanical consensus and experimentally validated pharmacological mechanisms reinforces the therapeutic relevance of the documented species. This pattern is consistent with contemporary reviews demonstrating that medicinal plants used in ulcer management commonly exhibit antioxidant, anti-inflammatory, antimicrobial, and mucosal-protective effects (Adebayo and Krettli, 2011; Ali *et al*., 2005; Borrelli and Izzo, 2000; Goel and Sairam, 2002). The strong alignment between traditional knowledge and scientific evidence underscores the potential of these species for further phytochemical characterisation and development into standardised phytomedicines.

Family distribution of medicinal plant species

The taxonomic analysis presented in *Figure 2* shows that the Fabaceae family was the most dominant group used in the treatment of PUD within the study area, represented by three species, two belonging to the subfamily Mimosoideae and one to Papilionoideae.

Table 1 – Plant species used in the treatment of peptic ulcer disease in Igabi Local Government Area, Kaduna State

Scientific name	Family	Life form	Local name	English name	Plant part used	Method of prepa-ration	Mode of adminis-tration	Freq. of occur-rence (FO)	Fide-lity level (FL%)
Mangifera indica Linn.	Anacardiaceae	Tree	Y- Mangoro H- Màngwàrò	Mango	Leaf	Decoction	Oral (drinking)	5	4.55
Ageratum conyzoides (L.) L.	Asteraceae	Herb	Y- Arunsansan Y- Imi esu	Goat weed	Leaf	Grinding	Oral (eating)	35	31.82
Vernonia amygdalina Delile	Asteraceae	Shrub	Y- Eewuro H- Shuwakaa	Bitter leaf	Leaf	Grinding	Oral (eating)	8	7.27
Newbouldia laevis (P. Beauv.) Seem. ex Bureau	Bignoniaceae	Tree	Y- Akoko	Tree of life, fertility tree	Bark	Burning, grinding	Oral (drinking)	2	1.82
Carica papaya L.	Caricaceae	Herb	Y- Ibepe H- Gwanda H- Masar	Pawpaw	Fruit	Soaking	Oral (drinking)	39	35.45
Argyreia nervosa (Burm. f.) Bojer	Convolvulaceae	Vine	Y- Ewe Rerinkomi	Elephant creeper	Leaf	Grinding	Oral (eating)	4	3.64
Bryophyllum pinnatum (Lam.) Oken	Crassulaceae	Herb	Y- Abamoda Y- Odundun H- Harfifi	Resurrec-tion plant	Leaf	Washing	Oral (eating)	40	36.36
Acacia nilotica L.	Fabaceae-Mimosoideae	Tree	H- Námíjìnbàg àrùwàà	Thorn mimosa	Pod	Grinding	Oral (swallow-ing)	9	8.18
Parkia biglobosa (Jacq.) G.Don	Fabaceae-Mimosoideae	Tree	Y- Igbaru H- Doruwa	Locust bean	Processed seed	Cooking	Oral (eating)	28	25.45
Arachis hypogaea L.	Fabaceae-Papilionoideae	Herb	Y- Epa H- Jeda	Groundnut	Seed	-	Oral (eating)	1	0.91
Ocimum gratissimum Linn	Lamiaceae	Shrub	H- Tagida H- Daddooya	Scent leaf	Leaf	Decoction	Oral (drinking)	45	40.91
Hibiscus sabdariffa L.	Malvaceae	Herb	H- Sóóbàróódò	Roselle	Calyx	Decoction	Oral (drinking)	7	6.36
Moringa oleifera Lam	Moringaceae	Tree	Y- Sogele H- Ríímínnásárà, H- Zoogale	Drumstick or horse-radish tree	Leaf	Decoction, Squeezing	Oral (drinking)	6	5.45
Musa sapientum L.	Musaceae	Herb	Y- Ogede weere H- Ayama	Banana	Peel, fruit	Burning, grinding, soaking	Oral (drinking)	30	27.27
Musa paradisiaca	Musaceae	Herb	Y- Ogede agbagba H- Ayaba	Plantain	Fruit	Soaking	Oral (drinking)	27	24.55
Psidium guajava L.	Myrtaceae	Tree	Y- Grofa H- Góóbàà	Guava	Leaf	Decoction	Oral (drinking)	12	10.91
Piper nigrum	Piperaceae	Vine	Y- Eeru Alamo	Black pepper	Seed	Grinding	Oral (eating)	3	2.73

Sorghum bicolor (L.) Moench	Poaceae	Herb	H- Mazakuwa	Guinea corn	Seed	Paste	Oral (drinking)	1	0.91
Zea mays	Poaceae	Herb	Y- Agbado H- Mosara	Maize	Seeds	Palp	Oral (drinking)	2	1.82
Vitellaria paradoxa C F. Gaertn	Sapotaceae	Tree	Y- Ori H- Kadanya	Shear butter	Oil	Cooking	Oral (eating)	10	9.09
Aframomum melegueta (Roscoe) K. Schum.	Zingiberaceae	Herb	Y- Atare H- Barkono/cita	Alligator pepper	Pod	Burning, grinding	Oral (drinking)	1	0.91
Kalanchoe crenata (Andrews) Haworth	Crassulaceae	Herb	Y- Odundun	Mother of Thousands or Chandelier Plant.	Leaf	Cooking	Oral (eating)	2	1.82

Note: Y = Yoruba name, H = Hausa name

This finding is consistent with earlier ethnobotanical reports, such as that of Inngjerdingen *et al*. (2004), who also identified Fabaceae and Combretaceae as prominent families in traditional wound and ulcer management across Africa. The predominance of Fabaceae in ulcer therapy is likely linked to its rich phytochemical composition. Members of this family are widely known to contain high levels of hydrolysable tannins and condensed polyphenols. These compounds exert potent gastroprotective effects by precipitating mucosal proteins to form a protective coagulum over ulcerated tissues, thereby reducing acid-pepsin damage and promoting healing.

Following Fabaceae, the families Asteraceae, Crassulaceae, Musaceae, and Poaceae were each represented by two species. The therapeutic relevance of Asteraceae is particularly noteworthy because this family is well documented for producing bioactive secondary metabolites, especially sesquiterpene lactones and flavonoids, that exhibit strong anti-inflammatory and cytoprotective activities in gastrointestinal research (Pandey *et al*., 2024). These pharmacological attributes reinforce the importance of further screening Asteraceae species for potential anti-ulcer drug development.

The remaining families, Anacardiaceae, Bignoniaceae, Caricaceae, Convolvulaceae, Lamiaceae, Malvaceae, Moringaceae, Myrtaceae, Piperaceae, Sapotaceae, and Zingiberaceae, were each represented by a single species (*Figure 2*). Although less frequent, their presence highlights the diverse botanical knowledge within Igabi LGA and suggests a polyherbal, multitarget approach to ulcer management. This diversity mirrors findings from other Nigerian studies, in which multiple plant families are similarly employed in ulcer treatment. For example, Agbatutu *et al*. (2022), Angela *et al*. (2021), and Musa *et al*. (2021) all reported a wide taxonomic distribution of medicinal plants used for ulcer therapy across Katsina, Taraba, and Kebbi States, respectively.

Comparable patterns have also been documented internationally. In Ethiopia, species from Asteraceae, Lamiaceae, and Caricaceae are widely used for gastrointestinal disorders (Lulekal *et al*.,

2014; Teklay *et al*., 2013). In India, families such as Musaceae, Myrtaceae, and Convolvulaceae are frequently cited for their anti-ulcer properties (Goel and Sairam, 2002; Singh *et al*., 2011). Similarly, in Latin America, species from Anacardiaceae and Crassulaceae, including *Mangifera indica* and *Bryophyllum pinnatum*, are recognised for their gastroprotective and flavonoid-rich profiles (Schmeda-Hirschmann and Yesilada, 2005). These cross-regional similarities suggest that the therapeutic value of these plant families is not culturally isolated but instead reflects shared phytochemical mechanisms that have been independently recognised across continents.

Plant growth forms

The growth characteristics of the medicinal plants recorded in the study area were classified into four major life forms: trees, shrubs, herbs, and vines (*Figure 3*). Herbs constituted the largest proportion, accounting for 11 species (47.62%). The predominance of herbs in ulcer treatment is consistent with ethnobotanical observations elsewhere, where herbs are frequently preferred because of their abundance, seasonal availability, particularly during the rainy season, ease of collection, and perceived therapeutic effectiveness compared with other growth forms (Koffi *et al*., 2009; Kumar *et al*., 2015). Following herbs, trees accounted for 7 species (33.33%), while shrubs and vines each comprised 2 species (9.52%).

The notable use of trees and shrubs may be attributed to their year-round availability, resilience to drought, and ability to withstand seasonal fluctuations, making them reliable sources of medicinal materials throughout the year.

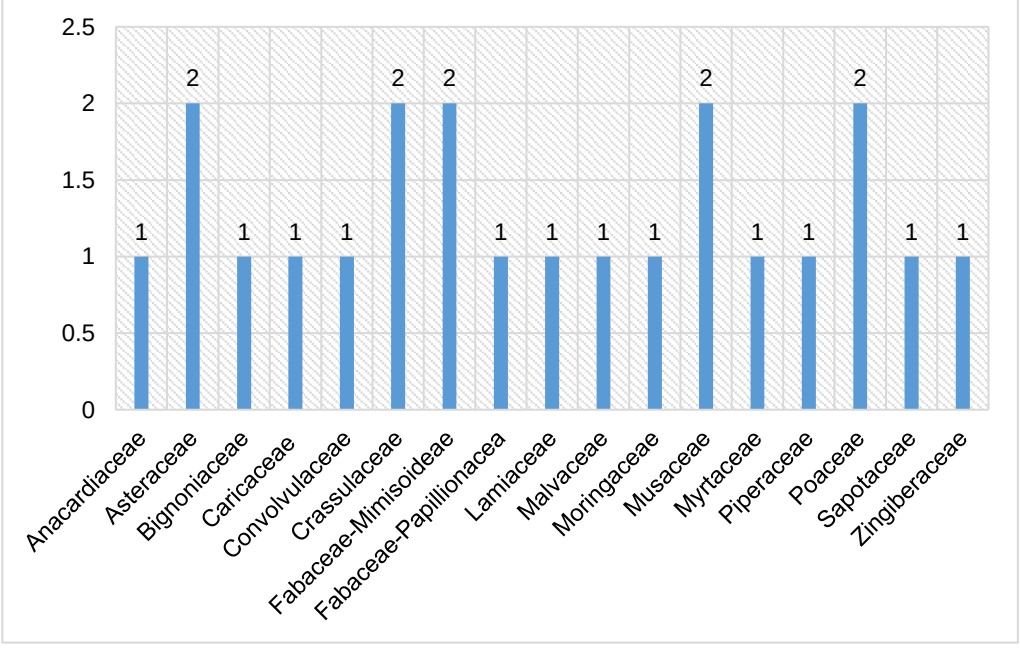

Figure 2 – Family distribution of medicinal plant species

These findings are consistent with those of similar ethnobotanical studies conducted in Nigeria. For instance, Agbatutu *et al*. (2022) and Musa *et al*. (2021) also reported a predominance of herbs and trees in traditional ulcer management in Katsina and Taraba States, respectively. Likewise, Angela *et al*. (2021) observed that herbs constituted the majority of medicinal plants used for gastrointestinal ailments in the Gwandu Emirate of Kebbi State. This pattern suggests a shared cultural preference for herbaceous species across northern Nigeria, likely driven by ecological availability and long-standing traditional practices.

Comparable trends have been documented internationally. In Ethiopia, Lulekal *et al*. (2014) and Teklay *et al*. (2013) reported that herbs and shrubs were the most frequently used growth forms for treating gastrointestinal disorders, reflecting similar ecological and cultural influences. In India, Goel and Sairam (2002) and Singh *et al*. (2011) found that herbaceous species dominated traditional anti-ulcer remedies, particularly those belonging to Musaceae, Asteraceae, and Lamiaceae. Likewise, studies from Latin America highlight the widespread use of herbs and small shrubs, such as *Bryophyllum* pinnatum and *Mangifera indica*, in ulcer therapy because of their rich phytochemical profiles and ease of access (Schmeda-Hirschmann and Yesilada, 2005).

Overall, the distribution of plant growth forms in the present study reflects a broader global pattern in which herbs and trees play central roles in traditional ulcer management. These similarities across regions suggest that ecological availability, cultural knowledge, and phytochemical richness collectively influence the selection of medicinal plants used for gastrointestinal disorders.

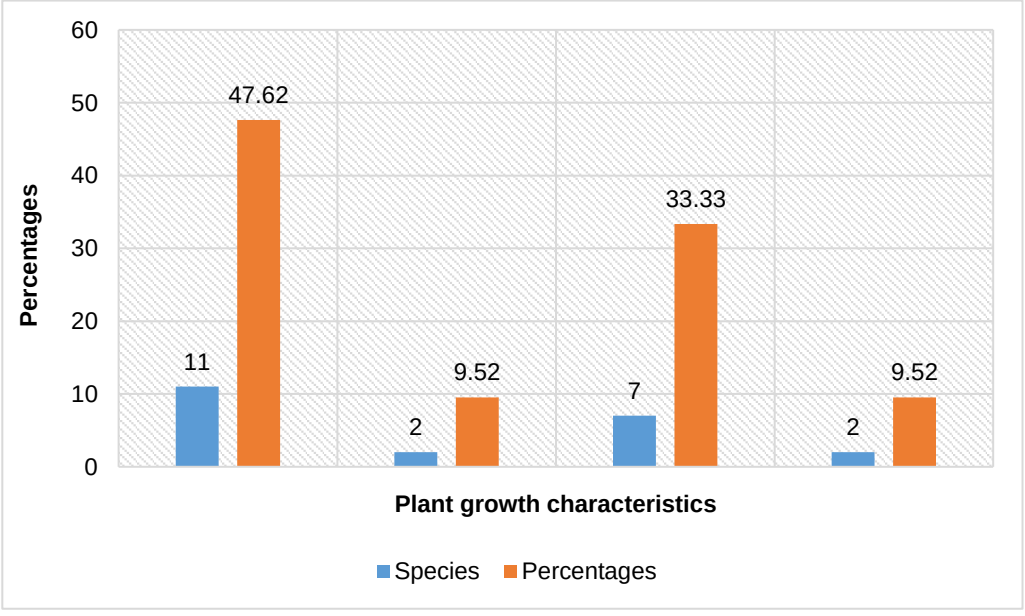

Figure 3 – Distribution of growth forms among the medicinal plant species

Plant parts used in the preparation of remedies

A wide range of plant parts is used in the preparation of ulcer remedies in the study area (*Figure 4*). These include leaves, bark, fruits, pods, seeds, peels, calyces, and shea butter oil extracted from *Vitellaria paradoxa*. Among all recorded species, only *Musa sapientum* had more than one plant part (peels and fruit) used in remedy preparation.

The choice of plant part is influenced by the distribution and concentration of bioactive compounds, which vary among different plant tissues (Diatta *et al*., 2013). Leaves were the most frequently used plant part, accounting for 40.91% of all preparations. Their predominance is likely attributable to their abundance, ease of harvesting, simple processing requirements, and high content of secondary metabolites synthesised through photosynthesis (Diatta *et al*., 2013).

This pattern is consistent with findings from several ethnobotanical studies across Africa and Asia. In Algeria, leaves were reported as the most commonly used plant part in medicinal preparations, with usage rates of 69% (Benabdesslem, 2019), 22% (Quadeh *et al*., 2021), 28% (Bentabet *et al*., 2022), and 27.9% (Meddour *et al*., 2022).

Similar trends have been documented in Morocco, where leaves accounted for 39.33% (Ajjoun *et al*., 2022), 28% (Mouchane *et al*., 2023), 41% (Mrabti *et al*., 2022), 32% (Idm'hand *et al*., 2020), and 38% (Jahjah *et al*., 2024) of plant parts used in traditional therapies. In India, Ralte and Singh (2024) also reported leaves as the most frequently used plant part, representing 30.39% of all medicinal plant applications. These consistent findings across regions highlight the global preference for leaves in traditional medicine.

The results of this study also corroborate earlier reports from Nigeria. Kadiri *et al*. (2013) in Abeokuta, Agbatutu *et al*. (2022) in Taraba State, and Musa *et al*. (2021) in Katsina State all identified leaves as the dominant plant part used in ulcer treatment. Similarly, Tesfaye *et al*. (2022) in Ethiopia reported that leaves constituted the highest proportion of plant parts used for gastrointestinal ailments.

Beyond ulcer therapy, the preference for leaves has been widely documented in the treatment of snakebites and wound healing (Inngjerdingen *et al*., 2004; Nwafor *et al*., 2018), measles (Ariyo, 2024; Yusuf *et al*., 2022), typhoid fever (Ali *et al*., 2021; Ariyo, 2023a; Francis and Sarada, 2021; Mahmoud *et al*., 2021), piles (Ariyo *et al*., 2020a), and cough (Ariyo *et al*., 2020b).

This widespread reliance on leaves across different ailments and regions underscores their therapeutic versatility and cultural importance. Following leaves, seeds (22.73%), fruits (9.09%) and pod (9.10%) were the next most commonly used plant parts. Bark, pods, peels, calyces, and shea butter oil each represented 4.55% of the total.

Additionally, shea butter oil derived from *Vitellaria paradoxa* was incorporated into some ulcer remedies, reflecting its recognised medicinal value in local healing traditions.

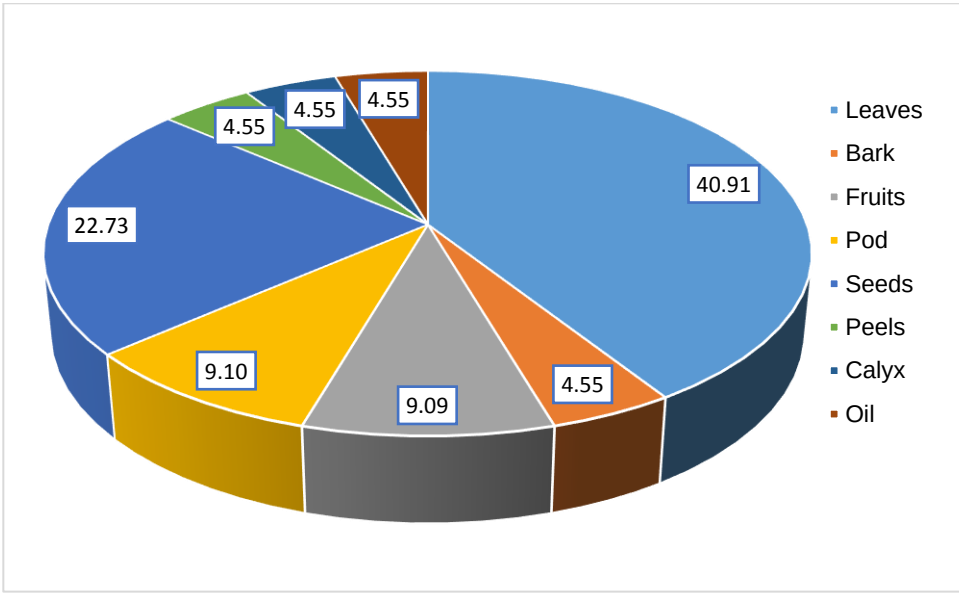

Figure 4 – Percentage distribution of plant parts used

Methods of preparation of remedies used in the treatment of ulcers

A variety of preparation methods were employed in formulating traditional remedies for peptic ulcer treatment in the study area (Figure 5). These methods included grinding, decoction, cooking, burning to ash, maceration, squeezing, washing, and drying. The analysis revealed that grinding into powder was the most common method, being used for 8 species (33.33%). This was followed by decoction, which was applied to 5 species (20.83%), while cooking and burning to ash were each used for 3 species (12.50%). Maceration accounted for 2 species (8.33%), whereas washing, drying, and squeezing were each used for 1 species (4.17%). Notably, some plants, such as *Newbouldia laevis*, *Moringa oleifera*, *Musa sapientum*, and *Aframomum melegueta*, had more than one method of preparation, reflecting their versatility in traditional healing practices. By contrast, *Bryophyllum pinnatum* and *Arachis hypogaea* lacked a clearly defined preparation method, as the leaves of *B. pinnatum* were consumed fresh, either alone or together with the seeds of *A. hypogaea*.

These findings show both similarities and differences when compared with other studies conducted in Nigeria. For instance, Musa *et al*. (2021) reported decoction (43%) as the dominant preparation method in Katsina State, followed by powdering (32%), maceration (11%), pounding (8%), ashing (3%), and oil extraction (3%). Similarly, Angela *et al*. (2021) found that medicinal plants used for ulcer treatment in the Gwandu Emirate of Kebbi State were primarily prepared through decoction and maceration. The predominance of decoction in these studies contrasts with the present findings, in which grinding into powder was more common. This variation may reflect differences in cultural practices,

the plant species available, and local perceptions of efficacy.

Comparable trends have also been documented internationally. In Ethiopia, Tesfaye *et al*. (2022) observed that decoction and maceration were the most frequently used preparation methods for gastrointestinal ailments, aligning with the patterns reported by Angela *et al*. (2021) but differing from the predominance of grinding observed in the present study. In India, traditional healers commonly rely on decoction, paste preparation, and powdering as primary techniques for preparing anti-ulcer remedies (Goel and Sairam, 2002; Singh *et al*., 2011). These similarities across regions highlight the widespread reliance on simple, low-technology preparation methods that preserve the bioactive compounds responsible for therapeutic effects.

Overall, the diversity of preparation methods observed in this study reflects the adaptability of traditional medical systems and the depth of cultural knowledge associated with medicinal plant use. The variation between regions, both within Nigeria and internationally, underscores the influence of ecological availability, cultural preferences, and traditional knowledge systems on how medicinal plants are processed for therapeutic use.

Mode of administration of remedies used in the treatment of ulcers

The mode of administration of ulcer remedies in the study area was predominantly oral, as shown in *Figure 6*. Oral administration included the consumption of medicinal preparations by drinking, eating, or swallowing. In this study, drinking accounted for the highest proportion of administrations (54.55%), followed by eating (40.91%), while swallowing solid preparations represented the smallest proportion (4.55%). The preference for oral administration is closely linked to the methods of preparation and the vehicles used, which often included water, honey, fermented maize water, or pap. As noted by Ariyo (2023b), these vehicles enhance palatability and facilitate the administration of herbal remedies.

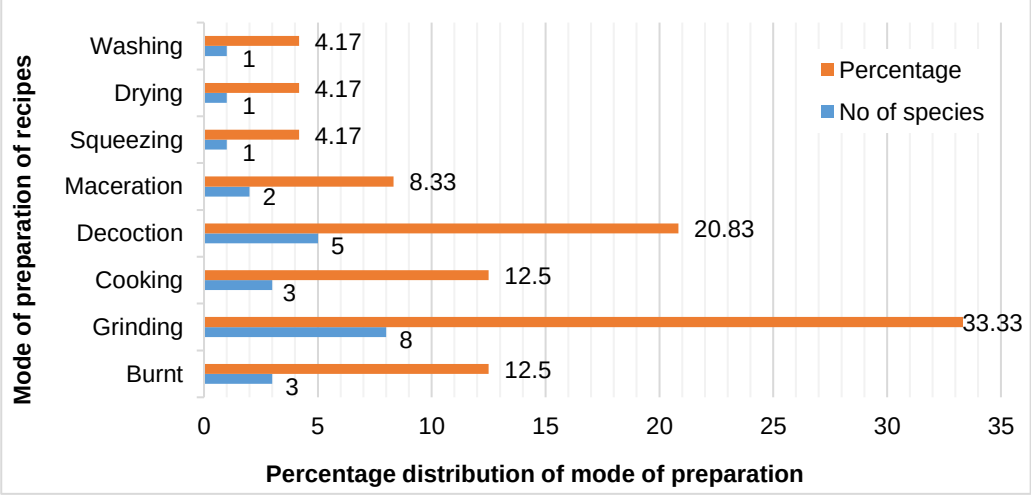

Figure 5 – Percentage distribution of methods of preparation

The predominance of oral administration observed in this study is consistent with findings from other regions of Nigeria. For example, Ariyo (2024, 2023a, b) and Ariyo *et al*. (2021) reported that herbal remedies used for measles, typhoid fever, erectile dysfunction, and skin diseases were primarily administered orally, either by drinking, licking, eating, or, in some cases, through bathing.

Similarly, Agbatutu *et al*. (2022) and Musa *et al*. (2021) documented oral administration as the most common route for ulcer remedies in Katsina and Taraba States, respectively.

These consistent patterns highlight a cultural preference for oral delivery, which is believed to enhance the absorption and systemic distribution of bioactive compounds.

Comparable trends have also been reported internationally. In Morocco, Benlamdini *et al*. (2014) observed that oral administration was the predominant route for gastrointestinal herbal therapies. In Ethiopia, Tesfaye *et al*. (2022) similarly noted that most remedies for digestive ailments were administered orally, often mixed with water or honey.

These parallels across regions suggest that oral administration is a globally preferred method because of its simplicity, effectiveness, and compatibility with traditional preparation techniques.

In the present study, vehicles such as water, honey, cold maize pap, and sorghum pap were commonly used during the preparation and administration of remedies. This finding is consistent with Agbatutu *et al*. (2022), who reported that ulcer formulations were frequently mixed with pap, water, or honey to facilitate administration. Likewise, Kadiri *et al*. (2013) noted that water, alcohol, palm wine, palm oil, and fermented maize water were widely used as vehicles in herbal preparations for ulcer treatment.

The dosage of the herbal remedies varied considerably, ranging from consumption of the entire preparation at once to administration of one teaspoon of powdered formulations or half a stainless-steel cup of liquid preparations once, twice, or three times daily. Among these, drinking half a stainless-steel cup was the most commonly reported practice.

Respondents did not specify precise quantities for remedies that were eaten or swallowed, particularly solid or semi-solid preparations.

This lack of dosage precision is a well-recognised challenge in traditional medicine and may pose risks associated with both underconsumption and overconsumption of bioactive compounds.

A major limitation of this study is the absence of standardised dosage guidelines; moreover, treatment duration was not recorded, which limits the assessment of consistency across traditional practices.

Although these findings are consistent with previous ethnobotanical studies in northern Nigeria (Agbatutu *et al*., 2022; Musa *et al*., 2021), they highlight the need to integrate traditional knowledge with modern pharmacological validation.

Establishing standardised dosing protocols supported by scientific evidence will be essential to ensure the safety, efficacy, and clinical relevance of these traditional ulcer remedies.

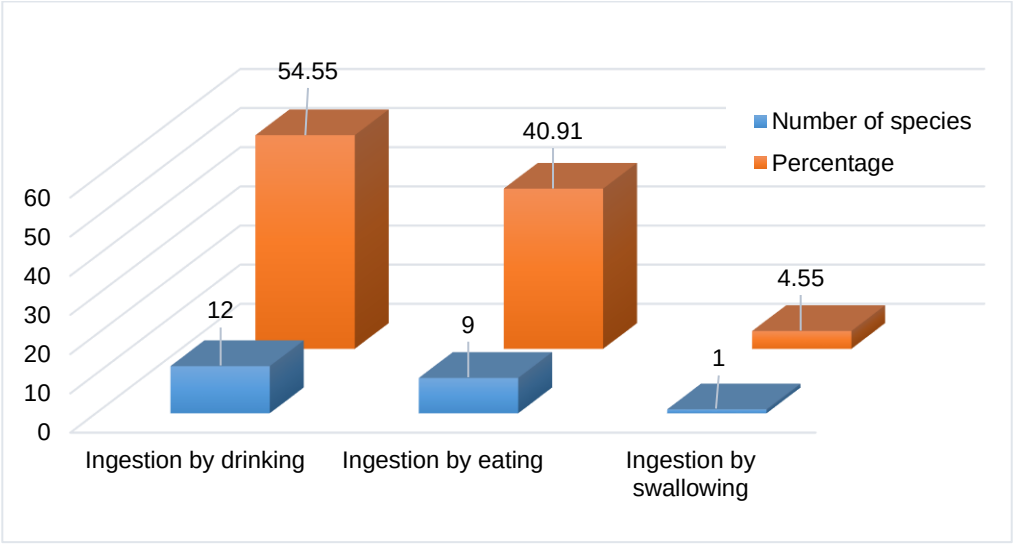

Figure 6 – Percentage distribution of modes of administration of remedies

To address this gap, future research should prioritise bioassay-guided fractionation, in vivo toxicological screening, and mechanistic studies, including investigations of pathways such as H^+/K^+-ATPase proton pump inhibition, to isolate active compounds, determine safe dosage ranges, and support the development of standardised herbal therapies.

Single-plant and polyherbal formulations used in the treatment of ulcers

The use of single plant species and combinations of plant species for ulcer treatment in the study area resulted in 13 distinct herbal recipes (*Table 2*). Of these, eight recipes were prepared from single plant species, each using one plant part, such as fruits, leaves, pods, or calyces. The remaining five recipes were formulated from combinations of two, three, or five plant species, reflecting a polyherbal approach. This observation is consistent with the findings of Khan *et al*. (2012), who reported that traditional ulcer therapies may involve either single plants or mixtures of multiple species, depending on cultural practices and perceived efficacy.

According to respondents, combining plant species enhances the potency of remedies through synergistic interactions, whereby the therapeutic effects of individual components reinforce one another. This belief is consistent with the report of Ariyo (2024), who noted that herbal combinations were more effective than single herbs in the treatment of measles. In the present study, some formulations also incorporated snails, which respondents considered essential for the treatment of duodenal ulcers, further illustrating the integrative nature of local healing traditions. The preference for polyherbal formulations was evident, as 88.18% of respondents reported using combinations of plant species, compared with only 11.81% who relied on single-plant preparations (*Table 3*).

Table 2 – Single plant species and combinations of plant species used in the treatment of ulcers in the study area

Plant species combination	Part used	Method of preparation
Ageratum conyzoides + *Vernonia amygdalina* + *Argyreia nervosa* + Snail + *Vitellaria paradoxa* + *Parkia biglobosa*	Leaf + Leaf + Leaf + Shea butter oil + Seed	Grind equal quantities of fresh leaves of *Ageratum conyzoides*, *Vernonia amygdalina*, and *Argyreia nervosa* together. Also grind three mature snails after removing the shells. Place a clay pot (*ape*) on the fire and add shea butter oil (*Vitellaria paradoxa* oil). Add plenty of *Parkia biglobosa* (locust bean; iru/woro), the ground snail shells, and the ground leaves, then add one whole snail. Allow the mixture to cook and remove the pot from the fire after 3 days. Eat the entire preparation at once. Repeat the process every 3 days. Note that the pot (*ape*) should not touch the ground when removed from the fire.
Musa sapientum + *Newbouldia laevis* + *Aframomum melegueta*	Peel + Bark + Pod	Burn dry peels of *Musa sapientum* (banana) together with the dry bark of *Newbouldia laevis* and one pod of dried *Aframomum melegueta* (alligator pepper), then grind into powder. Mix a small quantity of the powder (one full teaspoon) with cold pap and drink three times daily.
Ocimum gratissimum + *Mangifera indica* + *Sorghum bicolor*	Leaf + Leaf + Seed (Paste)	Boil fresh leaves of *Ocimum gratissimum* and *Mangifera indica*. Mix one stainless-steel cup of the decoction with *Sorghum bicolor* paste and natural honey. Drink half a stainless-steel cup twice daily.
Piper nigrum + Snail + *Parkia biglobosa* + *Kalanchoe crenata*	Seed + Snail + Seed + Leaf	Grind small quantities of black pepper seeds and cook with a giant land snail and plenty of *Parkia biglobosa* and *Kalanchoe crenata*. Eat the entire preparation. Repeat the process every 2 or 3 days.
Bryophyllum pinnatum + Arachis hypogaea	Leaf + Seed	Wash two or three leaves of *Bryophyllum pinnatum* and eat them together with groundnut (*Arachis hypogaea*) twice daily,
Carica papaya	Fruit	Soak unripe pawpaw fruits in water for 3 days in a clean container and drink half a stainless-steel cup three times daily.
Musa paradisiaca	Fruit	Soak plantain fruits in water for 7 days in a clean container and drink half a stainless-steel cup three times daily.
Musa sapientum	Fruit	Soak banana fruits in water for 7 days in a clean container and drink half a stainless-steel cup three times daily.
Bryophyllum pinnatum	Leaf	Collect fresh leaves of *Bryophyllum pinnatum* and wash them thoroughly. Eat two or three leaves in the morning and at night daily.
Moringa olifera	Leaf	Boil fresh leaves of *Moringa oleifera* in water or squeeze them in water. Drink half a stainless-steel cup twice daily.
Acacia nilotica	Pod	Dry the young seedless pods and grind them into powder. Take one teaspoon daily with warm water.
Hibiscus sabdariffa	Calyx	Boil the calyx in water for 5 minutes, allow it to cool, and then drink half a stainless-steel cup twice daily.
Psidium guajava	Leaf	Boil the leaves in water and drink half a stainless-steel cup twice daily. Warm before drinking.

Table 3 – Percentage of respondents using single-plant and multiple-plant recipes for ulcer treatment

Type of preparation	Frequency	Percentage (%)
Single plant	13	11.81
Plant combinations	97	88.18
Total	110	99.99

This trend corroborates the findings of Idowu *et al*. (2010), who observed that combining different plants and plant parts is a common practice among traditional healers, based on the belief that such mixtures enhance therapeutic effectiveness. Similarly, Anant and Jaya (2013) emphasised that each active ingredient within a multi-plant formulation contributes uniquely to alleviating ulcer symptoms, supporting the rationale for polyherbal therapies.

The widespread use of plant combinations in this study, such as mixtures involving *Ageratum conyzoides*, *Vernonia amygdalina*, and *Argyreia nervosa*, suggests a deliberate attempt to target multiple physiological pathways simultaneously. In ethnopharmacology, such combinations are believed to produce complementary effects: one plant may provide antimicrobial activity, another may reduce gastric acidity, while a third may promote epithelial regeneration. Comparable practices have been documented in other regions of Nigeria, where polyherbal remedies predominate in ulcer treatment (Agbatutu *et al*., 2022; Musa *et al*., 2021).

Internationally, similar trends have been reported in Ethiopia, India, and Morocco, where multi-plant formulations are commonly used to enhance therapeutic efficacy and broaden the spectrum of action (Ajjoun *et al*., 2022; Benlamdini *et al*., 2014; Goel and Sairam, 2002; Lulekal *et al*., 2014; Mrabti *et al*., 2022; Singh *et al*., 2011; Teklay *et al*., 2013).

Overall, the predominance of polyherbal preparations in this study reflects a sophisticated traditional medical system that seeks to harness synergistic interactions among plant species to achieve optimal therapeutic outcomes. This finding underscores the need for further pharmacological research to validate these formulations, isolate active compounds, and elucidate their mechanisms of action.

CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates that medicinal plants play a central and culturally significant role in the traditional management of PUD within the study area. The identification of 22 plant species belonging to 17 families, prepared in 13 distinct formulations, reflects both the rich botanical diversity available and the depth of ethnomedicinal knowledge preserved by local practitioners. The prominence of species from the Fabaceae family, particularly the subfamilies Mimosoideae and Papilionoideae, underscores their therapeutic relevance and long-standing cultural acceptance in ulcer treatment.

Several species, including *Ocimum gratissimum*, *Bryophyllum pinnatum*, *Carica papaya*, *Ageratum conyzoides*, *Musa sapientum*, *Parkia biglobosa*, and

Musa paradisiaca, recorded the highest frequencies of citation and fidelity levels, indicating strong community consensus regarding their effectiveness. The widespread preference for polyherbal formulations further suggests a traditional understanding of synergistic interactions, whereby combined plant species are believed to enhance therapeutic potency. Herbs were the most common growth form, leaves were the most frequently harvested plant part, grinding was the predominant method of preparation, and oral administration, mainly through drinking, was the primary route of administration. Together, these findings highlight a structured, culturally embedded, and highly adaptive traditional medical system for ulcer management.

Despite the strengths of this study, the absence of standardised dosages, variation in preparation methods, and reliance on self-reported information underscore the need for further scientific validation. To advance the integration of traditional knowledge with modern biomedical science, future research should prioritise detailed phytochemical profiling, pharmacological evaluation, and toxicological assessment of the documented species. Mechanistic studies, including investigations of antioxidant activity, mucosal protection, anti-inflammatory pathways, and inhibition of the H^+/K^+-ATPase proton pump, are essential to substantiate traditional claims. In addition, efforts should be directed towards standardising dosage guidelines, improving preparation protocols, and developing conservation strategies for frequently used species to ensure long-term sustainability.

Overall, this study contributes significantly to the preservation of Nigeria's ethnobotanical heritage and provides a strong foundation for the development of safe, effective, and culturally relevant therapeutic options for ulcer management.

Ethics approval and consent to participate: As stated in the Methods section, according to the applicable institutional guidelines of the Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria, this type of ethnobotanical survey did not require formal approval from an ethics committee. Informed consent, documented by signature or thumbprint, was obtained from all participants prior to their inclusion in the study.

Funding: There was no external funding for this study.

Data availability statement: The data supporting this study can be obtained from the author on request.

Conflicts of interest: There was no conflict of interest.

REFERENCES

Abebaw, M.; Mishra, B.; Gelayee, D.A. Evaluation of antiulcer activity of the leaf extract of Osyris quadripartita decne. (Santalaceae) in rats. *Journal of Experimental Pharmacology* **2017**, *9*, 1-11. https://doi.org/10.2147/JEP.S125383

Adebayo, J.O.; Krettli, A.U. Potential antimalerials from Nigerians plants: a review. *Journal of Ethnopharmacology* **2011**, *133*(2), 289-302. https://doi.org/10.1016/j.jep.2010.11.024

Agbatutu, A.; Imade, F.N.; Ogie-Odia, E.A.; Ifedele, M.O.; Abdulrasaq, F.M.; Eseigbe, D. Ethnobotanical Survey of Plants Used in The Management of Peptic Ulcer Diseases

in Wukari Metropolis. *Biology, Medicine & Natural Product Chemistry* **2022**, *11*(2), 137-143. https://doi.org/10.14421/biomedich.2022.112.137-143

Ajjoun, M.; Kharchoufa, L.; Alami, M.I.; Elachouri, M. Moroccan medicinal plants traditionally used for the treatment of skin diseases: From ethnobotany to clinical trials, *Journal of Ethnopharmacology* **2022**, *297*, 115532. https://doi.org/10.1016/j.jep.2022.115532

Akah, P.A.; Okafor, C.L. Blood sugar lowering effect of *Vernonia amygdalina* in an experimental Rabbits model. *Phytotherapy Research* **1992**, *6*, 171-173. https://doi.org/10.1002/ptr.2650060318

Akinwumi, I.A.; Sonibare, M.A. Use of medicinal plants for the treatment of gastric ulcer in some parts of Southwestern Nigeria. *African Journal of Pharmacy and Pharmacology* **2019**, *13*(15), 223-235.

Albuquerque, U.P.; Ramos, M.A.; de Lucena, R.F.P.; Alencar, N.L. Methods and techniques used to collect ethnobiological data. In *Methods and Techniques in Ethnobiology and Ethnoecology*, **2014**, 15-37. https://doi.org/10.1007/978-1-4614-8636-7_2

Al-Rajhi, A.M.H.; Qanash, H.; Bazaid, A.S.; Binsaleh, N..; Abdelghany, T.M. Pharmacological evaluation of *Acacia nilotica* flower extract against *Helicobacter pylori* and human hepatocellular carcinoma in vitro and in silico. *Journal of Functional Biomaterials* **2023**, *14*(4), 237. https://doi.org/10.3390/jfb14040237

Ali, B.H.; Al Wabel, N.; Blunden, G. Phytochemical, pharmacological and toxicological aspects of *Hibiscus sabdariffa* L.: A review. *Phytotherapy Research* **2005**, *19*, 369-375. https://doi.org/10.1002/ptr.1628

Ali, M.Z.; Abdulmalik, A.; Aliyu, N.; Ibrahim, S.; Haruna, U.B. Ethnopharmacological Survey of some selected Medicinal Plants Used for the Treatment of Typhoid in Kafin Hausa, North West, Nigeria. *Journal of Applied Biological Sciences* **2021**, *15*(2), 169-184.

Anant, G.S.; Jaya, P.H. Traditional Phytotherapy of Some Medicinal Plants used by Tharu and Magar Communities of Western Nepal, against Dermatological Disorders. *Scientific World* **2013**, *11*(11), 81-89. https://doi.org/10.3126/sw.v11i11.8558

Angela, N.U-K.; Ibrahim. S.; Lesley, S.K.; Grace, J.G. Ethnobotanical survey of medicinal plants used as antiulcer in Gwandu Emirate, Kebbi State, Nigeria. *History and Philosophy of Medicine*, **2021**, 1-8. https://doi.org/10.53388/HPM20210713005

Ankli, A.; Sticher, O.; Heinrich, M. Medical ethnobotany of the Yucatec Maya: Healers' consensus as a quantitative criterion. *Economic Botany* **1999**, *53* (2), 144-160. https://doi.org/10.1007/BF02866493

Aqib, S.; Mohib, S. Phytochemistry, pharmacological and traditional uses of *Datura stramonium* L. review. *Journal of Pharmacognosy and Phytochemistry* **2014**, *2*(5), 123-125.

Ariyo, O.C. Ethnobotanical Survey of Medicinal Plants used in the Traditional Treatments of Measles in Akinyele Local Government, Ibadan, Oyo State, Nigeria. *Journal of Research in Forestry, Wildlife & Environment* **2024**, *16*(4), 11-28.

Ariyo, O.C. Ethno-Botanical Survey of Potential Anti-Typhoid Fever Plant Species in Akinyele Local Government Area, Ibadan, Oyo State, Nigeria.

Nigerian Agricultural Journal **2023a**, *54*(2), 292-310.

Ariyo, O.C. Ethno-Botanical Survey of Medicinal Plants used in Traditional Treatment of Erectile Dysfunction in Akinyele Local Government Area, Ibadan, Oyo State, Nigeria; *Nigerian Agricultural Journal* **2023b**, *54*(1), 156-172.

Ariyo, O.C.; Usman, M.B.; Adelani, D.O.; Ariyo, M.O. Assessment of Medicinal Plants for Traditional Treatment of Skin Diseases in Akinyele Local Government Area, Ibadan, Oyo State, Nigeria. *Ethnobotany Research and Applications* **2021**, *21-37*, 1-18. http://dx.doi.org/10.32859/era.21.37.1-18

Ariyo, O.C.; Usman, M.B.; Emeghara, U.U.; Olorukooba, M.M.; Fadele, O.K.; Danbaki, C.A.; Olagunju, O.E.; Suleiman, R.; Ariyo, M.O. Indigenous Curative Plants Used in the Treatment of Piles from Akinyele Local Government Area, Ibadan, Oyo State, Nigeria. *Annual Research & Review in Biology* **2020a**, *35*(6), 78-89. https://doi.org/10.9734/ARRB/2020/v35i630238 https://www.journalarrb.com/index.php/ARRB/article/view/30238

Ariyo, O.C.; Usman, M.B.; Olorukooba, M.M.; Ariyo, M.O.; Suleiman, R.; Aasa, O.S.; Adetunji, A.J.; Oni, O.B. Ethno-botanical Survey of Medicinal Plants Used in the Treatment of Cough in Akinyele Local Government Area, Oyo State, Nigeria. *European Journal of Medicinal Plants* **2020b**, *31*(8), 101-113. https://doi.org/10.9734/ejmp/2020/v31i830263

Attahiru, A. Bioactive compounds and therapeutic prospects of Nigerian medicinal plants. *International Journal of Academic Health and Medical Research* **2025**, *9*(9), 24-28.

Benabdesslem, Y. Ethno-pharmacological, Phytochemical Study and Evaluation of *In Vitro* and *In Vivo* Biological Activities of *Salvia argentea* (in French). Doctoral Dissertation, Université de Saïda Dr. Moulay Tahar, Saïda, Algeria, 2019.

Benlamdini, N.; Elhafian, M.; Rochdi, A.; Zidane, L. Floristic and Ethnobotanical Study of the Medicinal Flora of the Eastern High Atlas (Upper Moulouya) (in French). *Journal of Applied Bioscience* **2014**, *78*(1), 6771-6787. https://doi.org/10.4314/jab.v78i1.17

Bentabet, N.; Rajaa, R.; Sakina, N. Ethnobotanical Survey and Inventory of Medicinal Plants Used in the Treatment of Dermatological Diseases in the City of Aïn Témouchent (in French). *Journal of Applied Bioscience* **2022**, *170*, 17704-17719. https://doi.org/10.35759/JABs.170.4

Beverly, C.D.; Sudarsanam, G. Ethnomedicinal plant knowledge and practice of people of Javadhu hills in Tamilnadu. *Asian Pacific Journal of Tropical Biomedicine* **2011**, *1*(1), 79-81. https://doi.org/10.1016/S2221-1691(11)60129-9

Bita-Nicolae, C.; Dhyani, P. Editorial: Plant diversity: the key to ecosystem resilence in a changing world. *Frontiers in Plant Sciences* **2025**, *15*, 1534119. https://doi.org10.3387/fpls.2024.1534119

Borrelli, F.; Izzo, A.A. The plant kingdom as a source of anti-ulcer remedies. *Phytotherapy Research* **2000**, *14*(8), 581-591. https://doi.org/10.1002/1099-1573

Cameron, A.; Ewen, M.; Ross-Degnan, D.; Ball, D.; Laing, R. Medicine prices, availability and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancer* **2009**, *373*(9659), 240-249. https://10.1016/S0140-6736(08)61762-6

Chan, F.K.L.; Graham, D.Y. Prevention of non-steroidal anti-inflammatory drug gastrointestinal complications - review and recommendations based on risk assessment. *Alimentary Pharmacology & Therapeutics* **2004**, *19*(10), 1051-1061. https://doi.org/10.1111/j.1365-2036.2004.01935.x

City Population. Igabi (Local Government Area, Nigeria): Population Statistics, Charts, Map and Location, 2022/ https://www.citypopulation.de/en/nigeria/kaduna/admin/IGABI/ (accessed on 20 February 2026).

Climate-Data.org. Climate Statistics for Igabi, Kaduna State, Nigeria, 2024. https://en.climate-data.org (accessed on 20 February 2026).

Copernicus Climate Change Service (C3S). Climate Data Store (CDS): ERA5-Based Climate Variables for Igabi, Kaduna State, Nigeria (2017–2022), 2024. https://cds.climate.copernicus.eu (accessed on 7 March 2026).

Daniel, V.T.; Wiseman, J.T.; Flahive, J.; Santry. H.P. Predictors of mortality in the elderly after open repair for perforated peptic ulcer disease. *Journal of Surgical Research* **2017**, *215*, 108-113. https://doi.org/10.1016/j.jss.2017.03.052

Debjit, B.; Chiranjib, C.; Tripathi, K.K.; Kumar, K.P.S. Recent trends of treatment and medication peptic ulcerative disorder. *International Journal of PharmTech Research* **2010**, *2*(1), 970-980.

Diatta, C.; Gueye, M.; Akpo, L. Medicinal Plants Used Against Dermatoses in the Baïnounk Pharmacopoeia of Djibonker, Ziguinchor Region (Senegal) (in French). *Journal of Applied Biosciences* **2013**, *70*(1), 5599. https://doi.org/10.4314/jab.v70i1.98762

Dike, I.P.; Obembe, O.O.; Adebiyi, F.E. Ethnobotanical survey for potential anti-malarial plants in south Western Nigeria. *Journal of Ethnopharmacology* **2012**, *144*(3), 618-26. https://doi.org/10.1016/j.jep.2012.10.002

Ezeorba, T.P.C.; Chukwuma, I.F.; Asomadu, R.O.; Ezeorba, W.F.C.; Uchendu, N.O. Health and therapeutic potentials of *Ocimum* essential oils: a review on isolation, phytochemistry, biological activities, and future directions. *Journal of Essential Oil Research* **2024**, *36*(3), 271-290. https://doi.org/10.1080/10412905.2024.2338117

Fowora, M.; Aina, O.; Omoregie, E.S.; Smith, S.; Osubor, C.C. The effect of *Acacia nilotica* on *Helicobacter pylori* colonization. *International journal of medicinal plants and natural products* **2021**, *7*(3), 1-10. https://doi.org/10.20431/2454-7999.0703001

Francis, O.; Sarada, P.M. Tourism Potential of Plants Species Used for the Treatment of Malaria and Typhoid Fever in Omo Forest Reserve Southwest Nigeria. *Journal of Tourism & Hospitality Education* **2021**, *11*, 64-92. https://doi.org/10.3126/jthe.v11i0.38247

Friedman, J.; Yaniv, Z.; Dafni, A.; Palewitch, D. A preliminary classification of the healing potential of medicinal plants based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev desert, Israel. *Journal of Ethnopharmacology* **1986**, *16*(3), 275-287. https://doi.org/10.1016/0378-8741(86)90094-2

Gadekar, R.; Singour, P.K.; Chaurasiya, P.K.; Pawar, R.S.; Patil, U.K. A potential of some medicinal plants as an antiulcer agents. *Pharmacognosy Reviews* **2010**, *4*(8), 136-136. https://doi.org/10.4103/0973-7847.70906

Garrido, G.; González, D.; Lemus, Y.; García, D.; Lodeiro, L.; Quintero, G.; Núñez-Sellés, A.J. In vivo and in vitro

anti-inflammatory activity of mangiferin. *Pharmacological Research* **2004**, *50*(2), 143-149. https://doi.org/10.1016/j.phrs.2003.12.003

Gbile, Z.O.; Soladoye, M.O. Vernacular names of Nigerian plants (Hausa). 2nd Edition, Forestry Research Institute of Nigeria, Ibadan. **2002**, 1-97.

Goel, R.K.; Sairam, K. Anti-ulcer drugs from indigenous sources with emphasis on *Musa sapientum*, *Tamrabhasma*, *Asparagus racemosus* and *Zingiber officinale*. *Indian Journal of Pharmacology* **2002**, *34*(2), 100-110.

Gulmez, S.E.; Holm, A.; Frederiksen, H.; Jensen, T.G.; Pedersen, C. Use of proton pump inhibitors and the risk of community-acquired pneumonia: A Population-Based Case Control Study. *Archives of Internal Medicine* **2007**, *167*, 950-955.

Heinrich, M.; Ankli, A., Frei, B.; Weimann, C.; Sticher, O. Medicinal plants in Mexico: Healers' consensus and cultural importance. *Social Science and Medicine* **1998**, *47*(11), 1859-1871. https://doi.org/10.1016/S0277-9536(98)00181-6

Idm'hand, E.; Msanda, F.; Cherifi, K. Ethnobotanical study and biodiversity of medicinal plants used in the Tarfaya Province, Morocco. *Acta Ecologica Sinica* **2020**, *40*(2), 134-44. https://doi.org/10.1016/j.chnaes.2020.01.002

Idowu, O.A.; Soniran, O.T.; Ajana, O.; Aworinde, D.O. Ethnobotanical survey of antimalarial plants used in Ogun State, Southwest Nigeria. *African Journal of Pharmacy and Pharmacology* **2010**, *4*(2), 055-060.

Ijeh, I.I.; Ejike, C.E.C.C. Current perspectives on the medicinal potentials of *Vernonia amygdalina* Del. *Journal of Medicinal Plants Research* **2011**, *5* (7), 1051-1061.

Inngjerdinge, K.; Sogn, C.N.; Diallo, D.; Pierre, P.M.; Smestad, B.P. An ethnopharmacological survey of plants used for wound healing in Dogonland, Mali, West Africa. *Journal of Ethnopharmacology* **2004**, *92*, 233-244. https://doi.org/10.1016/j.jep.2004.02.021

Jahjah, S.; Ait Alla, K.; Erbiai, E.H.; Legssyer, M.; Jamali, C.A.; Silva, JCGE. Ethnobotanical investigation of medicinal and aromatic plants used in the traditional treatment of COVID-19 in the rural commune of Bni Hadifa, province of Al Hoceima (Central Rif, Northern Morocco). *Multidisciplinary Science Journal* **2024**, *6*(8), 2024149. https://doi.org/10.31893/multiscience.2024149

Julián-Flores, A.; Aguilar-Zárate, P.; Michel, M.R.; Sepúlveda-Torre, L.; Torres-León, C.; Aguilar, C.N.; Chávez-González, M.L. Exploring the therapeutic potential of medicinal plants in the context of gastrointestinal health: A review. *Plants* **2025**, *14*(5), 642. https://doi.org/10.3390/plants14050642

Kadiri, M.; Ojewumi, A.W.; Kokumo, Y.O. Ethnobotanical Study of Plants Used in Managing Ulcer in Abeokuta Metropolis, Ogun State, Nigeria. *Journal of Natural Science, Engineering and Technology* **2013**, *12*, 76-88.

Kaido, T.L.; Veale, D.J.H.; Havlik, I.; Rama, D.B.K. Preliminary screening of plants used in South Africa as traditional herbal remedies during pregnancy and labour. *Journal of Ethnopharmacology* **1997**, *55*(3), 185-191.

Kayode, J.; Olanipekun, M.K.; Tedela, P.O. Medicobotanical studies in relation to veterinary in Ekiti-State, Nigeria Conservation of botanicals used for the treatment of poultry diseases. *Ethnobotanical Leaflets* **2009**, *13*, 40-246.

Khan, M.A.; Ajab, K.M.; Mujtaba, G.; Hussain, M. Ethnobotanical Study About Medicinal Plants of Poonch Valley Azad Kashmir. *The Journal of Animal & Plant Sciences* **2012**, *22*(2), 493-500.

Koffi, N.; Marie-Solange, T.; Emma, A.A.; Noel, Z.G. Ethnobotanical study of plants used to treat arterial hypertension in traditional medicine, by abbey and Krobou population of Agboville (Cote d'ivoire). *European Journal of Scientific Research* **2009**, *35*, 85-98.

Kumar, D.; Trivedi, N.; Dixit, R. K. Herbal medicines used in the traditional Indian medicinal system as a therapeutic treatment option for diabetes management: a review. *World Journal of Pharmaceutical Sciences* **2015**, *4*(4), 368-85.

Lulekal, E.; Kelbessa, E.; Bekele, T.; Yineger, H. An ethnobotanical study of medicinal plants used by local people in Ethiopia for stomach and intestinal ailments. *Journal of Ethnobiology and Ethnomedicine* **2014**, *10*, 46.

Mahmoud, D.A.; Saber, W.H.; Muhammad, U.; Salisu, M.T.; Namadi, S.; Abdukadir, Y. Therapeutic plants used for Typhoid Fever treatment in Kaduna State Nigeria. *Al Qadisiyah Journal of Pure Science* **2021**, *26*(3), 9-21.

Mahomoodally, M.F. Traditional Medicines in Africa: An Appraisal of Ten Potent African Medicinal Plants. Evidence-Based Complementary and Alternative Medicine **2013**, 1-14. https://doi.org/10.1155/2013/617459

Meddour, R.; Sahar, O.; Babkar, A. Savoirs locaux sur les plantes spontanées chez les populations de la wilaya de Tamanrasset (Sahara Central, Algérie) (in *French*). *Vertigo* **2022**, 22-1. https://doi.org/10.4000/vertigo.35315

Mouchane, M.; Taybi, H.; Gouitaa, N.; Assem, N. Ethnobotanical survey of medicinal plants used in the treatment and care of hair in Karia ba Mohamed (Northern Morocco). *Journal of Medicinal Plants and By-products* **2023**, *13*, 201-8. https://doi.org/10.22034/jmpb.2023.362044.1545

Mrabti, H.N.; Doudach, L.; Mekkaoui, M.; Khalil, Z.; Harraqui, K.; Fozia, F. Profile of Medicinal Plants Traditionally Used for the Treatment of Skin Burns. *Evidence-Based Complementary and Alternative Medicine* 2022, 1-10. https://doi.org/10.1155/2022/3436665

Musa, D.D.; Oti, E.C.; Junaidu, S. Ethnobotanical Survey of Plants used in Treatment of Ulcer by the Hausa-Fulani Tribals in Katsina State Nigeria. *International Journal of Pure & Applied Sciences* **2021**, *25*(1), 34-47.

Mykhailenko, O.; Jalil, B.; McGaw, L.; Echeverria, J.; Takubessi, M.; Heinrich, M. Climate change and the sustainable use of medicinal plants: a call for "new research" strategies. *Frontiers in Pharmacology* **2025**, *15*:1496792. https://doi.org/10.3389/fphar.2024.1496792

NPC. Population and Housing Census of the Federal Republic of Nigeria, 2010. http://www.population.gov.ng (accessed on 15 March 2026)

NPC & NBS. National Population Commission of Nigeria Portal, 2006. https://www.nigerianstat.gov.ng (accessed on 15 March 2026)

Nwafor, F.I.; Tchimene, M.K.; Onyekere, P.F.; Nweze, O.N.; Orabueze, I.C. Ethnobiological study of traditional medicine practices for the treatment of chronic leg ulcer in south eastern Nigeria. *Indian Journal of Tradition Knowledge* **2018**, *17*(1), 34-42.

Ojewumi, M.E.; Babatunde, D.E.; Orjiakor, T.G.; Ojewumi, E.O.; Olawale-Success, O.O. Exploring the therapeutic potential of *Ocimum*

gratissimum extracts against microbial infections: A Comprehensive review. *Medicine India* **2024**, *3*, 45-57. https://doi.org/10.25259/medindia_11_2024

Oloyede, O.I. Chemical profile of unripe pulp of *Carica papaya*. *Pakistan Journal of Nutrition*, **2005**, *4*(6), 379-381. https://doi.org/10.3923/pjn.2005.379.381

Owokotomo, I.A.; Ekundayo, O.; Abayomi, T.G.; Chukwuka, A.V. In-vitro anti cholinesterase activity of essential oil from four tropical medicinal plants. *Toxicology Reports*, **2015**, *2*, 850-857. https://doi.org/10.1016/j.toxrep.2015.05.003

Pandey, P.; Kushwaha, R.; Verma, A.; Tripathi, S.; Devhare, L. Phytochemical and pharmacological profiling of plants from Asteraceae family: A comprehensive review. *European Journal of Pharmaceutical Research* **2024**, *11*, 585-91.

Pukraj, H.A.; Tabassumyaseen, B. Studies of the medicinal plants uses of Tehsil Katlang district Mardan KPK Pakistan. Wud pecker *Journal of Medicinal Plants* **2013**, *2*(4), 085-093.

Quadeh, N.; Benhissen, S.; Belkassam, A.; Bendif, H.; Rebbas, K.; Étude ethnobotanique et inventaire des plantes médicinales de la région de Dréat (M'Sila, Algérie). *Geo Eco Trop* **2021**, *45*(4), 617-33.

Ralte, L.; Singh, Y.T. Ethnobotanical survey of medicinal plants used by various ethnic tribes of Mizoram, India. *PLoS One* **2024**, *19*(5), e0302792 https://doi.org/10.1371/journal.pone.0302792

Romano, B.; Lucariello, G.; Capasso, R. Topical Collection "Pharmacology of Medicinal Plants". *Biomolecules* **2021**, *11*(1), 101. https://doi.org/10.3390/biom11010101

Sarkar, M.; Hennessy, S.; Yang, Y.X. Proton-pump inhibitor use and the risk for community-acquired pneumonia. *Annals of Internal Medicine* **2008**, *149*, 391-398. https://doi.org/10.7326/0003-4819-149-6-200809160-00005

Schippmann, U.; Cunningham, A.B.; Leaman, D.J. Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues (Case Study No. 7). In *Biodiversity and the Ecosystem Approach in Agriculture, Forestry and Fisheries*, Satellite Event Session on the Occasion of the 9th Regular Session of the Commission on "Genetic Resources for Food and Agriculture", Rome, 12-13 October 2002. FAO Document Repository of United Nations, 2002.

Schmeda-Hirschmann, G.; Yesilada, E. Traditional medicine and gastroprotective crude drugs. *Journal of Ethnopharmacology* **2005**, *100*(1-2), 61-66. https://doi.org/10.1016/j.jep.2005.06.002

Singh, R.; Singh, B.; Singh, S. Traditional medicinal plants used for the treatment of gastric ulcers in India: A review. *Pharmacognosy Reviews* **2011**, *5*(10), 120-126. https://doi.org/10.2174/138955752066619122715939

Stewart, D.J.; Ackroyd, R. Peptic ulcers and their complications. *Surgery* **2011**, *29*(11), 568-574. https://doi.org/10.1016/j.mpsur.2011.08.006

Sun, W.; Shahrajabian, M. H. Therapeutic potential of phenolic compounds in medicinal plants-Natural health products for human health. *Molecules*, **2023**, *28*(4), 1845. https://doi:10.3390/molecules28041845

Tardío, J.; Pardo-de-Santayana, M. Cultural importance indices: A comparative analysis based on the useful wild plants of Southern

Cantabria (Northern Spain). *Economic Botany* **2008**, *62*(1), 24-39.

Teklay, A.; Abera, B.; Giday, M. An ethnobotanical study of medicinal plants used in the management of gastrointestinal disorders in Ethiopia. *Journal of Ethnopharmacology* **2013**, *150*(2), 528-536.

Tesfaye, Y.T.; Mulugeta, M.Z.; Samuel, B.D. Review of Ethnobotanical and Ethnopharmacological Evidence of Some Ethiopian Medicinal Plants Traditionally Used for Peptic Ulcer Disease Treatment. *Clinical and Experimental Gastroenterology* **2022**, *15*, 171-187. https://doi.org/10.2147/ceg.s384395

World Health Organisation. WHO global report on traditional and complementary medicine 2019. Geneva: World Health Organization, 2019. https://apps.who.int/iris/handle/10665/312342

Yusuf, O.M.; Olaniran, T.O.; Oluwabunmi, O.A.; Abdulwakeel, A.A. Traditional knowledge of medicinal plants used in Ile-Ife, Southwestern Nigeria. *Asian Journal of Ethnobiology* **2022**, *5*(2), 71-83.

Academic Editor: Dr. Constantin LUNGOCI