

Survey of Wild Vegetables in the Lebialem Highlands of South Western Cameroon

Ngone Abwe Mercy*, Ndam Lawrence Monah, Mih Afui Mathias

Department of Botany and Plant Physiology, Faculty of Science, University of Buea, Buea, Cameroon

Email address:

danmercy@yahoo.com (N. A. Mercy), nlmonah@yahoo.com (N. L. Monah), afuimih@yahoo.com (M. A. Mathias)

*Corresponding author

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Abstract: Wild vegetables are known to make important contributions to food baskets and livelihoods in the smallholder and subsistence farming communities of Sub-Saharan Africa. Protecting and promoting the sustainable use of these vegetables in concert with more mainstream agricultural innovation efforts has the potential to build household resilience to food insecurity. They are considered to be rich in micronutrients and can therefore be used to overcome inadequate nutrition. However, research on micronutrients in wild vegetables remains limited and sporadic. The Lebialem highlands which forms part of the forest agroecological zone of Cameroon is a rich source of a wide variety of wild plants, most of which have hardly been studied from the view point of its uses, proximate composition and nutritional profile. In this context, the present study was aimed at documenting the wild edible vegetables in the study area, as well as their traditional uses as there is dramatic loss of traditional knowledge regarding wild edible plants. Informed consent semi-structured interviews from 300 respondents of 15 communities were conducted to collect data. A total of 26 wild vegetables belonging to 18 families and 24 genera were documented. The Asteraceae was recorded as the most prominent, followed by Brassicaceae, Gnetaceae, Fabaceae and Piperaceae. These five families contributed about 50% of the wild vegetables in the area. Five dominant vegetables were recorded to be mostly consumed viz; Vernonia amygdalina, Gnetum spp., Lomariopsis guineensis, Pennisetum purpureum and Amaranthus dubius. Lomariopsis guineensis and Pennisetum purpureum are illustrated for the first time as wild vegetables in Cameroon. The tradition of using wild palatable plants is still alive in the rural populations though it is declining due to the introduction of exotic species. Consequently, the recording, preserving, and infusing of this traditional knowledge to upcoming generations is vital.

Keywords: Wild, Vegetable, Malnutrition, Food Security, Lebialem Highlands

1. Introduction

Wild edible plants constitute those plants that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action [1]. They include all vegetables that are gathered (not cultivated), whether they are harvested in agricultural areas, uncultivated areas, or forestland [2]. These vegetables make important contributions to culinary baskets and livelihoods in the smallholder and subsistence farming communities of Sub-Saharan Africa. Since time immemorial, the tradition of gathering wild edible vegetables has persisted in many Africa communities [3]. Rural communities in

particular make use of wild vegetables to supplement their diets which is based on rainfed cultivation of staples such as cassava, maize, millet and cocoyam [4, 5].

It is estimated that there are more than 45,000 species of plants in Sub-Saharan Africa of which about 1,000 can be eaten as green leafy vegetables [6]. While the vegetable sector in many developing countries have been more advanced, that of Sub-Saharan Africa has been under developed and vegetable consumption is relatively extremely low [7]. For many years, the vegetable crops that have enjoyed much attention are the exotic ones. A vast majority of the indigenous vegetable plant species of the same or much better potential nutritional values are in the wild, neglected and under-utilized. A lot of the neglected vegetable

species in our savannah and forest zones are also endowed with other by product (s) be they secondary or primary that may be of great importance to human race directly or indirectly in the ecosystem [8]. Some of these vegetables are gaining cross-cultural and economic importance and appropriate cultivation techniques need to be developed for their eventual domestication [9, 10].

The Lebialem highlands, located on the mountainous north eastern part of South West Cameroon, is a rich source of a wide variety of wild plants, most of which have hardly been studied from the view point of its uses, proximate composition and nutritional profile [11]. It is bordered to the east by the West Region, south and south west by the Banyang-Mbo Wildlife Sanctuary (BMWS) and North by Momo Division in the North West Region. The area ranges from 180m to about 2510m a. s. l. It is situated between latitudes 5°11" and 5° 45" and longitudes 9° 50" and 10° 00". Lebialem is composed of Nweh (Bangwa) and Mundani clans and covers a surface area of about 617 km² with an estimated 144,560 inhabitants. The population density is estimated at 100 persons per km² [14]. Lebialem is one of six administrative divisions in the South West Province. It is made up of three subdivisions: Alou, Menji and Wabane. The main vegetation type is grassland with patches of montane and submontane forests mainly as a result of human activities particularly cocoyam farming in the lowland forest [15]. The area is sensitive to erosion and landslides due to steep hill slopes and land use pattern. Over 90% of the people live between farmland and forest, and they depend highly on natural resources from the forest and agricultural products for sustenance [16].

Considering the importance of wild edible vegetables to household food security, it is essential that the social-ecological systems that make gathering these natural resources possible be appropriately protected, managed, and valued to avoid overexploitation and degradation [12]. A better understanding of ethnobotanical knowledge and wild vegetable uses is necessary to reform agricultural development initiatives, natural resource management, and food security policies that could facilitate more sustainable access to these resources and even increase their positive impact on community resilience [2, 13]. Whereas there is substantial knowledge on the medicinal uses of wild plants in this area, knowledge on their culinary uses is not documented, risking the loss of such traditional knowledge. This study was aimed at identifying vegetables gathered in the wild as well as documenting information on other uses of the plants.

2. Materials and Methods

2.1. Reconnaissance Survey and Selection of Study Sites and Informants

A reconnaissance survey was conducted from December 2 to 15, 2012 to have an overview of the terrain, meet with local officials and potential informants, and to select study

sites. Fifteen (15) study villages were selected based on proximity to the existing remnant forest and use of forest products. Prior to the survey, a semi-structured questionnaire was designed and pre-tested with key informants during the reconnaissance visits to the study sites to find out its suitability for the present study. The questionnaire was later modified according to the responses of the informants. This aspect was done in close collaboration with the Extension Officers of the Sub-Divisional Delegations of Agriculture and Rural Development. In each village, a purposive sampling method was employed to identify key informants and respondents. Key informants were selected for interviews with assistance from the staff of the local institutions. The key informants were selected based on their age, traditional knowledge of wild edible plants, their nativity, and duration of stay in the study area. Key informants were interviewed about their perceptions and experience concerning the diversity and uses of wild vegetables.

2.2. Ethnobotanical Data Collection

Ethnobotanical techniques were employed to collect data on the utilization and management of wild vegetables. The information was collected from the local community using semi-structured interview, focus group discussions, diversity fairs, ecological surveys, market surveys, pair wise ranking, direct matrix ranking, paired comparison and specimen collection. Twenty (20) semi-structured questionnaires were administered to both men and women of ages ranging from 18 to 75 at each of the 15 communities, giving a total of 300 respondents for the study area (Figure 1). Information regarding the local names of plant species, growth forms, part (s) used, availability in natural resources, method of processing and vegetable preparation was carefully recorded. Important species were collected and presented for group discussions about different species habitat, uses as foods, vegetables, medicines, or in cultural ceremonies.

2.3. Focus Group Discussion

The participants for the focus group discussion were selected from different socio-demographic groups based on the recommendations given by Extension Officers and elderly members of the community. The main criterion for their selection was knowledge on the diversity and utilization of wild edible plants. The focus group discussion was carried out based on semi-structured discussion guidelines and semi-structured interview questions. A focus group discussion was held in each of the communities to get a record of vegetables consumed and used for other purposes as well as to confirm responses obtained during the individual interviews. During these sessions, plant samples that could be found around were brought for show-and-tell demonstration [17]. Two focus group diversity shows were organized in each of the study sites with the objective of quickly assessing the general richness and status of wild vegetables.

2.4. Ecological Surveys

For the ecological inventory of wild vegetables, forest walks were done by a team accompanied by the key informants in the different communities. The opportunistic sampling technique was exploited in the survey for wild vegetables with each sampling site geo-referenced using a Garmin GPS version 2012. Transect lines of 200m were set up at each opportune spot that included farm fallows, secondary forest and virgin forest. Wild vegetables within 5m on each side of the transect lines were recorded and their

growth form and habitat noted. Based on the ethnobotanical information obtained from informants', plant specimens with their vernacular names were collected, numbered, pressed, and dried for identification. Further identification of all plant specimens was done using authenticated specimen and referring to published illustrations and taxonomic keys and with the assistance of an expert from the Limbe Botanic Gardens (SCA). All voucher specimens of the wild vegetables, labeled with scientific and vernacular names were deposited at the Limbe Botanic Gardens Herbarium.

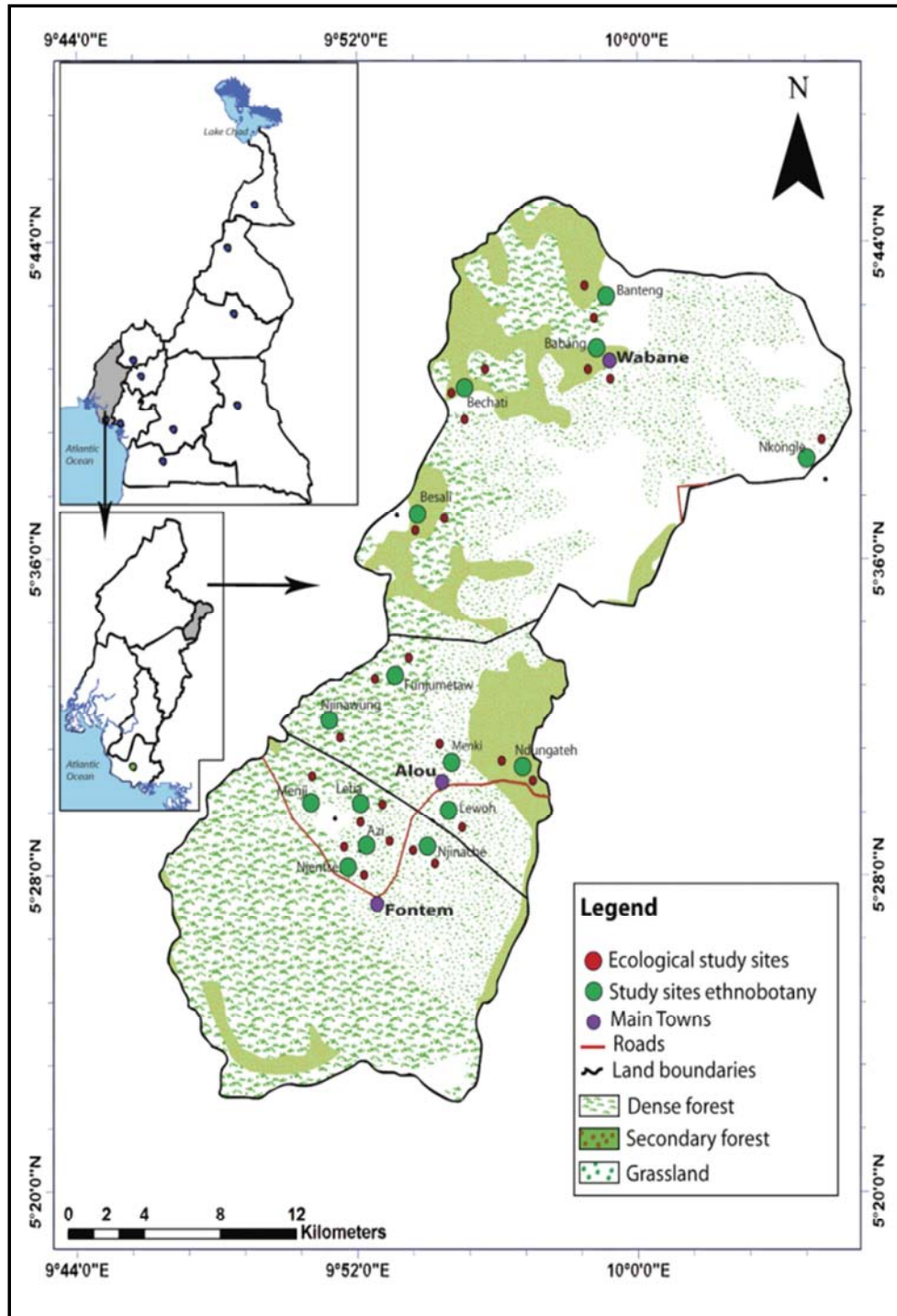


Figure 1. Ecological and ethnobotanical study sites in the Lebialem highlands, south western Cameroon.

2.5. Oosting Scale Ranking

The recorded wild vegetable species were categorised by using the modified Oosting scale [18]. Under this scale, the distribution pattern of the wild vegetable flora was made into five varying categories as follows: 1. least consumed, 2. fairly consumed, 3. moderately consumed, 4. highly consumed and 5. most highly consumed.

2.6. Species Preference Ranking

Five wild vegetables were identified by the focus group discussion participants for the variables (1) taste of leafy vegetable and (2) taste of other plant parts as vegetables. Because of the presence of many ethnic groups in the area, matrix of all possible combinations of the plants was prepared in local names for each variable to be explored. All possible pairs as well as order within each pair were randomized and made available for choice to the participants. A total of 7 participants, 5 from the study sites and 2 Agricultural Extension Officers were involved for preference ranking of the vegetables to all of the above variables. The participants were interviewed individually to choose one from all possible pairs of plants prepared for each of the variables. The score given to each species were added and the highest score was ranked to be first.

2.7. Pair-Wise Ranking

To understand the local people perception on activities threatening wild vegetables, pair wise ranking was conducted and the number of possible pairs was calculated using the relation:

$$Y = \frac{N(N-1)}{2} \tag{1}$$

Where ‘Y’, is the sum all factors rated by respondents in each site

‘N’ is the number of factors (activities).

Accordingly, many threatening factors were identified by

the community. The total number of factors was determined using the above formula and then the ten pairs were arranged and presented to the key informant to choose one from the two threats at a time. Then the score from each respondent summed up, the ranks determined and the factors that received the highest total score ranked first.

2.8. Direct Matrix Ranking (Use Diversity Ranking)

Direct matrix ranking was done following the method of Martin [19] in order to compare multipurpose use of a given species and to relate this to the extent of its utilization versus its dominance. The use categories included were edibility, medicinal value, construction value, household use, agricultural tool, fuel wood, forage and fencing. Each key informant was asked to assign and give value about the importance and usefulness of each wild edible plant species on the basis of the following rating as: 4=Excellent, 3=very good, 2=good, 1=least used, 0=not used. Accordingly, each key informant used such ratings to assign the five multipurpose wild edible vegetable species in each category. The values given by the informants were averaged and the use and value of each vegetable species was ranked.

A descriptive statistical method including percentage and frequency were used to summarize the ethnobotanical data collected through interviews and focus group discussions.

3. Results

3.1. Indigenous Knowledge

Out of the 300 respondents, the majority of the local community members with good knowledge of and use of wild vegetables were the older generation between the ages of 60 and 80 while the least are the younger generation below the age of 40. It was also noted that most of the household members involved in tending these vegetables are women across all age categories (Figure 2).

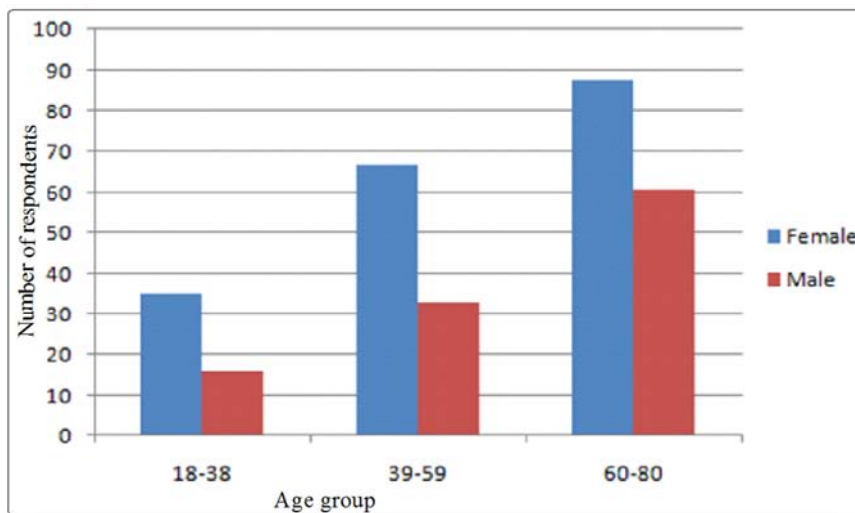


Figure 2. Age group and gender in relation to knowledge on wild vegetables in the Lebialem highlands of Cameroon.

3.2. Ethnobotanical Knowledge on Wild Vegetables

3.2.1. The Wild Vegetables

The diversity of plants used as vegetables in the Lebialem highlands of Cameroon is shown on Table 1. A total of 26 species in 24 genera of 18 families were identified.

Table 1. Inventory of wild vegetables consumed in the Lebialem highlands of Cameroon.

S/N	Family	Vernacular Name	Abundance (Oosting Scale)	IUCN Category	Growth form
1.	Acanthaceae, <i>Justicia insularis</i> T. Anders	<i>Mpahlu</i>	3	LC	Herb
2.	Amarantaceae, <i>Amaranthus dubius</i> Mart. Ex Thell.	<i>Angews</i>	4	LC	Herb
3.	Araceae, <i>Pistia stratiotes</i> L.	<i>Mbutzemelep</i>	2	LC	Aquatic herb
4.	Asteraceae, <i>Echinop giganteus</i> A. Rich	<i>Ayilagwem</i>	1	NT	Shrub
	<i>Launaea procumbens</i> L.	<i>Fusih</i>	1	Not classified	Herb
	<i>Vernonia amygdalina</i> Del.	<i>Mekang ndie</i>	5	LC	Shrub
	<i>Leucanthemum vulgare</i> Lam.	<i>nta</i>	1	Not classified	Herb
	<i>Taraxacum officinale</i> F. H. Wigg	<i>foun</i>	1	LC	Herb
5.	Brassicaceae, <i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	<i>nogn</i>	1	Not classified	Herb
	<i>Brassica oleracea</i> L.	<i>ntsu</i>	3	LC	Shrub
6.	Commelinaceae, <i>Commelina benghalensis</i> L.	<i>leng</i>	3	LC	Herb
7.	Fabaceae, <i>Desmodium scandens</i> Miq.	<i>Mbayang lagh</i>	3	Not classified	Herb
	<i>Pterocarpus mildbraedii</i> Harms.		1	LC	Tree
8.	Gnetaceae, <i>Gnetum africanum</i> Welw.	<i>Anoh</i>	4	LC	Vine
	<i>Gnetum buchholzianum</i> Engl.	<i>Anoh</i>	4	LC	Vine
9.	Lamiaceae, <i>Ocimum gratissimum</i> L.	<i>Mecheup</i>	3	LC	Herb
10.	Lomariopsidaceae, <i>Lomariopsis guineensis</i> (Underw.) Alston	<i>Mandong</i>	4	Not classified	Shrub
11.	Malvaceae, <i>Malva neglecta</i> Wallr.		3	Not classified	Herb
12.	Oxalidaceae, <i>Oxalis stricta</i> L.		1	Not classified	Herb
13.	Piperaceae, <i>Piper umbellatum</i> L.	<i>Amebume</i>	3	LC	Shrub
	<i>Piper guineense</i> Schumach.	<i>Fufop</i>	3	LC	Climber
14.	Poaceae, <i>Pennisetum purpureum</i> Schumach.	<i>Ntisong</i>	4	LC	Grass
15.	Polygonaceae, <i>Rumex crispus</i> L.		3	LC	Herb
16.	Portulacaceae, <i>Portulaca oleracea</i> L.		1	LC	Herb
17.	Solanaceae, <i>Solanum nigrum</i> L.	<i>Mbutiyin</i>	3	LC	Herb
18.	Zingiberaceae, <i>Aframomum melegueta</i> K. Schum.		3	LC	Herb

The most common life form used were herbs, meanwhile only one tree species, *Pterocarpus mildbraedii*, served as vegetable (Figure 3). Based on the Oosting scale, *Vernonia amygdalina* was categorized to be most highly consumed while *Gnetum spp.*, *Pennisetum purpureum*, *Lomariopsis guineensis*, and *Amaranthus dubius* were ranked as highly consumed.

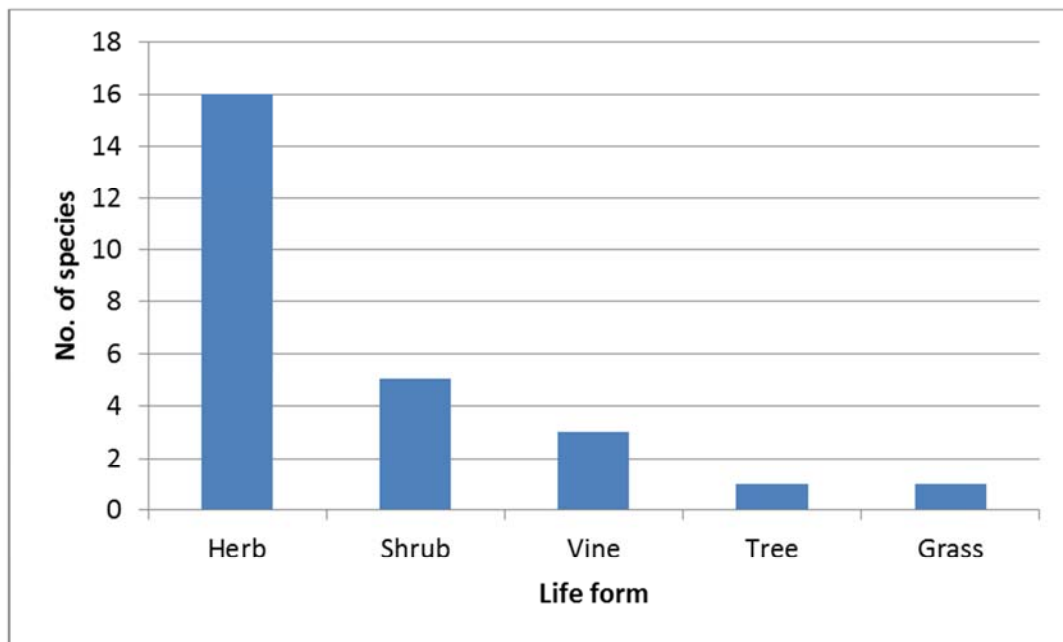


Figure 3. Life form of wild vegetables consumed in the Lebialem highlands of Cameroon.

The Asteraceae was the most dominant (19%), followed by Brassicaceae (8%), Gnetaceae (8%), Fabaceae (8%) and Piperaceae (8%). These five families contributed about 50% of the wild vegetables used in the study area. The other families with their respective consumption percentages are shown in Figure 4.

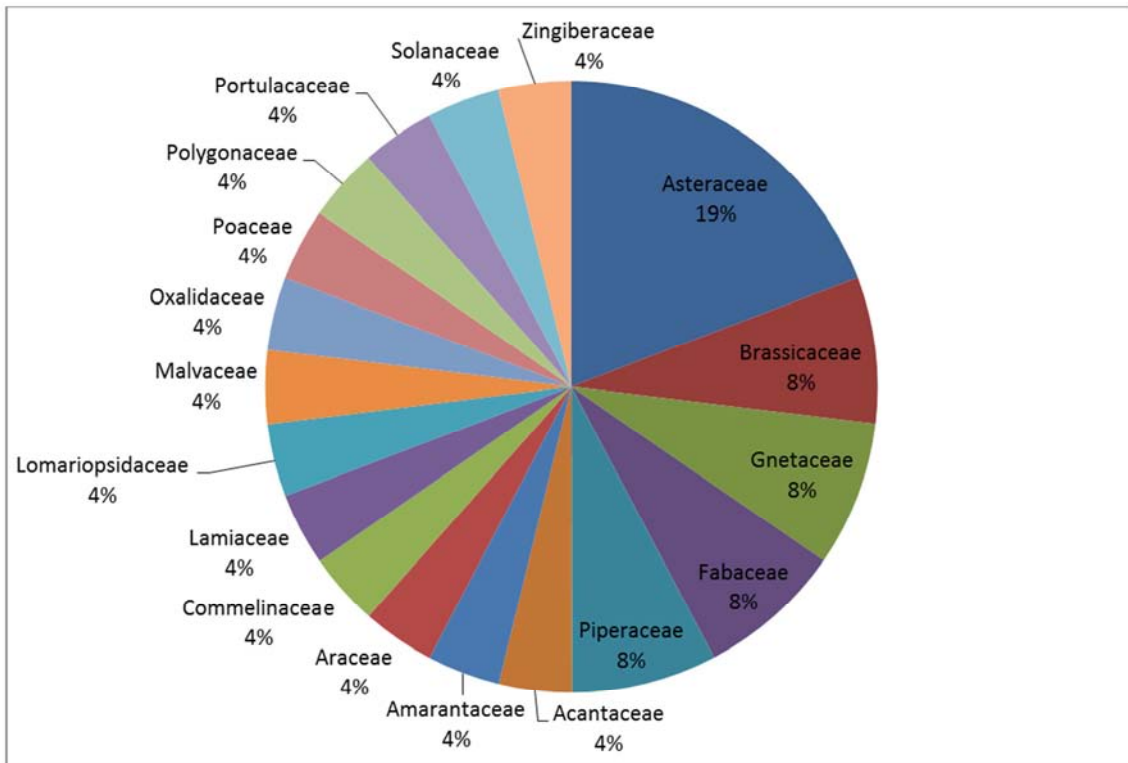


Figure 4. Plant families of wild vegetables used in the Lebialem highlands of Cameroon.

3.2.2. Culinary Value of Wild Vegetables

The study showed that for the 26 species recorded, the leaves are the plant parts generally consumed as vegetable. However, for some of the vegetable species, only the young leaves were indicated to be consumed. These included: *Justicia insularis*, *Leucanthemum vulgare*, *Rumex crispus*, *Taraxacum officinale*, *Alliaria petiolata* and *Desmodium scandens*. For the case of *Pennisetum purpureum* locally called *Ntison*, the very young tender shoots are the plant parts consumed (Table 2).

Table 2. Culinary and medicinal uses of wild vegetables in the Lebialem highlands of Cameroon.

S/N	Family	Culinary Uses	Medicinal Uses
1.	<i>Justicia insularis</i> T. Anders	Young leaves cooked as vegetable soup	Infusion of boiled leaves taken as enema to enhance fertility in women and reduce labour pain.
2.	<i>Amaranthus dubius</i> Mart. Ex Thell.	Leaves are parboiled and stir-fried	Raw leaves chewed to improve lactation in nursing mothers and ease constipation and treat diarrhoea and cholera in young children
3.	<i>Pistia stratiotes</i> L.	Leaves are parboiled and added in soups.	Leaf decoction used to treat oedema. Young leaves are chewed to treat cough and asthma.
4.	<i>Echinop giganteus</i> A. Rich	Leaves are cooked and used to spice soups	Concoction of roots, flowers and leaves used to treat yellow fever, abdominal pain, constipation, cough and menstrual pain
5.	<i>Launaea procumbens</i> L.	Leaves cooked as vegetable soup	Leaf infusion used as cooling drink in child fever.
6.	<i>Vernonia amygdalina</i> Del.	Leaves cooked as vegetable soups (Ndole); parboiled and stir-fried and also used as wrappings for food	Leaf decoction effective in the treatment of malaria. Infusion from leaves also used to reduce blood sugar level. Also implicated in the treatment of respiratory tract infections.
7.	<i>Leucanthemum vulgare</i> Lam.	Young leaves raw or cooked are finely chopped and added to salads	Leaf poultice used externally on bruises, wounds, ulcers and other cutaneous diseases
8.	<i>Taraxacum officinale</i> F. H. Wigg	Boiled young leaves sprinkled with salt and added to soups	Leaves chewed as laxative, for increasing appetite, and improving digestion
9.	<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	Young leaves cooked as a potherb or as a flavouring in soups	Leaves chewed to treat bronchitis, asthma and eczema. Externally, they are used as an antiseptic poultice on ulcers and are effective in relieving itching caused by bites and stings
10.	<i>Brassica oleracea</i> L.	Leaves steamed in one or more changes of water and cooked as soups or stir-fried	Decoction of leaves used to treat stomach disorders

S/N	Family	Culinary Uses	Medicinal Uses
11.	<i>Commelina benghalensis</i> L.	Leaves are cooked as regular greens or potherb	Leaf poultice used to treat skin infections and infusion taken as enema
12.	<i>Desmodium scandens</i> Miq.	Young leaves cooked as vegetable soup	Leaf poultice used to treat rheumatism
13.	<i>Pterocarpus mildbraedii</i> Harms.	Leaves cooked as vegetable soup	Young leaves chewed for the treatment of diarrhoea and dysentery
14.	<i>Gnetum africanum</i> Welw.	Leaves are finely chopped and used as a vegetable for soups commonly called <i>Eru soup</i> or <i>afang soup</i>	Leaf poultice used as a dressing for warts and boils. Infusion taken as treatment for enlarged spleen, sore throats, nausea and as a cathartic
15.	<i>Gnetum buchholzianum</i> Engl.	Leaves are finely chopped and used as a vegetable for soups commonly called <i>Eru soup</i> or <i>afang soup</i>	Leaf poultice used as a dressing for warts and boils. Infusion taken as treatment for enlarged spleen, sore throats, nausea and as a cathartic
16.	<i>Ocimum gratissimum</i> L.	Leaves cooked as spice in soups and seasoning of meats	Leaf infusion used to suppress coughs, fevers, and convulsions in children
17.	<i>Lomariopsis guineensis</i> (Underw.) Alston	Leaves chopped and cooked as vegetable soup	Leaves chewed as remedy for constipation, pneumonia, meningitis and also to suppress epileptic attacks
18.	<i>Malva neglecta</i> Wallr.	Leaves are mucus-forming, so when cooked in soups they tend to thicken it in much the same way as okra	Leaf infusion used as laxative for young children.
19.	<i>Oxalis stricta</i> L.	Leaves are cooked as regular greens or potherb	Leaf infusion used in the treatment of fevers, stomach cramps and nausea
20.	<i>Piper umbellatum</i> L.	Leaves cooked as vegetable soup and as food spice	Leaf poultice used for treatment of oedema. Leaves chewed to treat venereal infections, menstrual and stomach problems.
21.	<i>Piper guineense</i> Schumach.	Leaves cooked as food spice and as wrappings for fish	Leaf infusion used for the treatment of filaria, intestinal diseases, cough, bronchitis and rheumatism.
22.	<i>Pennisetum purpureum</i> Schumach.	Young tender leaves stir-fried and eaten as vegetable	Young leaves chewed to boost appetite, leaf infusion used to treat wounds and mild urinary tract infections
23.	<i>Rumex crispus</i> L.	Young leaves cooked in salted water and added to soups	Leaf infusion taken for treatment of constipation, diarrhea and especially piles
24.	<i>Portulaca oleracea</i> L.	Leaves are stir-fried, added to soups or eaten as salads	Leaf poultice used for insect or snake bites on the skin; boils, sores, pain from bee stings
25.	<i>Solanum nigrum</i> L.	Leaves boiled in slightly salted water and stir-fried	Infusions are used to treat dysentery, stomach complaints, and fever
26.	<i>Aframomum melegueta</i> K. Schum.	Leaves cooked as porridge food spice, seasoning and wrappings for food	Decoction of leaves taken to reduce bleedings or hemorrhages, especially those related to childbirth.

3.2.3. Preparation and Mode of Consumption

Analysis of the mode of consumption of wild vegetable revealed that 20 of 26 recorded 26 plant species were consumed boiled, 6 species stir-fried, 5 species parboiled and 2 species eaten raw (Figure 5).

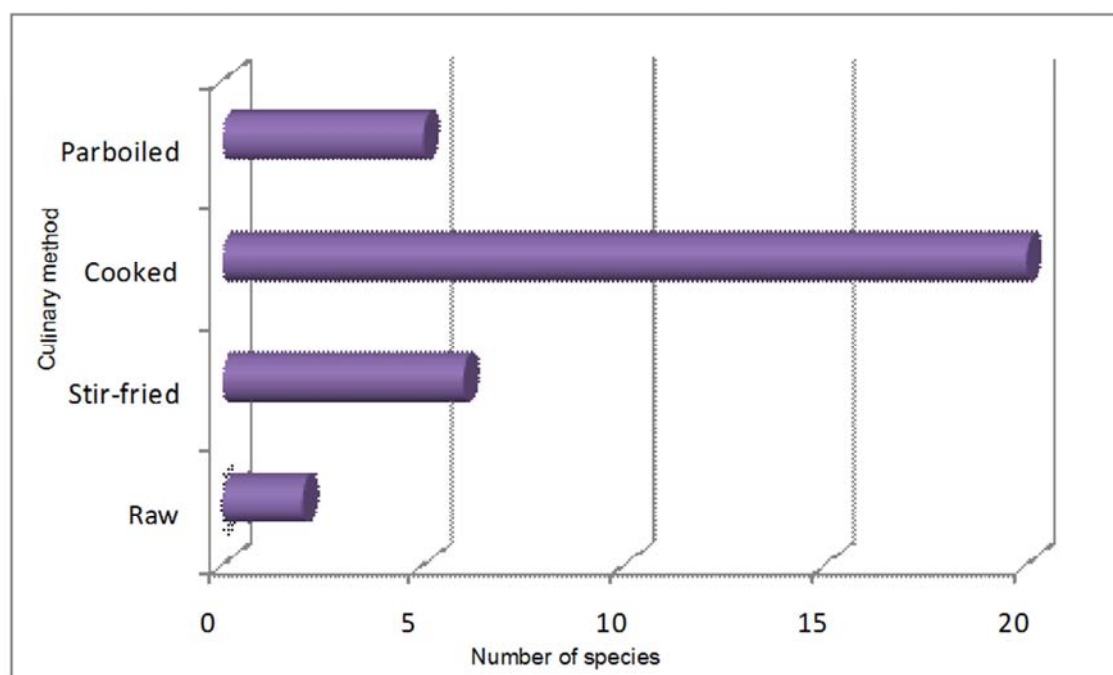


Figure 5. Mode of consumption of wild vegetable species in the Lebialem highlands of Cameroon.

For the most consumed wild vegetables species, leaves of *Amaranthus dubius* are parboiled and stir-fried while leaves of *Vernonia amygdalina* are either cooked or parboiled and stir-fried. For the case of *Gnetum* species and *Lomariopsis guineensis*, the leaves are finely chopped and cooked while the very tender shoots of *Pennisetum purpureum* are stir-fried. Most of the vegetable species are used to prepare soups, followed by the use as potherbs, food spices, wrappings, salads and as soup thickeners (Figure 6). Leaves of *Ocimum gratissimum*, *Echinop giganteus*, *Piper guineensis* and *Aframomum melegueta* are particularly used as spices and wrappings for foods. Young leaves of *Leucanthemum vulgare* and *Portulaca oleracea* are eaten raw as salads while those of *Malva neglecta* are used as soup thickeners.

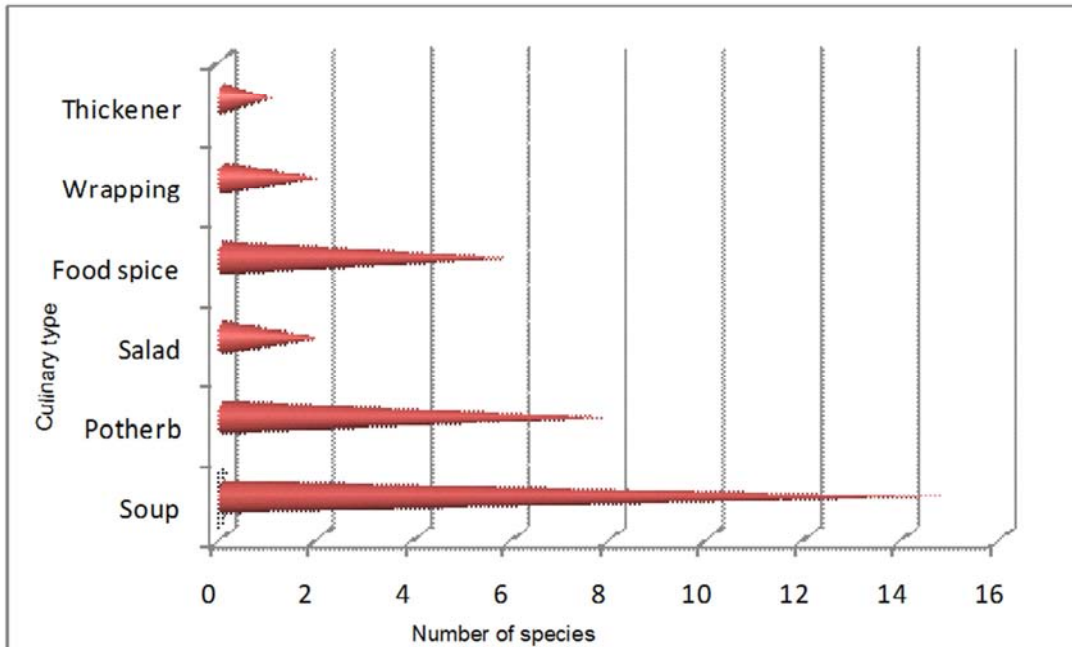


Figure 6. Preparation methods of wild vegetable species in the Lebialem highlands of Cameroon.

3.2.4. Wild Vegetables Used as Medicine

Information generated from the selected communities showed that majority of the wild vegetable species (24) are used to treat gastrointestinal diseases, 18 species for dermatological problems, 10 each for parasitic and respiratory disorders, 6 for gynaecological and 1 each for the other disease categories (Figure 7).

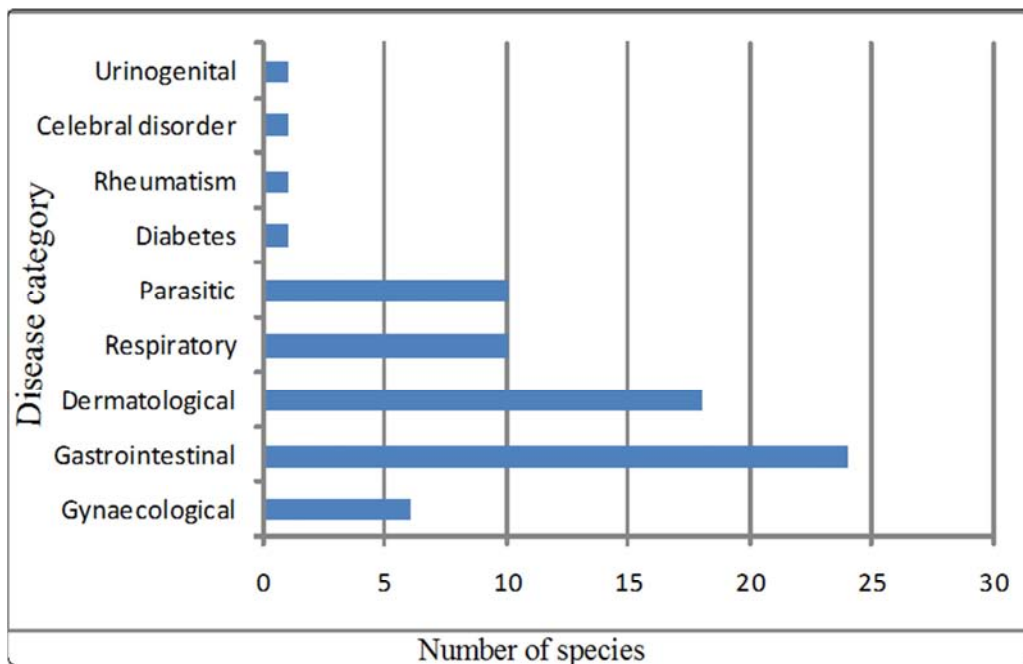


Figure 7. Medicinal uses according to disease categories of wild vegetable species in the Lebialem highlands of Cameroon.

3.2.5. Mode of Formulation of Wild Vegetables Used as Medicinal Plants

Out of the 26 reported wild vegetables, infusion was the most widely used method of preparation of phytomedicine followed by poultice with concoction being the least (Figure 8).

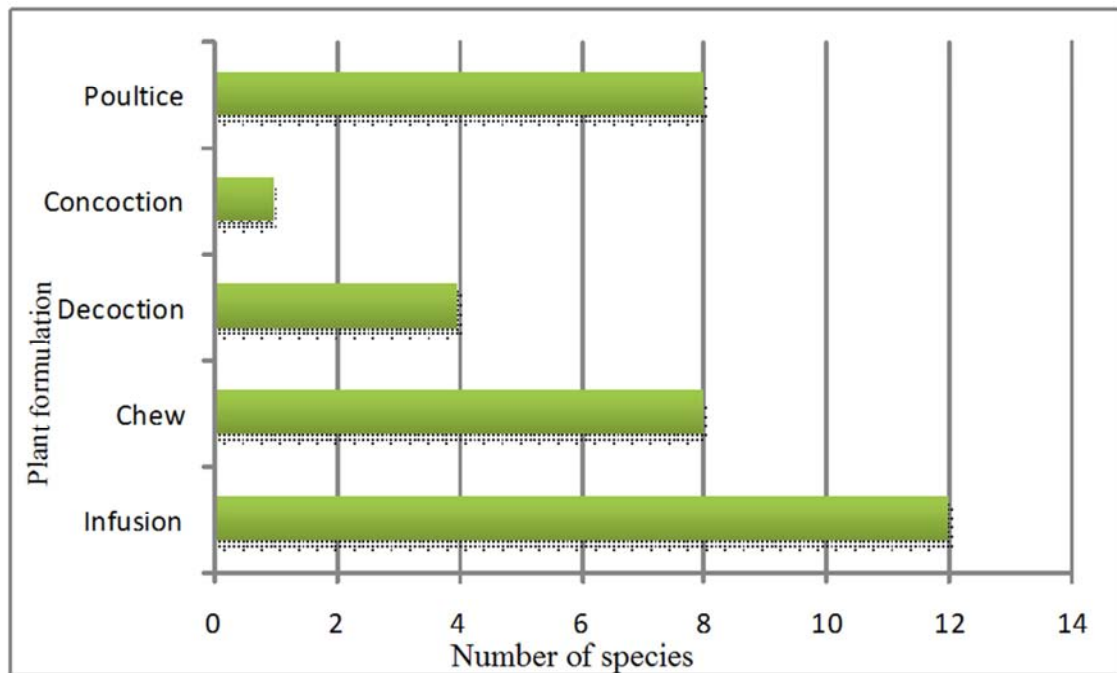


Figure 8. Plant formulation for use as medicine of the wild vegetable species in Lebialem highlands of Cameroon.

3.2.6. Species Preference Ranking

According to the local informants, the wild vegetables have a high index of consumption and as such, five species were identified and preferentially ranked for their taste by the local community. *Vernonia amygdalina* ranked first, followed by *Gnetum spp.*, *Lomariopsis guineensis*, *Pennisetum purpureum* and *Amaranthus dubius* in that order (Table 3).

Table 3. Pooled summary of pair wise ranking based on taste of the five preferred wild vegetables in Lebialem highlands of Cameroon.

Wild vegetable species	Respondents							Score	Rank
	1	2	3	4	5	6	7		
<i>Vernonia amygdalina</i>	4	3	5	3	4	5	5	29	1 st
<i>Pennisetum purpureum</i>	4	3	3	4	3	3	3	23	4 th
<i>Gnetum spp</i>	5	4	3	3	5	4	3	27	2 nd
<i>Amaranthus dubius</i>	3	4	2	3	2	3	2	19	5 th
<i>Lomariopsis guineensis</i>	3	3	4	5	4	3	2	24	3 rd

3.2.7. Direct Matrix Ranking for Multipurpose Use

Apart from food and medicinal values, most of the wild vegetables identified in the study area are used by the community for different purposes. They are commonly used as firewood, agricultural tools, fencing and as fodder for animals. As a result, eight vegetable species that are used for different purposes were identified by the community. Direct matrix ranking was undertaken in order to evaluate these multipurpose species and their relative importance to the local people and the extent of the existing threats related to their use values. The result of use diversity indicates that *Pterocarpus mildbraedii*, *Vernonia amygdalina* and *Pennisetum purpureum* ranked 1st, 2nd and 3rd respectively because they are used for different purposes in the study area. This revealed that the local people harvest the wild vegetable plants not only for food but also for fodder, fencing, and firewood (Table 4).

Table 4. Scores for direct matrix ranking of eight wild vegetable species in the Lebialem highlands of Cameroon.

Multipurpose use	Wild vegetable species and ranking*								Total	Rank
	1	2	3	4	5	6	7	8		
Firewood	0	0	3	3	0	2	0	0	8	3 rd
Agricultural tools	0	0	2	2	0	0	0	0	4	4 th
Fencing	2	2	3	3	3	1	1	1	16	2 nd
Fodder	3	2	1	2	0	4	2	3	17	1 st
Total score	5	4	9	10	3	7	3	4		
Rank	4 th	5 th	2 nd	1 st	6 th	3 rd	6 th	5 th		

*Key: 1=Justicia insularis, 2=Echinop giganteus, 3=Vernonia amygdalina, 4=Pterocarpus mildbraedii, 5=Ocimum gratissimum, 6=Pennisetum purpureum, 7=Solanum nigrum, 8=Piper umbellatum. Four use criteria (0=not used, 1=least used, 2=good, 3=very good, 4=excellent)

3.2.8. Threats to Wild Vegetables

Currently some of the remnant forests with large numbers of the wild vegetables in the study area are subjected to landslides and frequent deforestation by the local community. This is attributed mainly to human population pressure and

its associated effects. Agricultural land expansions, wild fire, fuel wood collection, over grazing and over harvesting are the main reasons for the destruction of wild vegetables. Of these factors, agricultural land expansion ranks first followed by fuel wood collection and uncontrolled wild fires (Table 5).

Table 5. Priority ranking on perceived threats factors to selected wild vegetables in the Lebialem highlands of Cameroon.

Factors	Respondents							Total Score	Rank
	1	2	3	4	5	6	7		
Over harvesting	2	2	3	2	2	1	2	14	4 th
Agricultural land expansion	3	4	3	4	3	4	2	23	1 st
Uncontrolled fire setting	3	2	2	3	2	3	2	17	3 rd
Over grazing	2	2	1	2	1	1	2	11	5 th
Fuel wood collection	3	4	3	2	3	3	2	20	2 nd

Based on their degree of destructive effects, values 1-5 were given: 1=the least destructive threat and 5=the most destructive threat

3.2.9. Conservation of Wild Vegetables and Associated Knowledge

Agricultural land expansion, fuel wood collection, and uncontrolled fire setting are the major threats to the conservation of wild edible plants in the study area. Despite the understanding of the local people about the importance of conserving the wild edible plants only some natural habitat conservation methods like planting in the form of fence to protected pasture land and demarcate farm margins are being practiced in the study area. This indicates the necessary conservation measures are not being taken into consideration in the area and hence the wild vegetables are not free of threats.

4. Discussion

The present study revealed that the majority of the local community members with good knowledge of the use of wild vegetables are the older generation (60-80 years old). This is because they are custodians of traditional knowledge and they know the uses of plants especially medicinal plants than the younger generation, who have moved to neighbouring towns since the area is prone to landslides [15]. It was also noted that most of the household members involved in tendering these vegetables are women for all age categories. Other studies revealed similar trends that opportunistic collection of wild edible foods is also done by women and children while undertaking activities such as firewood gathering or water collection [20, 21]. Shava [22] reported that women have more knowledge of leafy vegetables compared to men due to division of domestic chores (women being traditionally the cooks in the home), while men may be more versed with knowledge on indigenous fruits and edible roots. Most of the male respondents who were asked about edible plants would rather call for their female partner for information about vegetables. Philips and Gentry [23] also showed that wild edible plant knowledge is gained early in life and increases only slowly with age. In general, the younger generation is not interested in studying such traditional ways as a result

of acculturation [24, 25].

Out of the 26 wild vegetables recorded in the Lebialem highlands of Cameroon, most of them were found to have both food and medicinal uses. These exceeded the 13 species recorded by Dania-Ogbe *et al.* [26] from Edo and Delta States of Nigeria. This result also concurs with the works of Zemedede and Mesfin, Tilahun and Mirutse and Fentahun and Hager [27-29], who reported large number of edible wild species, including vegetables in their studies. A large number of the wild vegetables were herbs and shrubs, some vines and others trees. The species occurring as tree in their growth form could be advantageous in view of getting hold of diverse utilization in relation to agroforestry system [29]. Maroyi [30] also reported four types of growth forms of the plant species used as wild food include trees, shrubs, herbs and climbers. *Vernonia amygdalina* was categorized to be most highly consumed wild vegetables in Lebialem highlands while *Gnetum spp.*, *Pennisetum purpureum*, *Lomariopsis guineensis*, and *Amaranthus dubius* were highly consumed as well. The Asteraceae was the most dominant of the wild vegetables used in the study area. Similarly, of the 30 medicinal plants documented by Fonge *et al.* [15], the Asteraceae was the most commonly used plant family in the area of study. Also, Tardio *et al.* [31] reported that the Asteraceae showed the greatest number of species used as green vegetables in Spain.

All plants that were recorded as vegetables in this study are cosmopolitan agricultural weeds. These weedy vegetables grow naturally and abundantly in farmlands, abandoned gardens, along rivers and many other ecological areas where they usually occur as weeds and can exist independently of direct human action. However, the term ‘uncultivated’ does not necessarily imply a total absence of human influence because plants may be collected from common property areas in some regions but protected and managed in home gardens in other areas [32]. Some of the species that have been introduced into home gardens and agricultural fields, as they are crucial for the daily needs of the locals include: *Vernonia amygdalina*, *Commelina benghalensis*, *Ocimum gratissimum*, *Amaranthus dubius*, *Justicia insularis*, *Rumex*

crispus and *Solanum nigrum*.

The study showed that for the 26 species recorded, the leaves are the plant parts generally consumed as vegetable. This result agrees with Kebu and Fassil [33] and Fentahun and Hager [29] who reported fruit and leaves as major edible parts harvested or collected from the wild. Maroyi [30] reaffirmed that the plant parts identified as important sources of food are edible fruits, leaves and young shoots cooked as vegetables in Zimbabwe. For the case of *Pennisetum purpureum* locally called *Ntison*, the very young tender shoots are the plant parts consumed. The matrixes of the matured shoots are used for preparing the special soup called *ofe achara* by the Ngwa and Umuahia people of Abia State, in South Eastern Nigeria [34]. Based on local uses, the fundamental groups of wild plants were identified to be cooked as vegetable and used as spice in Nepal, the most frequently used parts being young shoots and leaves [35]. Other studies have also reported wild vegetables to have multiple functions as food and medicine as well as being of cultural or economic importance [16, 36-37]. Of the seven different food categories considered by Tardio *et al.* [31], green vegetables formed the largest group.

Wild vegetables are consumed boiled, stir-fried, parboiled and eaten raw. For the most consumed wild vegetables species, leaves of *Amaranthus dubius* are parboiled and stir-fried while leaves of *Vernonia amygdalina* are either cooked or parboiled and stir-fried. The leaves of *Gnetum* species and *Lomariopsis guineensis*, are finely chopped and cooked while the very tender shoots of *Pennisetum purpureum* are stir-fried. Maroyi [30] also reported that although the methods of utilization of vegetables vary from one household to another, boiling, steaming and frying were common and cross-cutting in almost all households surveyed. Young leaves and shoots were boiled with salt and fried in cooking oil with other ingredients such as tomatoes and onions.

Most of the vegetable species are used to prepare soups, followed by the use as potherbs, food spices, wrappings, salads and as soup thickeners. Leaves of *Ocimum gratissimum*, *Echinop giganteus*, *Piper guineense* and *Aframomum melegueta* are particularly used as spices and wrappings for foods. Studies by Tardio *et al.* [31] revealed that plants frequently used for seasoning are mostly species of the Lamiaceae, such as *Origanum vulgare*. Young leaves of *Leucanthemum vulgare* and *Portulaca oleracea* are eaten raw as salads while those of *Malva neglecta* are used as soup thickeners. Most vegetables and fruits have been reported to be consumed in a similar manner in other regions of the world [38]. Previous research on wild plants in Zimbabwe showed a wide range of uses, indicating that households have a broad knowledge of wild plants and their uses [39]. These results correlate strongly with the findings of Campbell [20], who found wild edible plants to be consumed raw and consumed either while walking or working in the fields.

Ethnobotanical information gathered in the Lebaleme highlands showed that a majority of the wild vegetable species are used to treat gastrointestinal diseases,

dermatological problems, parasitic and respiratory disorders, as well as gynaecological problems. Focho *et al.* [40] also reported that in the rural community, child birth is of great importance and gynaecological problems are treated with a variety of plants including *Vernonia amygdalina*. The methods of preparation of the phytomedicine from wild vegetables in the study area vary with infusion being the most widely used method followed by poultice and concoction.

Upreti *et al.* [35] also reported that among the wild plants studied, most of the species were predominately used to prepare medical remedies. These medicinal remedies were used to treat gastro-intestinal disorders, skin disorders, cough and cold, ear problems, and eye troubles. The medicinal properties of wild edibles in the past included their contribution to health by adding variety to the human diet. Many wild plants were probably a good source of vitamins and minerals, especially for children, when cultivated fruits and vegetables were not as easily available as they are today [31]. Apart from food and medicinal values, most of the wild vegetables identified in the study area especially *Pterocarpus mildbraedii*, *Vernonia amygdalina* and *Pennisetum purpureum* are used by the community for different purposes including as firewood, agricultural tools, fencing and a fodder for animals. Since there is no conservation practice employed in the localities, the practice of using these plants for these purposes is found destructive and a threat to wild edible plants. In this respect the present study is concurred with the result by Tigist [41] in dry land Ethiopia, who reported other uses of wild plants as fodder, fibre, fermenting material, thatching material, or fish poison. USDA [42] also reported *Pennisetum purpureum* as generally used as animal food, ornamental and for erosion control. This study also revealed that agricultural land expansions, wild fire, fuel wood collection, over grazing and over harvesting are the main reasons for the destruction of wild vegetables. Upreti *et al.* [35] reported that in Nepal wild plants are threatened due to various human activities and natural causes such as land use. Pairwise ranking revealed that wild edible plants are threatened mostly by habitat destruction, land-use change and over-harvesting. Similarly, uncultivated plants are over-exploited in other parts of the world [43-46]. During group discussions, decreasing forest cover, heavy dependency of people on these resources and illegal harvesting and trade were suggested as the major causes for perceived declining abundance of these species. These factors are also often cited as underlying causes of the decline in use of uncultivated resources in other studies [47, 48].

Despite the understanding of the local people about the importance of conserving the wild edible plants only some natural habitat conservation methods like planting in the form of fence to protected pasture land and demarcate farm margins are being practiced in the study area. This indicates that necessary conservation measures are not being taken into consideration in the area and hence the wild vegetables are not free of threats.

5. Conclusion

This study has revealed that the people of the Lebiale highlands continue to rely on wild vegetable species for consumption at times of food shortage and that these species have the potential to become valuable staple foods and important alternatives to the usual food crops cultivated by farmers. The wild vegetables were not only consumed for their nutritional value but they were also considered medicinal by the local people in the study area. *Lomariopsis guineensis* and *Pennisetum purpureum* are reported here for the first time as wild vegetables in Cameroon.

There are many choices of wild vegetable sources, but today many of them are neglected because of the preference towards uniform characteristics in modern agricultural technology. Therefore, it was of utmost importance to document the wild vegetables that are locally consumed in the area. Being found in the wild with an ability to highly resist drought, it can provide a cheap source of vegetable in alternative to cultivated vegetables during the dry season. Moreover, analysis of the use of species such as *Gnetum spp.* showed that there is a growing pressure on the wild resources especially as no conservation measures are being considered by the local people. There is need to determine the nutritional compositions of the wild vegetables and to validate the ethnomedicinal claims in the study area so as to enhance their exploitation.

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