

# Ethnobotanical survey and conservation of the indigenous plants used for traditional orthopedic care practices in Bayelsa Central Senatorial District, Nigeria

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**Abstract.** Olatokunbo HS, Olanipekun MK, Michael OO. 2022. Ethnobotanical survey and conservation of the indigenous plants used for traditional orthopedic care practices in Bayelsa Central Senatorial District, Nigeria. *Asian J Ethnobiol* 5: 130-137. The practices of the trado-orthopedic system of healing in all forms among indigenous healers are extensively linked to plant resources. We investigated the plant species exploited among folks involved in traditional orthopedic care services in Bayelsa Central Senatorial District, Nigeria. The district was delineated into three Local Government Areas (LGAs). Information on the plant species used for traditional orthopedic services was fetched by an open-ended conversation with 150 respondents across 15 communities in the LGAs. The respondents are mostly women, 117 (78%), while 33 (22%) are men. The adults 60 (52.67%) years and above showed more interest in using traditional medicine than the younger ones. The young people considered traditional medicine superstitious and used by uneducated or poor people. Thirty-nine (39) plant species in thirty (30) different families were accessed as species used for bone healing in the area. Thirty-two (82%) species of the plants were found on the scale of abundance, while seven of the species (18%) accessed were rare in occurrence. The plants were used as food, timber, and medicine; the highest citations occurred in Malvaceae and Amaranthaceae families, with three species each. Different sections of the plants were exploited for treatment options ranging from bone hardening to pain reliever, fester prevention and swelling, to pushing dislocated bones back in position. Physical examinations and oral interviews are major tools among TOCPs in the diagnostic test to ascertain the level of casualty such as deformity, the inability of the limb to act, and shortened limb, among others. Also, the extraction pattern, which was either predatory or annihilative, was noted. Given the preceding, plants for sustainable use of the species were proposed. Moreover, we recommended that further research into the efficacy and safety use of the species in treating fracture and bone-related ailments are taken on.

**Keywords:** Abundance, Bayelsa Central Senatorial District, bone healing, conservation, medicinal plants, traditional orthopedic care

## INTRODUCTION

The roles of plant resources in human society are manifold; aside from their basic uses for food and shelter, they are also being exploited as a suitable material for medicine, especially in rural areas (Tilahun and Moa 2018; Gaddy 2020; Ihinmikaye and Akinjagunla 2020; Az-Zahra et al. 2021). Ethnomedicine, a branch of botanical research that deals with the relationships between indigenous people and the plant community exploited in folk medicine to maintain health, prevent and treats physical and mental sicknesses based on theories, folk beliefs, and experiences (Gureje et al. 2018; Suchita 2019). There is medicine in plants. Plants show healing effects through different mechanisms like boosting the immune system, decreasing bacterial count, modulation wound and fracture healing, remodeling fibrin-rich granulation tissue, improving collagen deposition, increasing fibroblasts and fibrocytes, etc. (Sheen and Garla 2019). The economic benefits of the use and the development of indigenous medicines from medicinal plants for the treatment of various diseases, such as back pains, chicken pox, infections, gonorrhoea, syphilis, stroke, diarrhea, wound healing, and skin diseases, among others, were reported to be among the illnesses that

traditional healers can treat (Tugume et al. 2016; Aziz et al. 2017; Tewelde et al. 2017; Kidane et al. 2018).

The potency, relevance, and use of herbal medicine result from the inherent bioactive ingredients present in medicinal plants when used as herbal remedies (Adedjei et al. 2018). Therefore, the practice of traditional medicine, especially in remote areas, plays a notable role in the prevention and healing of people's health, as reported by Liu et al. (2009), Ahmad et al. (2014), Tugume et al. (2016), Tewelde et al. (2017), Aziz et al. (2017), and Kidane et al. (2018). It was estimated that 3.5 billion people in the developing world depend on medicinal plants as part of their primary health care (Balick and Cox 1996; Ahmad et al. 2014; Olanipekun et al. 2020). That was corroborated by the reports of WHO that 80% of the world's inhabitants, especially in developing countries, depend on traditional medicine for their primary healthcare needs (Bannerman et al. 1983; Aziz et al. 2017). Unfortunately, synthetic drugs and access to high-quality orthopedic care in the hospital are not well available in rural areas, especially in the study areas. Therefore, treating Musculoskeletal and bone fractures injuries is usually done using herbal medicine with plants. That could also be because of the high cost of modern medicine compared to

indigenous herbal medicines, wide socio-cultural acceptance of traditional medicine, and the belief that natural products pose less or no risk are the various advantages herbal medicine has over orthodox medicine. In orthopedics management, bone healing using plants and their extract and poultice together with a splint without a cast is widely practiced in traditional medicine. In Nigeria, the diverse floristic compositions of plant forms, which include trees, shrubs, herbs, and other non-timber forest resources, have contributed greatly to the widespread use of Nigerian plants as medicine (Sonibare and Gbile 2008; El-Ghani 2016; Erinoso and Aworinde 2018; Lawal et al. 2020; Mukaila et al. 2021; Ajao et al. 2022). The use of medicinal plants is well-known among the indigenous peoples in Bayelsa, the Eastern part of Nigeria. Also, the acceptance and use of herbal medicine are increasing globally because of its effectiveness and availability of plant materials (Zhu and Woerdenbag 1995; Huai and Pei 2002; Brandão et al. 2006). Bone healing or fracture healing is a proliferative, physiological process in which the body facilitates the repair of a bone fracture. It involves complex processes of cell and tissue proliferation and differentiation. The treatment consists of pushing dislocated bones back in place via relocation with or without anesthesia, stabilizing their position, and then waiting for the bone's natural healing process.

However, bone healing using plants and their extract and poultice together with a splint without a cast is widely practiced in traditional medicine. The traditional bone healing process focuses on diagnosing, preventing, and correcting disorders and deformation related to the musculoskeletal system (Esrafilian et al. 2013). Also, traditional medicine practitioners specialize in using plant materials to treat bone and fracture repair (Alam et al. 2016), employing different tactics such as massage, traction, splint, etc., using the plant as the main raw material in manipulating and setting fractures. Such understanding came through a series of long observations and trials from one generation to another, and the knowledge is transmitted orally to posterity or apprenticed (Onuminya 2004; Dada et al. 2011). Also, the increased preference for herbal medicine has consequently propelled the search for pharmaceutical remedies against different ailments from plants. Unfortunately, many medicinal plants are collected from the wild, which has negatively affected the availability of plant resources due to unsustainable exploitation rates and the health of many people who cannot afford orthodox medicine.

Nevertheless, various studies have identified and documented medicinal plants of medicinal importance. Interestingly, the rich history of African cultures and their innovative utilization of plants as a source of remedies have been passed down through generations mainly by oral tradition (Olanipekun et al. 2020). However, unfortunately, this knowledge is gradually lost due to inadequate written documentation, overharvesting of medicinal plants from their natural habitat, and conversion of forest reserves for building or construction purposes. That poses a major threat to traditional medicine as the custodians hold the information secretly and die before passing on information

to the younger generations (Su et al. 2011).

It was noted that studies on plants used by the people of Bayelsa State for the traditional bone healing process are rare; in fact, a literature search shows that a dearth of studies on plant species use in trado-orthopedic care among other ethnic groups in Nigeria abounds. Therefore, substantial documentation remains important to mitigate the potential loss of valuable indigenous knowledge associated with plant resources used in trado-orthopedic care among local communities. Furthermore, the potential of medicinal plants is still far from being extensively explored locally and nationally as well as internationally. Thus, this study aims at generating an inventory of plants with the medicinal value among selected local communities in Bayelsa State.

## MATERIALS AND METHODS

### Description of study area

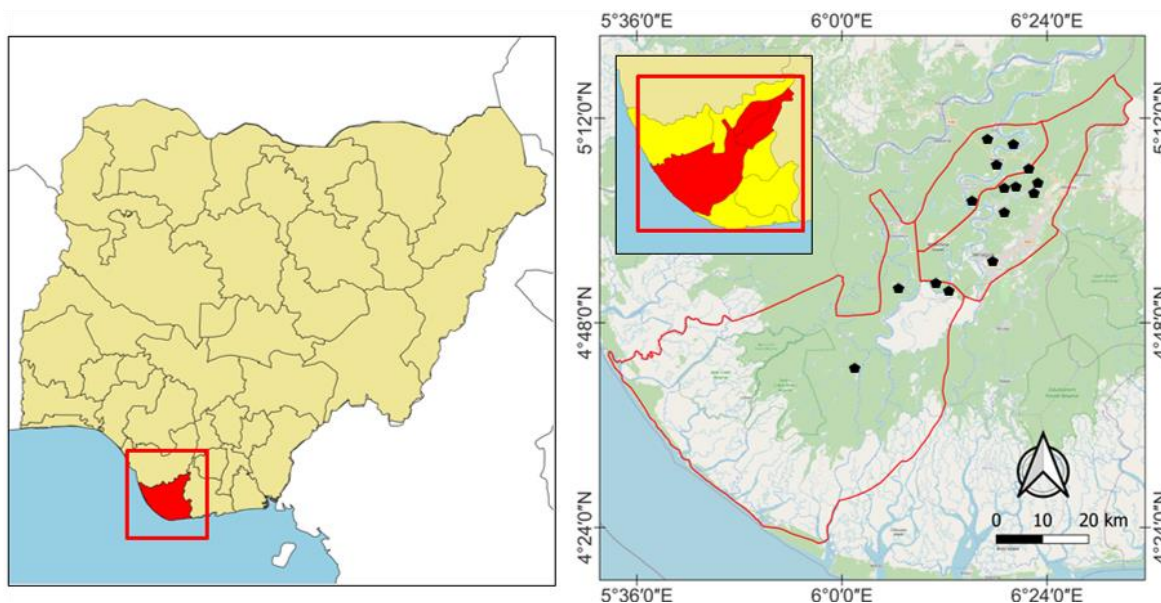
Bayelsa Central Senatorial District (BSCD), Nigeria, is one of the three districts that constitute Bayelsa State. The senatorial district comprises three Local Government Areas (LGA): Yenegoa, Southern Ijaw, and Kolokuma/Opokuma, which lies between latitudes 5°70' and 6°43' N and longitudes 4°60' and 4°81' E, with a landmass about 3,004 km<sup>2</sup>. The climate is tropical, with mean monthly temperature ranging from 25°C to 31°C. Ethnic Ijaw groups such as Kolokuma, Ekpetiama, Igbriran, Epie/Atissa, and Biseni are the main inhabitants of the area. Farming and fishing are the predominant trades, though many engage in businesses related to forest resources.

### Socio-demographic characteristics of the respondents

The reference population was all persons over 30 years of age born and living in various locations in the state as shown in Figure 1. An open-ended, semi-structured questionnaire was used to carry out this research. The questionnaire was used to assess 150 people from March 2020 to March 2021. The various questions were based on the population's socio-demographic characteristics, age, sex, profession, education status, and family situation. Also, information on the medicinal plants of importance, such as species name, part of the plants identified, methods and mode of preparation, and information on conservation measures, were assessed and documented.

### Sample collection and identification

The study was conducted between March 2020 and March 2021. Fifteen communities were selected for the study: Korokorosei, Ekeni, Ayama, Otuan, and Odewari, in Southern-Ijaw LGA; Beseni, Zarama, Polaku, Igeibiri, Gbaran, in Yenagoa LGA; and Kaiama, Odi, Ogboloma, Sampou, Opokuma in Kolokuma/ Opokuma LGA. A total of 150 respondents (50 from each LGA) comprised of traditional bone healers and members of the communities who had maintained domicile for less than 15 years and with knowledge of plants used for fracture treatment and bone-related disorders were selected for the study. The bone healers selected were well-known in the community based on skill and years of experience.



**Figure 1.** Map of Bayelsa State in Nigeria showing the study area

An open-ended conversation, structured questionnaire guide, and direct field observation allow each respondent to express personal viewpoints freely without being interrupted or contradicted by others (Martin 1995). The interview provided various information on the conditions associated with bone fractures and management. Similarly, plant species that could be used as herbal medicine to treat fractures were documented. Also, the parts of the plants, the habit, the habitat, the methods of preparation, the mode of administration, and the abundance status of the plants were recorded. It was also noted that the plants that could be sighted physically between thirty to sixty minutes were documented as common plants, while those that could be seen within sixty minutes to several hours were regarded as scarce, rare, and endangered plant species, respectively (Ihinmikaiye et al. 2020). Voucher specimens of the plants were prepared and deposited at the Herbarium unit of the Department of Plant Science and Biotechnology, Bayelsa State University. All the data collected were encoded in the Microsoft Excel spreadsheet and processed using Statistical Package for Social Sciences (SPSS). Descriptive Statistical analysis (percentages) was used to summarize the data.

#### **Intellectual property agreement statement**

Before the interviews, a two-time visit was made to the study area where the Kings, the traditional rulers, and elders were duly informed about the objectives of the research work with a verbal agreement that the information gathered during the research shall be protected and that the research shall not be used for commercial purposes. Still, to enlighten the students and document medicinal plants used for the management of bone fractures in order to protect our heritage from eroded, thus, the interview was granted.

#### **RESULTS AND DISCUSSION**

The socio-demographic characteristics of the indigenous people using herbal medicine to manage fractures and the various bones related conditions in the study area reveal that mature and older adults were experienced in using herbal medicine (52.67%) (Table 1). The distribution of knowledge about the use of medicinal plants varies considerably between men and women. While women (78%) used herbal remedies to treat fractures, only (22%) of men used herbal remedies. It was obvious that women knew better about using plants as an alternative therapy than men. This result could be explained by the fact that in the study area, women are in charge of managing the health of the household members, using knowledge acquired from their parents. That was following the report of Deressa and Ali (2009) in the south-central district of Ethiopia that women have a higher general knowledge of managing and treating symptoms associated with health challenges than men. This result is also following the work of Chohra and Ferchichi (2019) and the north African scale by Mehdioui and Kahouadji (2007), who noted that the household management of caring for household members with the prudent spending of the family money and budget is mainly assigned to women to reduce the costs induced by the doctor and on the drug. The respondents of age groups of 60 years and above has the largest representation of 38.22%, while ages between (50-59), (40-49), (30-39) and (20-29) have a percentage of 22.54%, 17.66%, 13.45%, and 8.13% respectively. The older people showed more interest in their demonstration of how to collect, process, administer and prescribe medicinal plants with great belief in the efficacy of herbal remedies than the young generation, which showed low participation in all aspects. That corroborates the work of Abera (2014) on medicinal plants used in traditional medicine by the

Oromo people, Ghimbi District, South-West Ethiopia, in which there was a decreasing positive attitude towards the use of medicinal plants by the younger generation.

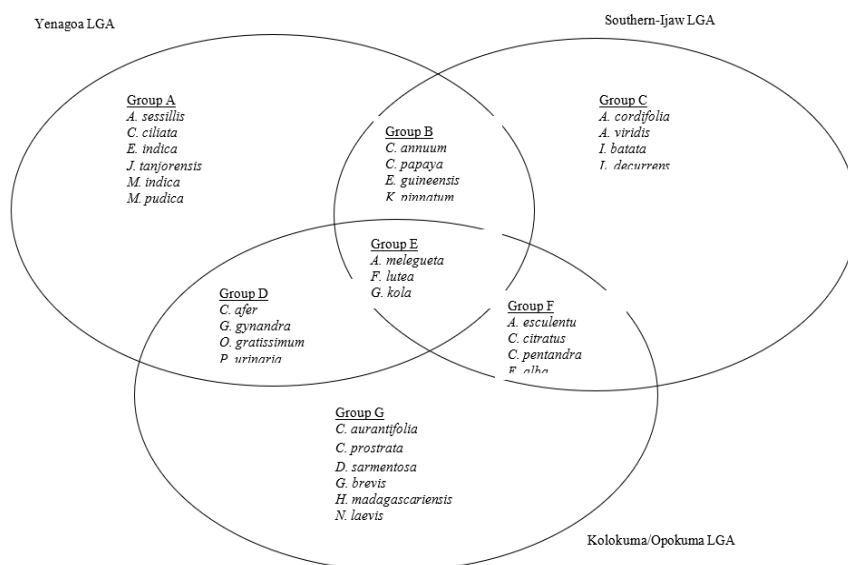
The young generation considered traditional medicine superstitious and used by poor and uneducated people. In addition, most of the older adults kept their knowledge secret from the young people to generate income and obtain respect from their community; thus, indigenous knowledge declined. It was also noted that 63.87% of plant users discovered their experiences through trial and error, and those of ancestors in the use of medicinal plants as remedies, 19.28% solicit herbalists. In comparison, 16.85% consult books and radio/television programs specializing in herbal medicine. Also, it was asserted by Teshome (2005) and Abera (2014) that the absence of formal education in traditional knowledge in developing nations is another factor in the decline of indigenous knowledge. On the contrary, medicinal plant use decreased as plant users' education level increased. Health professionals in developed nations intensively search for medicinal plants to combat old, emerging, and re-emerging diseases. Still, their African counterparts greatly underestimate traditional medicine's contribution to health care systems., which may result in the loss of rich and useful traditional knowledge accumulated over many generations.

Thirty-nine (39) plant species belonging to thirty different families were identified as being used for fractures and bone healing processes in the study area (Table 2). Vernacular/Ijaw names of the species identified are presented in the Table. The highest number of plant citations occurred in families Malvaceae and Amaranthaceae, with three species each, while many of the remaining plants were found belonging to one family each. Eighty-two percent (82%) species of the identified plants were found on the abundance scale, while eighteen percent of the species (18%) accessed were rare in abundance. The plants were probably for their primary uses, ranging from food to timber and medicine (Table 2).

Bayelsa Central Senatorial District is rich in biocultural diversity, and ethnomedicinal practices are well appreciated. Most interviewees acknowledged that experience in bone treatments was acquired through knowledge transfer (from one generation to the next) via traditional verbal means and by apprenticeship for substantiating (Vinayak et al. 2012). The Trado-Orthopedic Care Providers (TOCPs) usually administered to treat all kinds of bone fractures and dislocations; meanwhile, different practices such as massage, traction, and splint with sticks were employed in the treatment phases corroborating (Alam et al. 2016). However, complicated cases are referred to superiors (within the study area) whose skills and knowledge sometimes find relevance in conventional healthcare centers in Bayelsa State and beyond, as they are sometimes invited for such jobs. Physical examination and oral interviews are major tools among TOCPs in diagnostic tests to ascertain the level of casualties such as deformity, the inability of the limb to act, shortened limb, gaps in between the bone section affected, severe pain and swelling thus, substantiating (Onuminya 2004), yet in exceptional cases; ritual is performed, and everything engaged were shrouded in secrecy.

**Table 1.** Demographic profile of the respondents in the study area

Indicator	Description	Total	Frequency (%)
Age	30-39	18	12
	40-49	22	14.67
	50-59	31	20.67
	>60	79	52.67
Gender	Female	117	78
	Male	33	22
Education	Illiterate	71.34	47.56
	Primary	30.04	20.02
	Secondary	28.85	19.23
	University	19.77	13.18



**Figure 2.** Venn diagram showing similarities in the use of the plant species for trado-orthopedic treatment

Diverse sections of the plants are employed in traditional orthopedic services either singly or in a combination of two and above during preparation and treatment. Each respondent mentioned no fewer than five species as plants for orthopedic care, which follows the reports of Upadhyaya et al. (2012), Hong et al. (2015), and Vibhi (2017) that citations of medicinal plants that are more than two indicate a good knowledge of informant, biodynamic compounds of therapeutic value and synergistic effects of such medicinal plants and poultice with a splint and without a cast that is widely practiced with positive results in traditional medicine. Leaves were a notable ingredient in the treatment options (Table 2). The exploitation of leaves is better and not annihilative to the plants' survival than stem bark and the roots of plants. Leaves regenerate and re-

grow quickly against other parts of plants, which can lead to the death of the plant. Most of the plant species applied in the healing processes grow in the wild, and the proportion cultivated was relatively low, being meant for uses other than orthopedic value. The primary use apart from the medicinal purpose of some of the plants is vegetables, fruits, fibers, and stimulants, respectively (Table 2).

The method of preparation of the identified plants is shown in (Table 3). The various plant parts, such as the leaves, stems, and roots of the plants, were found to be used in the preparation of the herbal mixtures for the management of bone fractures. Also, leaves poultices of *N. laevis* were used to treat a dislocation, heal damaged connective tissue, and stop sepsis.

**Table 2.** Abundant status and habit of the plants used for traditional bone in the study area

Botanical name	Family name	Habit	Vernacular/Ijaw name	Abundant status
<i>Abelmoschus esculentus</i> (L.)	Malvaceae	Shrub	Okro/ Kiyabu	Abundant
<i>Aframomum melegueta</i> (K.Schum.)	Zingiberaceae	Herb	Alligator pepper/ Sani	Abundant
<i>Alchornea cordifolia</i> (Mull. Arg.)	Euphorbiaceae	Shrub	Adeginapumue	Abundant
<i>Alternanthera sessilis</i> (L.R.Br. ex DC).	Amaranthaceae	Herb	Canapunu	Abundant
<i>Amaranthus viridis</i> (L.)	Amaranthaceae	Herb	Green amaranth /Enina	Abundant
<i>Capsicum annuum</i> (L.)	Solanaceae	Herb	African pepper/Egina	Abundant
<i>Carica papaya</i> (L.)	Caricaceae	Herb	Pawpaw /Edemudepumue	Abundant
<i>Ceiba pentandra</i> (L.)	Malvaceae	Tree	Cotton tree/ Asisaye	Rare
<i>Citrus aurantifolia</i> (Christm) Swingle	Rutaceae	Tree	Lime leave/Ongoberi	Frequent
<i>Cleome ciliate</i> (L.) Briq.	Cleomaceae	Herb	Cleome/Kakagben/ Agbalala	Abundant
<i>Costus afer</i> (Ker. Gawl.)	Costaceae	Herb	Ginger lily/Ogbodo	Abundant
<i>Cyathula prostrata</i> (Linn.)	Amaranthaceae	Herb	Pasture weed/ Oborikorigha	Abundant
<i>Cymbopogon citratus</i> (DC.) Stapf.	Poaceae	Herb	Lemon grass/Bekepiri	Abundant
<i>Diodia sarmetosa</i> (Sw.)	Rubiaceae	Herb	Button weed/Iyaimo, Ikinrinrin	Abundant
<i>Eclipta alba</i> (L.)	Asteraceae	Herb	Eclipta/Ekigaliapumue	Abundant
<i>Elaeis guineensis</i> (Jacq.)	Arecaceae	Tree	Oil palm/ Lobolou, Lugutin	Abundant
<i>Eleusine indica</i> (Linn.)	Poaceae	Grass	Bermuda grass/Agolo	Abundant
<i>Ficus lutea</i> (Vahl.)	Moraceae	Tree	Lagos rubber tree /Ula, Native pop	Rare
<i>Garcinia kola</i> (Heckel.)	Guttiferae	Tree	Eka/Bitter kola	Rare
<i>Glyphaea brevis</i> (SprengMonach.)	Tiliaceae	Tree	Itolo	Frequent
<i>Harungana madagascariensis</i> Lam. ex Poir.	Clusiaceae	Tree	Haronga/ Boopulo	Rare
<i>Ipomoea batatas</i> (L. Lam.)	Convolvulaceae	Vine	Pokueduku/Sweet potato	Abundant
<i>Jatropha tanjorensis</i> (Ellis & Saroja)	Euphorbiaceae	Shrub	Hospital too far	Abundant
<i>Kalanchoe pinnatum</i> (Lam.)	Crassulaceae	Herb	Live leaf/Beri	Abundant
<i>Ludwigia octovalvis</i> (W.)	Onagraceae	Herb	Eviesaberi	Occasional
<i>Mangifera indica</i> (L.)	Anacardiaceae	Tree	Mango/Ogune	Abundant
<i>Mimosa pudica</i> (L.)	Fabaceae	Herb	Sensitive plant/Igbanagbana, Dabomenetibigban	Abundant
<i>Newbouldia laevis</i> (Seem. ex Bureau.)	Bignoniaceae	Tree	Tree of live/Ogurizi	Abundant
<i>Ocimum gratissimum</i> (L.)	Lamiaceae	Shrub	Scent leaf/Kara furu	Abundant
<i>Phyllanthus amarus</i> (Schum. & Thonn.)	Phyllanthaceae	Herb	Amarus/Tukaben	Frequent
<i>Piper guineense</i> (Schum. & Thonn.)	Piperaceae	Vine	African black pepper/Aziza, Uziza	Rare
<i>Portulaca oleracea</i> (L.)	Portulacaceae	Herb	Purslane/Kalaorwoegina	Abundant
<i>Psidium guajava</i> (L.)	Myrtaceae	Tree	Guava/ Aguava	Abundant
<i>Solenostemon monostachyus</i> (P. Beaux.)	Lamiaceae	Herb	Catnip/Ipain	Occasional
<i>Spondias mombis</i> (L.)	Anacardiaceae	Tree	Cat's tail grass/ Owenyaiyaitogo	Frequent
<i>Theobroma cacao</i> (L.)	Malvaceae	Tree	Cocoa/Odukuku	Frequent
<i>Vernonia amygdalina</i> (Del.)	Compositae	Shrub	Bitter leaf/Kiriorugbo	Abundant
<i>Xylopi aethiopica</i> (Dunal) A. Rich.	Annonaceae	Tree	Ethiopian pepper / Enge	Rare
<i>Zingiber officinale</i> (Roscoe.)	Zingiberaceae	Herb	Ginger/Zinza	Rare

**Table 3.** Primary uses and Trado-orthopedic uses of the identified botanicals

Botanical name	Preparation and treatment	Primary use
<i>A. esculentus</i>	The fruits are crushed and the warm poultice is applied externally to soothe the stiffness of limbs and pushing dislocated bone back to its position.	Vegetable
<i>A. melegueta</i>	The seeds are externally used with native chalk as a poultice on the fractured areas for bone hardening and pain reliever.	Medicinal, spice
<i>A. cordifolia</i>	The leaves paste was applied externally over the fractured area to check infection and facilitate recovering	Medicinal purpose
<i>A. sessillis</i>	The pounded leaves paste applied in synergy with others ( <i>C. aurantifolia</i> , <i>A. melegueta</i> , and <i>E. indica</i> ) over the fracture for bone hardening, pain relief and antiseptic	Medicinal purpose
<i>A. viridis</i>	The pounded leaves paste is applied to reduce inflammations.	Vegetable
<i>C. annuum</i>	For treating sprain, arthritis and rheumatism, the fruits and leaves paste is applied on the affected areas.	Vegetable, spice
<i>C. papaya</i>	The poultice of the leaves is applied over the affected area to induce healing after pushing dislocated bone to its position	Fruit, medicinal use
<i>C. pentandra</i>	Pulverize the bark, and apply the alcohol infusion as a plaster on the dislocated area to treat the wound and reduces swollen	Fibers
<i>C. aurantifolia</i>	The leaves poultice is applied on the affected area to check for infection	Fruit
<i>C. afer</i>	Apply the squashed stem, fruit and leaves on the fracture to induce bone reunion.	Medicinal
<i>C. prostrata</i>	Apply the squashed leaves and the inflorescence on the fractured areas to treat wound and irritation	Medicinal, antidote
<i>C. citratus</i>	Used the leaves poultice for fracture, itching wounds and treating irritation.	Medicinal, spice
<i>D. sarmentosa</i>	Apply the squashed leaves on the sprain and the area affected by rheumatoid arthritis.	Medicinal
<i>E. alba</i>	Apply alcohol poultice of pulverized leaves on the dislocated area	Medicinal
<i>E. guineensis</i>	Apply the pulverized leaves on the dislocated area to induce bone mending. The frond rib is used as a splint	Vegetable oil
<i>E. indica</i>	The root poultice is applied to the affected areas to heal connective tissue damaged during fracture.	Medicinal
<i>F. lutea</i>	The stem serves as a local splint; the leaves are used in traction and stiffness of limbs. Applied on the affected part to induce quick reunification of bones	Medicinal
<i>G. kola</i>	Apply the alcohol poultice of the pulverized leaves on the fractured area to strengthen the bone after setting and prevent infection.	Stimulant, water treatment
<i>G. brevis</i>	Apply the pulverized leaves on the broken area for bone hardening and to reduce inflammation	Medicinal
<i>C. ciliata</i>	The fruit and leave poultice are applied on the area to prevent festering and to facilitate wound healing	None
<i>H. madagascariensis</i>	Applying the leaves poultice helps bone healing. The sap stops itching around the affected area.	Fuel wood, timber
<i>I. batatas</i>	The poultice of the leaves helps in bone healing and reduces inflammation	Vegetable
<i>J. tanjorensis</i>	Use the leave paste to stop bleeding and induce blood clotting.	Vegetable, medicinal
<i>K. pinnatum</i>	The leaves poultice is used to treat dislocation	Medicinal
<i>Ludwigia octovalvis</i>	The leave paste is applied on the affected area to treat the wound; it also serves as an analgesic	None
<i>M.indica</i>	Apply the leaves poultice on the broken area to enhance fracture mending and to harden merged bones	Fruit, medicinal
<i>M. pudica</i>	Used the leave paste in the treatment of inflammation around the affected area and stiffness of limbs	Medicinal
<i>N. laevis</i>	Use the leaves poultice to treat a dislocation, heal damaged connective tissue and stops sepsis.	Land border, medicinal
<i>O. gratissimum</i>	Extract from the leaves is applied to the fracture. It is used in synergy with other leaves	Spice
<i>P. amarus</i>	The poultice of the entire plant part is applied to the affected area to heal connective tissue damaged during bone fracture.	Medicinal
<i>P. guineense</i>	Apply the leaves and fruit poultice to treat inflammation in the dislocated area and stop itching	Spice, medicinal
<i>P. oleracea</i>	Apply the whole plant extract topically on the fractured area to relieve pain and hasten to heal	Vegetable
<i>P. guajava</i>	Use together with other herbs to harden bone and treat the wound.	Medicinal
<i>S. monostachyus</i>	The leave poultice is applied on the affected areas to reduce pain and heal the connective tissue affected.	Medicinal
<i>S. mombis</i>	The root and bark decoction is applied to reduce pain and stop sepsis.	Medicinal, ornamental
<i>T. cacao</i>	The seeds serve externally as soothing while massaging dislocated bone back to position	Stimulants, medicinal
<i>V. amygdalina</i>	The leaves poultice is applied in synergy with other herbs on the fractured area.	Medicinal
<i>X. aethiopica</i>	Use the crushed fruit paste in synergy with other herbs to treat fracture and dislocation	Spice, medicinal
<i>Z. officinale</i>	The fruit is externally used as a poultice on the fractured areas to induce bone healing and pain relief after the initial treatment.	Spice, medicinal

Similarly, the extract from the leaves is applied to the fracture. It is used in synergy with other leaves, such as *P. amarus*. The similarity in the use of the plants for traditional orthopedic care in the three LGAs is presented in Figure 2. Plants in Group E were reportedly used by all the respondents using TOCPs in the three LGAs; they applied the same way in preparing and treating bone fractures. However, their uses and wide acceptability as ingredients in bone treatment arise from the species' availability and effectiveness, although different approaches were applied in the administration. The previous assertion of Rakotoarivero et al. (2015) and Sheen and Garla (2019) opined that plants are commonly used among folks because of their efficacy for treatment. Traditional medicine has gained renewed interest in healthcare services throughout the continent. That could probably be due to the increasing awareness of alternative medicine's potential and curative abilities to manage different diseases, especially from medicinal plants.

Species in Group A, C, and G (on the Venn diagram) were peculiar by use to TOCPs in Yenagoa, S. Ijaw, and Kolokuma/Opokuma LGA, respectively. The peculiarity in using a plant species in rural societies could be attributable to custom, acceptability, and availability (Alam et al. 2016).

While the indigenous people enjoy enormous plant resources in their environment, the plants suffer depletion from extraction patterns that are either predatory or annihilative. Also, collection patterns observably involve stem and branch cutting and uprooting, making such collections devastating. That means harvesting results in the ruin of plants in their natural source, as a harvest involving stems, rhizomes, roots, bulbs, and barks seriously affects the mother plant's survival (Yirga and Zeraburk 1993). Also, such plants' regeneration rate always lags behind their extraction rate leading to the species' absence and death. As a result, prioritizing sustainable use and wilding of the species must be guaranteed by discouraging indiscriminate clearing of forests, discriminating bush burning at the local level, and creating awareness of the possible disappearance of the forest should the status quo persist.

In conclusion, this study highlighted new findings in the study area where plants such as *Abelmoschus esculentus* (L.), *Aframomum melegueta* (K.Schum.), *Alchornea cordifolia* (Mull. Arg.), *Alternanthera sessilis* (L R.Br. ex DC), *Amaranthus viridis* (L.), *Capsicum annuum* (L.), *Carica papaya* (L.), *Ceiba pentandra* (L), *Citrus aurantifolia* (Christm) Swingle, etc. are used as herbal medicine for managing bone fractures. It was shown that traditional herbal medicine practices to manage bone fractures existed in the study area. The plants are relatively available and effective. The knowledge of the preparation and mode of administration is well known to the indigenous people. Therefore, conservation strategies such as avoidance of cutting trees, efficient utilization of natural resources, and avoidance of conversion of forest reserves to subsistence farming systems should be put in place. However, the chemical compositions of the plants, in vivo, and computational studies of the plants should be assessed to validate their use scientifically.

## REFERENCES

- Abera B. 2014. Medicinal plants used in traditional medicine by Oromo people, Ghimbi District, Southwest Ethiopia. *J Ethnobiol Ethnomed* 10: 40. DOI: 10.1186/1746-4269-10-40.
- Adedeji DE, Kayode J, Ayeni, MJ. 2018. An ethnobotanical study of plant species used for medicine by the Eegun indigenous tribal group of Lagos State, Nigeria. *Not Sci Biol* 10: 318-327. DOI: 10.15835/nsb10310306.
- Ahmad M, Sultana S, Fazl-i-Hadi S, Ben Hadda T, Rashid S, Zafar M, Khan MA, Khan MPZ, Yaseen G. 2014. An Ethnobotanical study of medicinal plants in high mountainous region of Chail Valley (District Swat-Pakistan). *J Ethnobiol Ethnomed* 10 (1): 36. DOI: 10.1186/1746-4269-10-36.
- Ajao AA, Mukaila YO, Sabiu S. 2022. Wandering through southwestern Nigeria: An inventory of Yoruba useful angiosperm plants. *Heliyon* 8: e08668. DOI: 10.1016/j.heliyon.2021.e08668.
- Alam W, Shah FA, Ahmed A, Ahmad S, Shah A. 2016. Traditional bonesetters; frequency of complications with treatment by traditional bonesetter. *Professional Med J* 23 (6): 699-704. DOI: 10.17957/TPMJ/16.3354.
- Aziz MA, Khan AH, Adnan M, Izatullah I. 2017. Traditional uses of medicinal plants reported by the indigenous communities and local herbal practitioners of Bajaur Agency, Federally Administrated Tribal Areas, Pakistan. *J Ethnopharmacol* 198: 268-281. DOI: 10.1016/j.jep.2017.01.024.
- Az-Zahra FR, Sari NLW, Saputry R, Nugroho GD, Sunarto, Pribadi T, Setyawan AD. 2021. Review: Traditional knowledge of the Dayak Tribe (Borneo) in the use of medicinal plants. *Biodiversitas* 22: 4633-4647. DOI: 10.13057/biodiv/d221057.
- Balick MJ, Cox PA. 1996. *Plants, People and Culture: The Science of Ethnobotany*. The Scientific American Library, New York.
- Bannerman RH, Burton J, Chen WC. 1983. *Traditional Medicine and Health Care Coverage: A Reader for Health Administrators and Practitioners*. World Health Organization, Geneva. DOI: 10.2202/1553-3840.1025.
- Brandão MGL, Acúrcio FA, Montemor RLM, Marlière LDP. 2006. Complementary alternative medicine in Latin America: Use of herbal remedies among a Brazilian metropolitan area population. *J Complement Integr Med* 3 (1): 2006 DOI: 10.2202/1553-3840.1025.
- Chohra D, Ferchichi L. 2019. Ethnobotanical study of Belezma National Park (BNP) plants in Batna: East of Algeria. *Acta Sci Natur* 6 (2): 40-54. DOI: 10.2478/asn-2019-0017.
- Dada AA, Yinusa W, Giwa SO. 2011. Review of the practice of traditional bone setting in Nigeria. *Afr Health Sci* 11 (2): 262-265.
- Deressa W, Ali A. 2009. Malaria-related perceptions and practices of women with children under the age of five years in rural Ethiopia; *BMC Public Health* 9: 259. DOI: 10.1186/1471-2458-9-259.
- El-Ghani MMA. 2016. Traditional medicinal plants of Nigeria: An overview. *Agric Biol JN Am* 7: 220-247.
- Erinoso S, Aworinde D. 2018. Current outlook and future promise of ethnobotany in Nigeria: A review and personal observation. *Afr J Plant Sci* 12: 73-80. DOI: 10.5897/AJPS2017.1571.
- Esrafilian A, Karimi MT, Amiri P, Fatoye F. 2013. Performance of subjects with knee osteoarthritis during walking: differential parameters. *Rheumatol Intl* 33 (7): 2753-1761. DOI 10.1007/s00296-012-2639-2.
- Gaddy HG. 2020. Using local knowledge in emerging infectious disease research. *Soc Sci Med* 258: 1-5. DOI: 10.1016/j.socscimed.2020.113107.
- Gureje O, Nortje G, Makanjuola V, Oladeji, B, Soraya S, Jenkins R. 2018. The role of global traditional and complementary systems of medicine in treating mental health problems. *Lancet Psychiat* 2 (2): 168-177. DOI: 10.1016/s2215(15)00013-9.
- Hong LY, Guo ZY, Huang KH, Wei SJ, Liu B, Meng SW, Long CL. 2015. Ethnobotanical study on medicinal plants used by Maonan people in China. *J Ethnobiol Ethnomed* 11: 32. DOI: 10.1186/s13002-015-0019-1.
- Huai HY, Pei SJ. 2002. Medicinal Ethnobotany and its advances. *Chin Bull Bot* 2 (19): 129-36.
- Ihinmikayie SO, Ochekwu BE, Ikuli JM. 2020. Ethnobotanical studies on floras used for storage in Bayelsa State, Nigeria. *Sci Res J* 8 (12): 29-34. DOI: 10.31364/SCIRJ/v8.i12.2020.P1220826.
- Ihinmikayie SO, Akinjagunla AD. 2020. Ethnobotanical survey of medicinal plants used by the indigenous people of Bayelsa State, Nigeria. *IJEAST* 5 (1): 771-784. DOI: 10.33564/IJEAST.2020.v05i01.135.

- Kidane L, Gebremedhin G, Beyene T. 2018. Ethnobotanical study of medicinal plants in Ganta Afeshum District, Eastern Zone of Tigray, Northern Ethiopia. *J Ethnobiol Ethnomed* 14: 64. DOI: 10.1186/s13002-018-0266-z.
- Lawal IO, Olufade II, Rafiu BO, Aremu AO. 2020. Ethnobotanical survey of plants used for treating cough associated with respiratory conditions in Ede South Local Government Area of Osun State, Nigeria. *Plants* 9: 647. DOI: 10.3390/plants9050647.
- Liu Y, Dao Z, Yang C, Liu Y, Long CL. 2009. Medicinal plants used by Tibetans in Shangri-la, Yunnan, China. *J Ethnobiol Ethnomed* 5 (1): 15. DOI: 10.1186/1746-4269-5-15.
- Martin GJ. 1995. *Ethnobotany: A Methods Manual*. Chapman and Hall Pub., London.
- Mukaila YO, Oladipo OT, Ogunlowo I, Ajao AAN, Sabiu S. 2021. Which plants for what ailments: A quantitative analysis of medicinal ethnobotany of Ile-Ife, Osun State, southwestern Nigeria. *Evid-Based Complementary Altern Med* 2021: 5711547. DOI: 10.1155/2021/5711547.
- Olanipekun MK, Otoide JE, Adedeji E, Amoo JA, Olajumoke DA. 2020. Assessment of bioactive of compositions of selected plants used in managing hypertension conditions in Osun State Nigeria. *Res J Med Plant* 13 (13): 5-42. DOI: 10.3923/rjmp.2020.35.42.
- Onuminya JE. 2004. The role of the traditional bonesetter in primary fracture care in Nigeria. *S Afr Med J* 94 (8): 652-658.
- Rakotoarivony NH, Rakotoarivony F, Ramarosandratana AV, Jeannoda VH, Kuhlman AR, Randrianasolo A, Bussmann RW. 2015. Medicinal plant used to treat the most frequent diseases encountered in Ambalabe rural community, Eastern Madagascar. *J Ethnobiol Ethnomed* 11: 68. DOI: 10.1186/s13002-015-0050-2.
- Sheen JR, Garla VV. 2019. *Fracture Healing Overview*. InStatPearls (internet). Treasure Island (FL) StatPearls Publishing LLC. Available from: [pubmed.ncbi.nlm.nih.gov/31869142](https://pubmed.ncbi.nlm.nih.gov/31869142)
- Sonibare MA, Gbile ZO. 2008. Ethnobotanical survey of anti-asthmatic plants in South Western Nigeria. *Afr J Tradit Compl Altern Med* 5: 340-345. DOI: 10.4314/ajtcam.v5i4.31288.
- Su SL, Zhang TT, Zhang B, Huang K, Zeng XB. 2011. Ethnobotany study in the minority area of Baise region. *Anhui Agri Sci Bull* 17 (23): 123-4 142.
- Suchita T. (2019). Ethnomedicine and future challenges. *Glob J Arch Anthropol* 10 (5): 555796. DOI: 10.19080/GJAA2019.10.555796.
- Teshome W. 2005. Impacts of urbanization on the traditional medicine of Ethiopia. *Anthropologist* 8: 43-52. DOI: 10.1080/09720073.2006.11890933.
- Tewelde F, Mesfin M, Tsewene S. 2017. Ethnobotanical survey of traditional medicinal practices in Laelay Adi-Yabo District, Northern Ethiopia. *Intl J Ophthalmol Visual Sci* 2 (4): 80-87. DOI: 10.11648/j.ijovs.20170204.11.
- Tilahun TJ, Moa M. 2018. Ethnobotanical study of medicinal plants used to treat human diseases in Berbere in Berbere district, Bale zone of Oromia regional State, South East Ethiopia. *Evid-Based Complement Altern Med* 2018: 8602945. DOI: 10.1155/2018/8602945.
- Tugume P, Kakudidi EK, Buyinza M, Namaalwa J, Kamatenesi M, Mucunguzi P, Kalema. 2016. Survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda. *J Ethnobiol Ethnomed* 12 (1): 5. DOI: 10.1186/s13002-015-0077-4.
- Upadhy V, Hegde HV, Shripad B, Hurkadale PJ, Kholkute SD, Hegde GR. 2012. Ethnomedicinal plants used to treat bone fracture from North-Central Western Ghats of India. *J Ethnopharmacol* 142: 557-562. DOI: 10.1016/j.jep.2012.05.051.
- Vibhi. 2017. Medicinal plants and bone healing. *Natl J Maxillofac Surj* 8 (1): 4-11. DOI: 10.4103/0975-5950.208972.
- Vinayak U, Harsha UH, Shripad B, Pramod JH, Kholkute SD, Hegde GR. 2012. Ethnomedicinal plants used to treat bone fracture from North-Central Western Ghats of India. *J Ethnopharmacol* 142: 557-562. DOI: 10.1016/j.jep.2012.05.051.
- Yirga G, Zeraburk S. 2011. Ethnobotanical study of traditional medicinal plants in Gindeberet district, Western Ethiopia. *S Afr J Bot* 78: 165-169. DOI: 10.1016/j.sajb.2011.06.006.
- Zhu YP, Woerdenbag HJ. 1995. Traditional Chinese herbal medicine. *Pharm World Sci* 17 (4): 103-112. DOI: 10.1007/BF01872386.