IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Biodiversity Status of some Lesser-used Edible Leafy Vegetables in Akwa Ibom State – Nigeria

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Abstract

Lesser-used vegetables have numerous dietary and health potentials. Investigations on the biodiversity status of some lesser-used edible leafy vegetables in Akwa Ibom State were carried out using a questionnaire. Twenty (20) vegetables were categorized into four groups and ranked by respondents from 1^0-16^0 in order of their importance. In these, ten lesser used vegetables were identified viz: [*Microdesmis puberula* (Mp), *Bombax buonopozense* (Bb), *Sterculia tragacantha* (St), *Sesamum indicum* (Si), *Glyphaea brevis* (Gb), *Hibiscus rosa-sinensis* (Hr), *Heinsia bussei* (Hb) and *Vernonia polysphaera* (Vp), *Cleome ciliata* (Cc) and *Diplazium sammatii* (Ds)]. Results show that the ten vegetables were from different plant families. Cc, Ds, Hr, Ji and Si in Uyo had the highest frequency of occurrence of 60% and the least were recorded in Bb, Gb, Hb, Tt and Vp with 20% each. Cc dominated 8000 plants/ha while Bb was 40 plants/ha. Ikot Ekpene recorded 60% in Ji, La, Mp and Tt while 40% was observed in Bb, Cm, Ds, and Pm with the highest and lowest density of 1,200 and 40 plants/ha respectively. In Eket, *Glyphaea brevis* had the highest occurrence of 80% while the least (20%) were noticed in Ah, Cc, Ds and Mp. Si had the highest density (4,200 plants/ha) while 40 plants/ha was recorded in Ga. Ten vegetables showed a high use-value index while 8 were least observed. The conservation status of *Gnetum africana* in all three study areas was recorded to be near threatened (food value, agriculture and aquaculture). Results confirmed that the leafy edible vegetables were mostly used as Food, Medicine, Ornamentals and timbers. Due to the expensive cost and limited availability of modern medication, rural and tribal populations rely on vegetables as a source of medicine. To safeguard valuable veggies, native/wild plant species' cultural legacy and traditional knowledge must be justified by scientific methodologies.

Keywords: Leafy vegetables, lesser-used, status, biodiversity, use-value index.

1.0. Introduction

Africa is blessed with numerous ecosystems and community of vegetation that support an immense diversity of native and naturalized species of plants and this has been estimated to be at least 40,000 species [1]. Approximately 8 – 10% of these are consumed as food rural areas. Roughly 1000 species are used as vegetables, the majority of which about 80% are leafy vegetables, with the rest made up of vegetables from fruits, seeds, roots and tubers, stems, buds anthers and flowers. Besides the rich flora, the high number of edible vegetable

species is attributed to several other factors. Among these is the continent's high cultural diversity, as depicted by the over 2000 spoken languages. Other factors include the high dependence of human populations upon locally available resources as opposed to manufactured or market products [2].

In addition to these reasons, Africa's high use of vegetables is also attributable to the widespread culture of using vegetables as an accompaniment for the main dish. The latter is often starchy, mainly made from cereals but also roots and tubers, starchy stems, or fruit parts (like plantain). Poverty and frequent hardships have also led to local innovations and discoveries of lesser used vegetable species as communities seek to cope with such hardships and enrich their knowledge of local species. The discovery or selection of such vegetable types has involved both introduced species as well as native African species. Mostly, African vegetable are of localized importance either due to their limited distribution (occurrence) or to the fact that the potential as a vegetable is known to specific geographic communities and the species are not part of the local food culture of other communities or regions. Some other species, on the other hand are widely used across the continent and this is particularly so for introduced cultivated vegetable species [3].

The word 'vegetable' is non-scientific and hence, difficult to define precisely. The term in is limited to plant parts (underground or shoot parts, including stem, leaves, fruit. buds and flowers) usually eaten fresh or processed in many ways either cooked, steamed, dried or marinated and that are not used as conventional fruit, nut, root/tuber crop, pulse or staple, but as an accompaniment of the main dish or alone as a snack mainly for their micronutrient potentials [4]. This can be categorized as any plant part that is consumed usually fresh or after minimal processing to facilitate consumption of the main dish as well as for its micronutrients. It is a difficult term on which to put rigid restrictions as there will be crops that may behave more as vegetables in certain situations (like pulses) and as non-vegetable in others; but, generally, vegetables are consumed for their freshness and for their being good sources of nutrients (especially vitamins A and C), some minerals and roughage. Linking this with the characteristics of indigenous or naturalized species results in the concept of African indigenous vegetables [5, 6].

Poor conservation of certain vegetable species or varieties is a major concern. While in the cultivated species the major loss is at varietal level, for wild species the main concern is habitats loss and overexploitation leading to diminished populations that are not viable and even local extinctions. Research on easy and cheap technologies of cultivating the plants should be of utmost priority [7].

The rural communities of developing countries depend on wild edible plants to meet their food requirements during periods of food shortage. Studies conducted by Mandu *et al*. [8] indicated that the wild edible plants are mostly serving as supplementary foods in different parts of Africa. Wild edible plants are nutritionally rich [9] and can supplement especially vitamins and micronutrients [10]. These show that wild edible plants are essential components of many African diets, especially in period of seasonal food shortage.

In spite of the huge diversity, only a handful of species have widespread use in the continent or regions. Species or varieties that are not useful to a community would be more likely to be neglected and forgotten in favour of useful ones. Many vegetable species and varieties can thus be saved if communities continue to attach

some value to them as they are rich with essential mineral and vitmains. Declining use of less common vegetables is likely to lead to loss of knowledge and finally, loss of the species or variety and awareness of the value could contribute to conservation [11]. There are limited research reports on the biodiversity status of lesser-used edible leafy vegetables in Akwa Ibom State. Hence, the need for this research. It is therefore envisaged that the result of this investigation may provide a scientific justification for the lesser-used vegetables.

2.0. Materials and Methods

2.1. Description of study area

This research was carried-out in the three Local Government Areas of Akwa Ibom State (Uyo, Ikot Ekpene and Eket) representing the three geopolitical zones. Akwa Ibom has an annual rainfall of about 3000 mm, often with long duration and intensities rising to 200 mmh^{-1} resulting in a high erosivity power which plays a dominant role in erosion and soil loss problems. The average annual minimum and maximum temperatures are approximately 17.8^{0}C and 28.6^{0}C, respectively. The vegetation of the State is dominated by forest and oil palm trees, raffia palms, shrubs, herbs and grasses. The State has a land mass of about 7,081 km^2 and a population density of 770 persons/km^2. Akwa Ibom State is geographically bounded by Cross River, Abia, Rivers State and the Atlantic Ocean to the South as shown in Figure 1 [12].

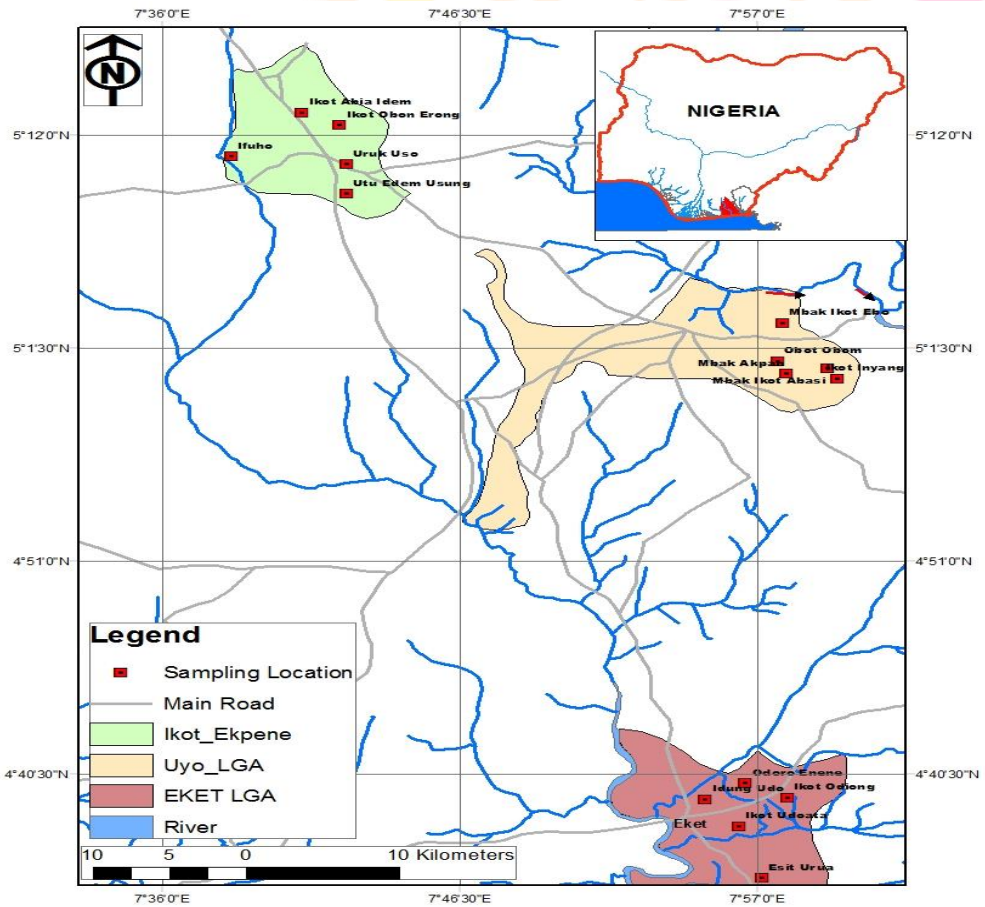

Figure 1: Map of Akwa Ibom State showing the three study areas

2.2 Sampling locations

Five communities in each Local Government Area were selected as follows: Uyo (Mbak Ikot Abasi, Obot Obom, Mbak Ikot Ebo, Ikot Inyang Idung and Mbak Akpan Ekpenyong), Ikot Ekpene (Ikot Abia Idem, Ifuho, Ikot Obon Edong, Utu Edem Usung and Uruk Uso), Eket (Odoro Enen, Ikot Odiong, Ikot Udoata, Idung

Udo and Esit Urua). The co-ordinates of the sampling locations were taken from each community and recorded (Table 1). The global positioning system (GPS) model ARC GIS11 (Digital Instrument, Inc.) Tonawanda, New York was used to determine the coordinates.

Table 1: Sampling locations and communities in the study areas

Location/L.G.A	Community	Coordinate (Latitude/Longitude)
UYO (UY)	Mbak Ikot Abasi	$4^0$47'48"N,$7^0$58'36"E
	Obot Obom	$5^0$20'59"N,$8^0$3'18"E
	Mbak Ikot Ebo	$5^0$7'17"N, $7^0$17'19"E
	Ikot Inyang Idung	$5^0$10'17"N, $7^0$15'78"E
	Mbak Akpan Ekpenyong	$5^0$35'19"N, $8^0$28'90"E
IKOT EKPENE (IK)	Ikot Abia Idem	$5^0$11'26"N, $7^0$86'31"E
	Ifuho	$5^0$19'38"N, $7^0$26'11"E
	Ikot Obon Edong	$4^0$58'01"N, $7^0$18'95"E
	Utu Edem Usung	$5^0$27'58"N, $7^0$21'12"E
	Uruk Uso	$5^0$33'48"N, $7^0$16'21"E
EKET (EK)	Odoro Enen	$7^0$38'48"N, $4^0$56'34"E
	Ikot Odiong	$7^0$12'26"N, $4^0$17'52"E
	Ikot Udoata	$7^0$16'42"N, $4^0$21'48"E
	Idung Udo	$7^0$43'18"N, $4^0$32'19"E
	Esit Urua	$7^0$55'33"N, $4^0$19'44"E

2.3 Source of plant materials and identification

Twenty (20) leafy edible vegetables were collected in January 2016. The fresh edible parts of the plants were harvested from their different habitats. The plant samples were identified and authenticated by a Plant Taxonomists, Prof. (Mrs.) U. A. Essiett, Department of Botany and Ecological Studies, University of Uyo, yo, Nigeria. The voucher specimens were prepared and deposited in the University of Uyo Herbarium. Details of the twenty vegetable sample specimens are presented in Table 2.

Table 2: Leafy vegetable samples in the study area

S/N	Vegetable sample	Specimen code/label	Abbreviated name
1	*Microdesmis puberula*	Okon, UUH 3007	*M. puberula*
2	*Bombax buonopozense*	Okon, UUH 3008	*B. buonopozense*
3	*Sterculia tragacantha*	Okon, UUH 3009	*S. tragacantha*
4	*Sesamum indicum*	Okon, UUH 3010	*S. indicum*
5	*Glyphaea brevis*	Okon, UUH 3011	*G. brevis*
6	*Hibiscus rosa-sinensis*	Okon, UUH 3012	*H. rosa-sinensis*
7	*Heinsia bussei*	Okon, UUH 3013	*H. bussei*
8	*Vernonia polysphaera*	Okon, UUH 3014	*V. polysphaera*
9	*Cleome ciliata*	Okon, UUH 3015	*C. ciliata*
10	*Diplazium sammatii*	Okon, UUH 3016	*D. sammatii*
11	*Amaranthus hybridus*	Okon, UUH 3017	*A. hybridus*
12	*Cucurbita maxima*	Okon, UUH 3018	*C. maxima*
13	*Gnetum africanum*	Okon, UUH 3019	*G. africanum*
14	*Justicia insularis*	Okon, UUH 3020	*J. insularis*
15	*Lansianthera africamum*	Okon, UUH 3021	*L. africamum*
16	*Piper guineense*	Okon, UUH 3022	*P. guineense*
17	*Pterocarpus mildbraedii*	Okon, UUH 3023	*P. mildbraedii*
18	*Talinum triangulare*	Okon, UUH 3024	*T. triangulare*
19	*Telfairia occidentalis*	Okon, UUH 3025	*T. occidentalis*
20	*Vernonia amygdalina*	Okon, UUH 3026	*V. amygdalina*

2.4 Determination of use-value index

The use-value index was used to select the ten (10) leafy edible vegetables from the twenty (20) vegetable samples collected. The use-value index was calculated using the expression in Equation (1) according to the methods of Anwana *et al.* [13] as:

$$UV = \sum U_i / n \quad (1)$$

where UV = use-value index, U_i = Number of uses for a given vegetable, n = Total number of respondents.

2.5 Vegetation sampling

Systematic sampling method was used to sample the vegetables using quadrat of $10m \times 10m$ for herbs, $20m \times 20m$ for shrubs and $40m \times 40m$ for trees species. In each quadrat, vegetables were identified to species level and their frequency and density were calculated after enumeration. Vegetables were collected for identification and confirmation. Voucher specimens have been deposited in Botany and Ecological Studies Departmental Herbarium. The frequency (f) and relative frequency (Rf) of occurrence of each vegetation was calculated using Equations (2) and (3) according to Ubom [14] as:

$$f = \frac{\text{Number of occupied quadrat for vegetable}}{\text{Total number of quadrats thrown}} \times 100 \quad (2)$$

$$\mathrm{R_f} = \frac{\text{Frequency of a vegetable}}{\text{Total frequency of all vegetables}} \text{ X } 100 \quad (3)$$

2.6 Density

The density of each vegetable was estimated by enumerating all individual vegetable present in each quadrat. The mean number of individual vegetables was taken as a proportion of the area of the quadrats to a given density in m^2 which was multiplied by 10,000 m^2 [15]. The density and relative density of the leafy vegetable samples were calculated using the expressions in Equations (4) – (7) as:

$$\text{Mean of the vegetable} = \frac{\text{Number of individuals of the species}}{\text{Number of transect} \times \text{No of quadrat}} \quad (4)$$

$$\text{Density per } m^2 = \frac{\text{Mean}}{\text{Area of quadrat}} \quad (5)$$

$$\text{Density/ha} = \text{density per } m^2 \times 10{,}000 \quad (6)$$

$$\mathrm{R_d} = \frac{\text{Density of a vegetable}}{\text{Total density of all vegetables}} \text{ X } 100 \quad (7)$$

2.7 Determination of morphological and growth characteristics

The growth parameters such as plant height, internode length and petiole length were measured using the metre rule in centimeters. Leaf area were measured according to the methods of Umoh and Esenowo [16], Okon *et al*. [17]. The leaf area of each plant was determined by multiplying the leaf length by the leaf width and correlation co-efficient (r) according to the methods of Hoyt and Brafort [18], Equation 8.

$$\text{Leaf Area (LA)} = \mathrm{L} \times \mathrm{W} \times \mathrm{r} \quad (8)$$

where L = Leaf length, W = Leaf width, r = Correlation co-efficient

3.0. Results and Discussion

3.1. Botanical classification of the ten selected edible leafy vegetables

Table 3 and Figure 2 presents the summary of the ten selected edible leafy vegetables from the three study Areas: Uyo, Ikot Ekpene and Eket. The results showed that the vegetables were from different plant families. A total of ten vegetables from different plant families were selected based on lower use-value index, low frequency (%) of occurrence, low and high density recorded. The result concurs with the work of Kebu and Fassil [19].

Table 3: Botanical classification of selected edible leafy vegetables in the study area

S/N.	Scientific Name	Common Name	Ibibio Name	Family	Authority Citation
1.	*Microdesmis puberula*	-	Ntabid	Euphorbiaceae	Hook. F. ex Planch.
2.	*Bombax buonopozense*	Red-silt cotton tree	Ukim	Bombacaceae	P. Beauv.
3.	*Sterculia tragacantha*	African tragacanth	Udod Eto	Sterculiaceae	Lindl.
4.	*Sesamum indicum*	Sesame	Etehedeh	Pedaliaceae	L.
5.	*Glyphaea brevis*	-	Ndodido	Tiliaceae	(Spreng.) Monachino
6.	*Hibiscus rosa-sinensis*	Red hibiscus	Frawa	Malvaceae	Linn.
7.	*Heinsia bussei*	-	Atama Idim	Rubiaceae	Verdc.
8.	*Vernonia polysphaera*	Bitter leaf	Asio-isong	Compositae/ Asteraceae	Baker
9.	*Cleome ciliata*	Consumption weed	Mkpat unen	Capparidaceae	Jacq.
10.	*Diplazium sammatii*	Fern	Nyama Idim	Athyriaceae	(Kuhn) C. Chr.

Sources: Hutchinson and Dalziel, 1963; Etukudo, 2003; Nyananyo, 2006.

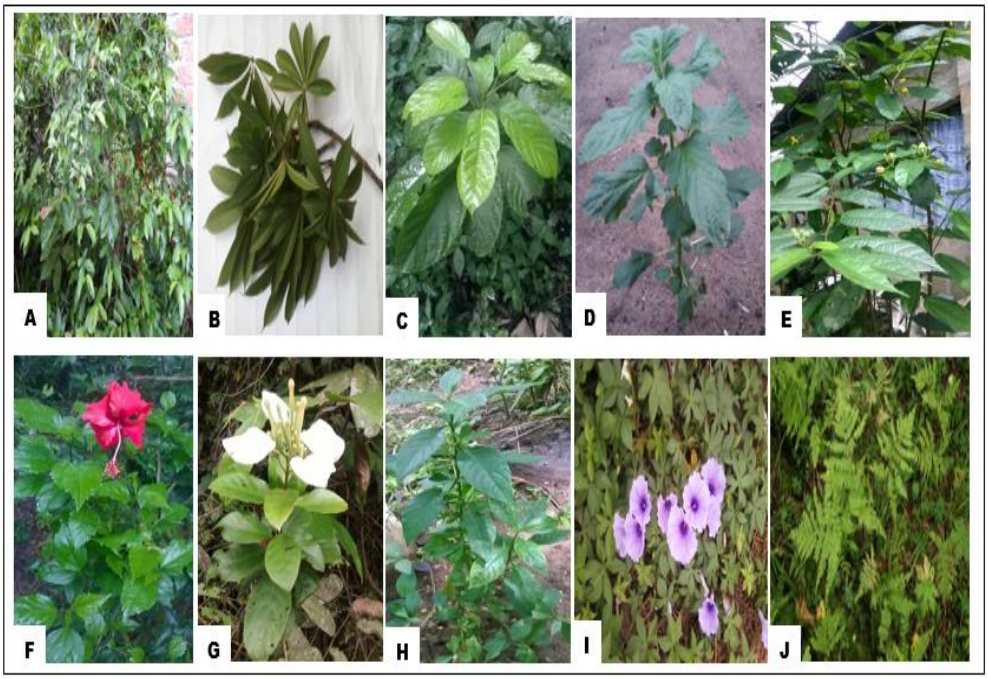

Figure 2: Ten Lesser-used Edible Leafy Vegetables. **A**, *M. puberula*; **B**, *B.* buonopozense; **C**, *S. tragacantha*; **D**, *S. indicum*; E, *G. brevis*; **F**, *H. rosa-sinensis*; **G**, *H. bussei*; **H**, *V. polysphaera*; **I**, *C. ciliata*; **J**, *D. sammatii*

3.2. Frequency of occurrence and relative density of vegetables

The frequency of occurrence and relative density of the 20 leafy vegetable crops grown in the study area are presented in Table 4, 5 and 6 for UY, IK and EK locations, respectively. From Table 4, vegetables *C. ciliate, D. sammatii, J. insularis* and *S. indicum* in UY location each had the highest frequency of occurrence of 60% each while vegetables, *B. buonopozense, G. brevis, H. bussei, T. triangulare* and *V. polysphaera* had the least frequency value of 20% each. The highest density value of 8000 plants/ha (Table 4) was recorded for *C. ciliata* vegetable, while the lowest density value of 40 plants/ha was associated with *B buonopozense*.

In IK, *J. insularis, L. africanum, M. puberula* and *T. triangulare* vegetables recorded the highest frequency of occurrence of 60% each while species like *B. buonopozense, C. maxima, D. samamatii, P. mildbraedii, V. amygdalina* and *V. polysphaera* had the lowest frequencies of occurrence of 20% (Table 5). *D. sammatii* and *P. mildbraedii* had the highest and lowest density values of 1200 plants/ha and 40 plants/ha (Table 5), respectively. The frequency occurrence and densities of vegetables in EK (Table 6) revealed that *Glyphaea brevis* had the highest frequency of occurrence of 80%, while the least frequency of 20% (Table 6) was associated with *A. hybridus, C. ciliata, D. sammatii* and *M. puberula* vegetable species. *S. indicum* had the highest density value of 4200 plants/ha, while *B. buonopozense* had the lowest density value of 40 plants/ha. Also, the results revealed that *G. africanum* was near threatened. This result also concurs with the works of Zemede and Mesfin [20].

Threats that affected the vegetables were due to agricultural activities, aquaculture, food value, construction, and urbanization (Tables 4-6). There were variations in the frequency of occurrence and relative density among the selected edible vegetables. These views agree with the findings of Ubom *et al*. [21]. who reported that selective exploitation and high anthropogenic disturbances are contributing factors. These may account for the low species density recorded in some vegetables in the three study locations. It has been reported that high plant species density and frequency reflect undisturbed vegetation while low species density and frequency is characterized by disturbances [22].

3.3. Use-value index

The use-value index was determined based on the different categories for a particular vegetable. Lower use-value index, low frequency (%) of occurrence, low and high density necessitate the selection of the leafy vegetables used. Results obtained showed a high index for the following vegetables, *T. triangulare, V. amygdalina, P. guineense, P. mildbraedii, L. africamum, J. insularis, G. fricanum, C. maxima, A. hybridus* and *T. occidentalis* while the least use-value was recorded in *M. puberula, B. buonopozense, S. tragacantha, G. brevis, H. bussei* and *V. polysphaera, C. ciliata, D. sammatii*. Also, all the ten vegetables selected for analysis were observed to be available in the wild except *H. rosa-sinensis* (Table 7). Among the three studied locations, the forest was not found in the satellite/urban cities. This observation is in accordance with the report by Adebooye and Opabode [23] on the diversity of indigenous leafy vegetables and fruits of Africa being seriously eroded as a result of a multiplicity of environmental, political and socio-economic factors. Based on the findings from this research, it is suggested that urgent steps need to be taken as a nation, individually and in Africa in general to arrest the wave of loss of plant genetic resources and therefore ensure the conservation of our remaining indigenous leaf vegetables and fruits heritage.

Reports show that the use of fruits has the potential through selective conservation and domestication which can contribute to the maintenance of plant biodiversity. There is a need to distinguish/recognize these fruits and their value added products in the local or national or international market. It is also important to analyze the market environment for these fruits compared with alternative possibilities such as exotic fruits or agricultural crops. In general, future contemplations on wild edible fruits around the globe need to be studied at forefront by involving local indigenous communities [24]. Plant species richness in a region is primarily influenced by the climatic (temperature, rainfall, altitude), edaphic and biotic factors [25]. Sharma *et al.* [26] added that the species are widely available but are important only in situ. Studies strongly indicate that the wild edible plants (WEPs) can significantly substantiate the global food basket in today's era of climate instability [27].

Safaa *et al*. [28] confirms a high number of wild leafy vegetables (158 species) associated with a rich ethnobotanical traditional knowledge is still in use in Lebanon. Species of high citation frequency and many others have very high potential to support food security and dietary quality of traditional Lebanese communities. These species should be recognized and conserved to support the development of sustainable and diversified food systems and enhance food nutritional value and micronutrient content. Among the cited species, six were classified as globally threatened (EN or VU), five of which were endemics to Lebanon and Syria and scored relatively high rating values prioritizing them for conservation actions.

Apart from their food and medicinal value, most of the identified wild edible plant species in the study area are used by the community for other different purpose. The local people harvest the wild edible plants not only for food but also for construction, fire wood, and furniture. Particularly, wild edible plant species such as *Syzygium guineense* and *Cordia africana* are multipurpose plant species widely used by the local communities. Thus, this has led to a high level of threats to the wild edible plant species in the study area. In addition, many of the wild edible plants found in the study area are found to be under growing pressure, due to anthropogenic and socioeconomic factors. This has resulted in the dwindling of the species of wild edible plants and the associated indigenous knowledge [24, 29].

3.4. Morphological characteristics of vegetables

The results in Table 8 summarized the morphological characteristics of the ten (10) selected edible leafy vegetables. The leaf area varied from plant to plant, the highest leaf area was recorded in *S. tragacantha* (178.40$\pm$0.44 cm^2) while *D. sammatii* had the lowest leaf area (12.04$\pm$0.30 cm^2). Petiole length ranged from 1.00$\pm$0.23 – 17.20$\pm$0.30 cm. *M. puberula, V. polysphaera* and *D. sammatii* had petiole length of 1.0 cm (Table 8). All the vegetables possessed internode with the highest being observed in *H. bussei* (6.23$\pm$0.72 cm) and the least in *D. sammatii* (2.02$\pm$0.15 cm). *B. buonopozense, C. ciliata* and *D. sammatii* had compound leaves while *M. puberula, S. tragacantha, S. indicum, G. brevis, H. rosa-sinensis, H. bussei* and *V. polysphaera* showed simple leaf type.

Four (04) margin leaf forms were recorded within the vegetables: entire, serulate, serrate and runcinate. Also, the leaf shapes varied from lanceolate, elliptical and ovate to spear-head lanceolate. Leaf apex was observed to be cuspidate, acuminate and rounded. All the vegetables showed an alternate leaf arrangement except in *H. bussei* with the opposite arrangement. Flower colours cut across yellow, white, red, purple and *D. sammatii* had brown spores. The highest plant height was recorded in *B. buonopozense* with 40-60 metres while *D. sammatii* was 10-60 cm (Table 8). The vegetables showed different habits which included herbs, shrubs, trees, creeper-climber and lianas.

Findings from this research showed that all ten (10) edible leafy vegetables studied were lesser-used in all three study locations. These observations are in line with the report of the Food and Agricultural Organization [30] on countries of West and Central Africa sub-regions identified with a large number of underutilized species that are important to the livelihoods of the local populace.

Table 4: Frequency of occurrence and relative density of vegetables in Uyo L.G.A.

S/N.	Vegetables	Habitats	Frequency (%)	Density (Plts/ha.)	Rel. Freq.	Rel. Density	Conservation Status	Threats
1	*A. hybridus*	Herb	40	220	6.67	1.37	NYBA	Fv, Ag
2	*B. buonopozense*	Tree	20	40	3.33	0.25	NYBA	Ag, UR, CO
3	*C. ciliata*	Herb	60	8000	10.00	49.81	NYBA	CO
4	*C. maxima*	Herb	0	0	0	0	NYBA	-
5	*D. sammatii*	Herb	60	1600	10.00	9.96	NYBA	-
6	*G. brevis*	Shrub	20	80	3.33	0.49	NYBA	-
7	*G. africanum*	Herb	0	0	0	0	Near Threatened	Fv, Ag, Aq
8	*H. bussei*	Herb	20	60	3.33	0.37	NYBA	-
9	*H. rosa-sinensis*	Shrub	60	180	10.00	1.12	NYBA	UR, CO
10	*J. insularis*	Herb	60	1000	10.00	6.23	NYBA	UR, CO
11	*J. africamum*	Shrub	40	240	6.67	1.49	NYBA	Fv, UR, CO
12	*M. puberula*	Shrub	40	240	6.67	1.49	NYBA	CO, UR
13	*P. guineense*	Herb	40	60	6.67	0.37	NYBA	Fv, Ag
14	*P. mildbraedii*	Tree	0	0	0	0	NYBA	-
15	*S. indicum*	Herb	60	2200	10.00	13.69	NYBA	Fv, CO, UR
16	*S. tragacantha*	Tree	40	80	6.67	0.49	NYBA	CO, UR
17	*T. triangulare*	Herb	20	800	3.33	4.98	NYBA	Fv, Ag, UR
18	*T. occidentalis*	Herb	0	0	0	0	NYBA	Fv, UR, CO
19	*V. amygdalina*	Shrub	0	0	0	0	NYBA	Fv, UR, CO
20	*V. polysphaera*	Herb	20	1260	3.33	7.85	NYBA	CO, UR

Ag = agriculture, Aq = Aquaculture, FV = Food value, CO = Construction, UR = Urbanization, NYBA = not yet been assessed.

Table 5: Frequency of occurrence and relative density of vegetables in Ikot Ekpene L.G.A.

S/N.	Vegetables	Habitats	Frequency (%)	Density (Plts/ha.)	Rel. Freq.	Rel. Density	Conservation Status	Threats
1	*A. hybridus*	Herb	40	280	7.14	4.93	NYBA	Fv, Ag
2	*B. buonopozense*	Tree	20	60	3.57	1.06	NYBA	Ag, UR, CO
3	*C. ciliata*	Herb	40	400	7.14	7.04	NYBA	CO
4	*C. maxima*	Herb	20	300	3.57	5.28	NYBA	-
5	*D. sammatii*	Herb	20	1200	3.57	21.13	NYBA	-
6	*G. brevis*	Shrub	40	300	7.14	5.28	NYBA	-
7	*G. africanum*	Herb	0	0	0	0	Near Threatened	Fv, Ag, Aq
8	*H. bussei*	Herb	0	0	0	0	NYBA	-
9	*H. rosa-sinensis*	Shrub	40	300	7.14	5.28	NYBA	UR, CO
10	*J. insularis*	Herb	60	1000	10.71	17.61	NYBA	UR, CO
11	*L. africamum*	Shrub	60	360	10.71	6.34	NYBA	Fv, UR, CO
12	*M. puberula*	Shrub	60	460	10.71	8.09	NYBA	CO, UR
13	*P. guineense*	Herb	40	60	7.14	1.06	NYBA	Fv, Ag
14	*P. mildbraedii*	Tree	20	40	3.57	0.70	NYBA	-
15	*S. indicum*	Herb	0	0	0	0	NYBA	Fv, CO, UR
16	*S. tragacantha*	Tree	0	0	0	0	NYBA	CO, UR
17	*T. triangulare*	Herb	60	600	10.71	10.56	NYBA	Fv, Ag, UR
18	*T. occidentalis*	Herb	0	0	0	0	NYBA	Fv, UR, CO
19	*V. amygdalina*	Shrub	20	220	3.57	3.87	NYBA	Fv, UR, CO
20	*V. polysphaera*	Herb	20	100	3.57	1.76	NYBA	CO, UR

Ag = agriculture, Aq = Aquaculture, FV = Food value, CO = Construction, UR = Urbanization, NYBA = not yet been assessed.

Table 6: Frequency of occurrence and relative density of vegetables in Eket L.G.A.

S/N.	Vegetables	Habitats	Frequency (%)	Density (Plts/ha.)	Rel. Freq.	Rel. Density	Conservation Status	Threats
1	*A. hybridus*	Herb	20	140	3.33	1.52	NYBA	Fv, Ag
2	*B. buonopozense*	Tree	40	40	6.67	0.43	NYBA	Ag, UR, CO
3	*C. ciliata*	Herb	20	420	3.33	4.55	NYBA	CO
4	*C. maxima*	Herb	40	260	6.67	2.81	NYBA	-
5	*D. sammatii*	Herb	20	1200	3.33	12.98	NYBA	-
6	*G. brevis*	Shrub	80	480	13.33	5.19	NYBA	-
7	*G. africanum*	Herb	0	0	0	0	Near Threatened	Fv, Ag, Aq
8	*H. bussei*	Herb	60	140	10.00	1.52	NYBA	-
9	*H. rosa-sinensis*	Shrub	40	180	6.67	1.95	NYBA	UR, CO
10	*J. insularis*	Herb	40	600	6.67	6.49	NYBA	UR, CO
11	*L. africamum*	Shrub	0	0	0	0	NYBA	Fv, UR, CO
12	*M. puberula*	Shrub	20	200	3.33	2.16	NYBA	CO, UR
13	*P. guineense*	Herb	0	0	0	0	NYBA	Fv, Ag
14	*P. mildbraedii*	Tree	40	120	6.67	1.29	NYBA	-
15	*S. indicum*	Herb	40	4200	6.67	45.45	NYBA	Fv, CO, UR
16	*S. tragacantha*	Tree	0	0	0	0	NYBA	CO, UR
17	*T. triangulare*	Herb	40	400	6.67	4.33	NYBA	Fv, Ag, UR
18	*T. occidentalis*	Herb	0	0	0	0	NYBA	Fv, UR, CO
19	*V. amygdalina*	Shrub	40	220	6.67	2.38	NYBA	Fv, UR, CO
20	*V. polysphaera*	Herb	60	640	10.00	6.93	NYBA	CO, UR

Ag = agriculture, Aq = Aquaculture, FV = Food value, CO = Construction, UR = Urbanization, NYBA = not yet been assessed.

Table 7: Plant categories and use-value index

S/N	Scientific Name	Family	Common Name	Local Name	Harvest type	Uses	No. of categories Used	No. of Respondents	∑	Rank/%	UV
1	*M. puberula*	Euphorbiaceae	-	Ntabid	Wild	Md	1	5	5	12/10	0.02
2	*B.buonopozense*	Bombacaceae	Red silt cotton tree	Ukim	Wild/cultivated	Tb	1	2	2	15/4	0.02
3	*S. tragacantha*	Sterculiaceae	African tragacanth	Udod Eto	Wild/cultivated	Md	1	4	4	13/8	0.02
4	*S. indicum*	Pedaliaceae	Sesame	Etehedeh	Wild/ cultivated	Fd, Md	2	14	28	9/28	0.04
5	*G. brevis*	Tiliaceae	-	Ndodido	Wild/cultivated	Md	1	6	6	11/12	0.02
6	*H. rosa-sinensis*	Malvaceae	Red hibiscus	Frawa	Cultivated	Md, Om	2	14	28	9/28	0.04
7	*H.bussei*	Rubiaceae	-	Atama Idim	Wild	Md	1	2	2	15/4	0.02
8	*V. polysphaera*	Compositae/ Asteraceae	Bitter leaf	Asio-isong	Wild/ cultivated	Md	1	10	10	10/20	0.02
9	*C. Ciliata*	Capparidaceae	Consumption weed	Mkpat unen	Wild	Md	1	3	3	14/6	0.02
10	*D. sammatii*	Athyriaceae	Fern	Nyama Idim	Wild	Om	1	1	1	16/2	0.02
11	*T. triangulare*	Portulaceae	Waterleaf	Mmon-mmon ikon	Cultivated	Fd, Md, Om	3	42	126	6/84	0.06
12	*V. amygdalina*	Compositae/ Asteraceae	Bitter leaf	Etidod	Cultivated	Fd, Md,	2	49	98	2/98	0.04
13	*P. guineense*	Piperaceae	Guinea black pepper	Odusa	Wild/cultivated	Fd Md	2	50	100	1/100	0.04
14	*P. mildbraedii*	Papilionaceae	White Camwood	Mkpa	Wild/cultivated	Fd, Md, Tb	3	48	144	3/98	0.06
15	*L. africamum*	Icacinaceae	-	Editan	Wild/cultivated	Fd, Md	2	50	100	1/100	0.04
16	*J. insularis*	Acanthaceae	Hunter's weed	Mmeme	Wild/cultivated	Fd, Md	2	50	100	1/100	0.04
17	*G. africanum*	Gnetaceae	Afican salad	Afang	Wild/cultivated	Fd, Md, Om	2	46	92	4/92	0.04
18	*C. maxima*	Cucurbitaceae	Melon pumpkin	Ndise	Wild/cultivated	Fd, Md	2	37	74	7/74	0.04
19	*A. hybridus*	Amarantheceae	Amaranth	Inyan-afia	Wild/cultivated	Fd, Md	2	43	86	5/86	0.04
20	*T. occidentalis*	Cucurbitaceae	Fluted pumpkin	Ikon ubon	Cultivated	Fd, Md	2	49	98	2/98	0.04

Notes: Fd = Food, Md = Medicine, Om = Ornamental, Tb = timber, UV = Use-value.

Table 8: Morphological characteristics of selected edible vegetables in Akwa Ibom State

Vegetables	Leaf Length (cm)	Leaf Width (cm)	Leaf Area (cm^2)	Petiole Length (cm)	Internode Length (cm)	Leaf Type/ Margin	Leaf Shape	Leaf Apex	Leaf Arrang.	Flower Colours	Plant Heights	Habit
M. puberula	7.50±0.22	3.30±0.20	17.82±0.21	1.00±0.67	2.70±0.20	Simple/ Enitre	Lanceolate	Cuspidate	Alternate	Yellow	5-7 m	Shrub
B. buonopozense	17.90±0.91	3.90±0.22	50.30±0.57	17.20±0.30	2.30±0.62	Compound/ Entire	Lanceolate	Acuminate	Alternate	White	40-60 m	Tree
S. tragacantha	22.32±0.53	11.10±0.34	178.40±0.44	6.30±0.42	3.50±0.43	Simple/ Entire	Ellyptical	Acuminate	Alternate	Purple	5-25 m	Shrub-Tree
S. indicum	14.90±0.19	3.70±0.19	39.70±0.19	1.90±0.19	4.70±0.22	Simple/ Serulate	Ellyptical	rounded	Alternate	Purple	50-70 cm	Herb
G. brevis	15.40±0.62	6.10±0.60	67.63±0.61	2.30±0.30	4.10±0.40	Simple/ Serulate	Ellyptical	Cuspidate	Alternate	Yellow	5-8 m	Herb
H. rosa-sinensis	13.02±1.30	8.60±0.73	80.62±1.02	3.20±0.50	4.40±0.32	Simple/ Serrate	Ovate	Cuspidate	Alternate	Red	1.5-2.4 m	Shrub
H. bussei	18.60±0.70	9.80±0.75	131.24±0.73	3.60±0.50	6.23±0.72	Simple/ Entire	Ellyptical	Acuminate	Opposite	White	10-30 m	Shrub-lianas
V. polysphaera	16.70±0.82	7.20±0.75	86.67±0.79	1.00±0.23	3.60±0.40	Simple/ Serulate	Ellyptical	Acuminate	Alternate	Purple	10-70 cm	Herb
C. ciliata	5.70±0.40	6.9±0.31	28.31±0.36	8.90±0.70	4.23±0.40	Compound/ Entire	Spear-head lanceolate	Acuminate	Alternate	Purple	5-10 m	Creeper-Climber
D. sammatii	7.60±0.70	2.20±0.30	12.04±0.50	1.00±0.05	2.02±0.15	Compound/ Runcinate	Lanceolate	Cuspidate	Alternate	Brown Spores	10-60 cm	Herb

Results are means of five determinations ± Standard Error. cm = centimeters, m = mitres, Arrang. = arrangement.

4.0. Conclusion

The study showed that all three studied areas had a high frequency of occurrence with a remarkable density of plants/ha of wild edible leafy vegetables. Preserving wild vegetable populations is an important process for the conservation of biodiversity. The near-threatened plant was *G. africanum* caused by commercialization, the disappearance of traditional farm gardens and the depopulation of rural areas.

Vegetables are always considered a very important source of medicine especially for the population of the rural areas and tribes because of the high cost and difficult accessibility to modern medicine. In order to avoid the threat to valuable vegetables, there is an urgent need to protect the cultural heritage and traditional knowledge of the native/wild plant species by justifying the therapeutic potential and biological activities of the plants with reported scientific methods. Also, there is a need for special attention to the potential plants of the area which are on the verge of extinction by excessive deforestation and development. This will not only achieve the conservation of plant species and biodiversity but will also improve the well-being of local populations.

In the modern-day, world global change influences traditional ecology in ways that loom biodiversity and at the same time demoralize human effort, health is a crucial foundation for protecting, managing biodiversity and conserving plant resources. The growing body of data supporting the premise that biodiversity can be compared with dietary diversity which in turn can be compared with health should be the beginning for further findings and pragmatic action.

Competing interest

The authors declare that they have no competing interests.

Acknowledgements

The authors are grateful to the informants and local communities of Uyo, Eket and Ikot Ekpene for sharing their incredible accumulated knowledge of the edible leafy vegetables in the field.

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