

Traditional leafy vegetables and their use in the Benin Republic

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Abstract Seventy-three villages randomly selected in 29 ethnic areas and three regions or agro-ecological zones of Benin were investigated by a participatory rural appraisal survey to assess the diversity of the species used as traditional leafy vegetables (TLVs). In total, 187 plant species belonging to 141 genera and 52 families were recorded. Among these, 47 (25.13%) were cultivated and 140 (74.87%) were gathered from the wild. Herbs (64.78%) were the most numerous followed by shrubs (19.78%) and trees (15.50%). The Shannon–

Weaver diversity index calculated was 3.232. The total number of TLVs used highly varies, across ethnic groups, from 15 (Toli tribe) to 58 (people Mahi) with, on average, 36 species per ethnic group. The relative proportions of the wild and cultivated species used also vary with the tribes but on average appeared almost the same. Of the species inventoried, 18 of national importance were found among which *Solanum macrocarpon*, *Corchorus olitorius*, *Amaranthus cruentus* and *Gymnanthemum amygdalinum* ranked first. The matrix scoring technique yielded 12 criteria of different natures used to define preference. Among these, four (taste, ease of preparation, availability and quantity of required condiments) were the most important and represent, all together, more than 72% of responses. Despite the diversity of species used as leafy vegetables, they were all basically consumed in the same way. Sauces were the main type of preparation and involved all the species. The perceived nutritional and medicinal (curative, regulative and stimulative) properties of the species as well as their cultural significance were documented. Some TLVs are known and consumed by all or many ethnic groups while many others were simply ethno-specific or used by only a few peoples. However, no correlation was found between the distribution of the utilisation of the species and their degree of consumption which all depend on the eating habits of the peoples. Cluster analysis revealed that peoples sharing a common geographical space and/or cultural identity or origin seem to consume almost the same

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types of TLVs and cluster together. Given the large quantity of evidence of the importance of the TLVs, there should be a systematic effort to improve their understanding and their uses to reduce if not alleviate rural poverty and malnutrition in Benin.

Keywords Benin · Biodiversity · Ethnobotany · Leafy vegetables · Preference criteria · Utilisation

Introduction

There is great diversity of plants in sub-Saharan Africa that are used for food and other purposes (Okigbo 1977; Burkill et al. 1985; Almekinders and de Boef 2000). Akoègninou et al. (2006) reported for the flora of Benin a total of 2,807 plant species among which the traditional leafy vegetables (TLVs). TLVs are rich in vitamins (especially A, B, and C), minerals, fibres, carbohydrates and proteins and some even possess medicinal properties (Platt 1965; Chweya 1985; Stevels 1990; Mnzava 1997; Almekinders and de Boef 2000; Schippers 2002; Grubben and Denton 2004). They represent cheap but quality nutrition for large segments of the population in both urban and rural area of sub-Saharan Africa and offer an opportunity of improving the nutritional status of many families (Chweya and Eyzaguirre 1999).

The diversity of the African TLVs is enormous. Researchers in sub-Saharan Africa have listed and given an account of about 1,000 species (Getahun 1974; Chweya 1985; Guarino 1997; Mnzava 1997; Schippers and Budd 1997; Chweya and Eyzaguirre 1999; Schippers 2002). In Kenya alone more than 210 species of leafy vegetables are part of traditional diets and have not been fully exploited (Chweya and Eyzaguirre 1999). Many TLVs are unknown to us and many more are falling into disuse or are simply being lost leaving behind just a fraction of the most popular varieties and a growing dependence on foreign vegetables that are less nutritious and more dependent on pesticides and fertilizers. With regards to the importance of TLVs, the erosion of their genetic resources will have immediate consequences on the nutritional status and food security of the populations. For the potential of TLVs to be exploited to advantage, there is a need to understand their diversity, ethnobotany, indigenous knowledge and to preserve them.

To contribute to the documentation and conservation of the biodiversity of African TLVs, IPGRI initiated in 1997 a collaborative research project with researchers from five countries (Botswana, Cameroon, Kenya, Senegal, and Zimbabwe) across sub-Saharan Africa (Chweya and Eyzaguirre 1999). Benin, unfortunately, was not included. In Benin, the rare research activities conducted on vegetables and reported to date are concerned only with aspects of agronomic evaluation and plant protection on foreign vegetables such tomato, pepper, and *Amaranthus* (INRAB 2006). Therefore, the diversity of the TLVs used is still unknown and their associated ethnobotanic and indigenous knowledge are not documented anywhere for use by researchers or development agencies. Neglect by scientific research and development will surely lead to a decline in their production, consumption and diversity and this will have significant impact on the incomes of women farmers and the nutritional status of their households. To avoid such a situation, our research unit initiated a research programme to promote the use and conservation of TLVs in Benin. We report in this paper the results of a survey conducted throughout the country in order to:

- Compile an inventory of the species of plants consumed as leafy vegetables and document their status (cultivated, wild), degree of consumption, variation across ethnic groups, period of availability, mode of utilisation, cultural significance as well as their perceived nutritional and medicinal value
- Identify the most preferred species and the criteria used to define this preference
- Analyze the similarities between ethnic groups in terms of species consumed.

Material and methods

The study area

The Republic of Benin is situated in West Africa and between the latitudes 6°10' N and 12°25' N and longitudes 0°45' E and 3°55' E (Adam and Boko 1993). It covers a total land area of 112,622 km² with a population estimated at about 7 millions (Adomou 2005). The country is partitioned into 12 departments (Fig. 1) inhabited by 29 ethnic groups (Adam and

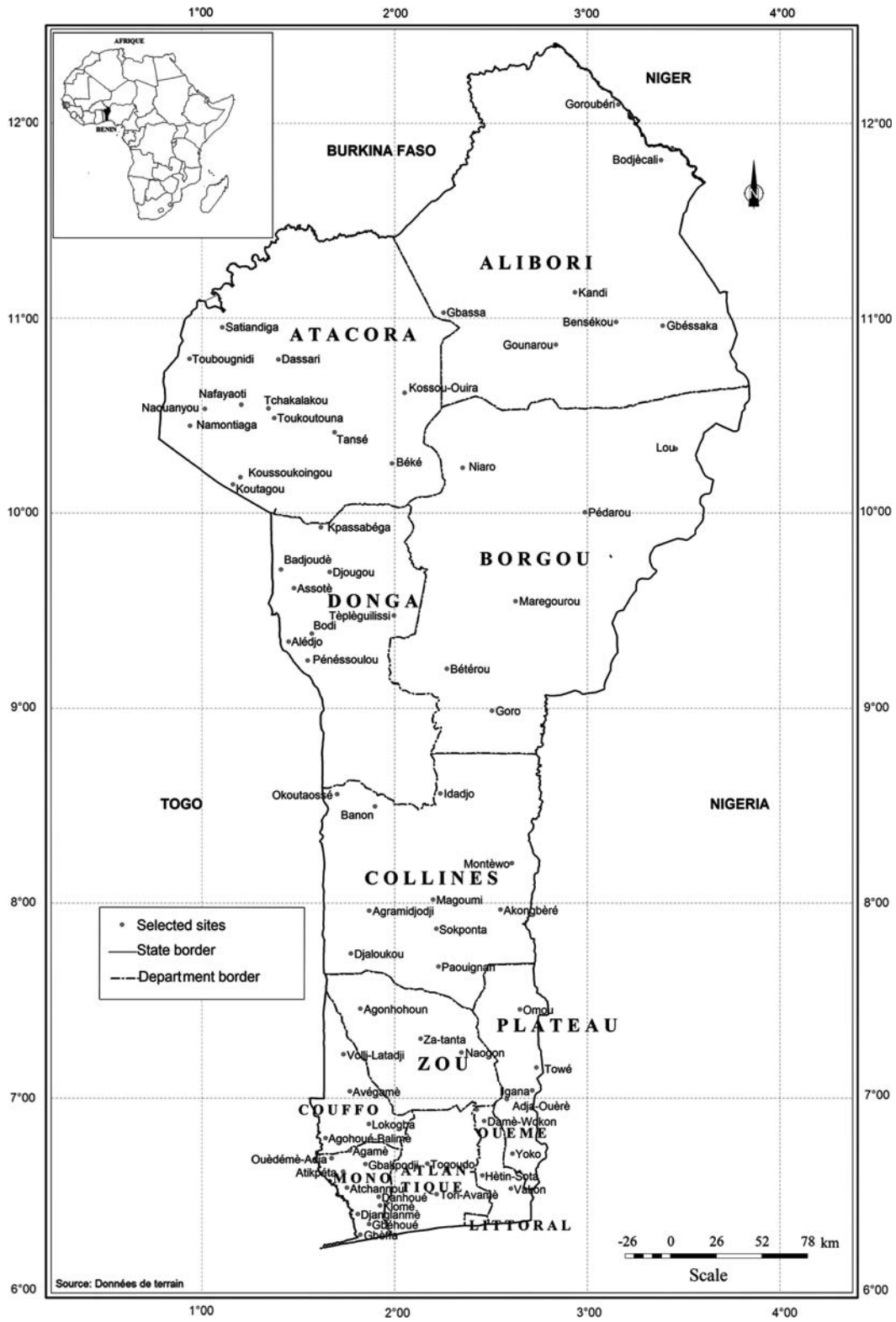


Fig. 1 Benin map showing the sites selected and surveyed

Boko 1993). The south and the north where peoples are more diverse and concentrated are occupied respectively by 10 (Adja, Cotafof, Holly, Ouémègbé, Péda, Saxwè, Toli, Watchi, Xwla, Yorouba) and 14 (Ani, Bariba, Berba, Boko, Dendi, Ditamari, Gourmantché, Kotokoli, Lokpa, M'bermin, Natimba, Peulh, Wama) ethnic groups while the centre is shared by only 5 (Fè, Fon, Idatcha, Mahi, Tchabè).

The south and the centre are relatively humid agro-ecological zones with two rainy seasons and mean annual rainfall varying from 1,100 to 1,400 mm/year (Adam and Boko 1993). The north is situated in arid and semi arid agro-ecological zones characterized by unpredictable and irregular rainfall oscillating between 800 and 950 mm/year with only one rainy season. Mean annual temperatures range from 26 to 28°C and may exceptionally reach 35–40°C in the far northern localities (Adomou 2005; Akoègninou et al. 2006). The country has 2,807 plant species (Akoègninou et al. 2006). Vegetation types are semi-deciduous forest (south), woodland and savannah woodland (centre-east and northeast), dry semi deciduous forest (centre-west and south of northwest) and tree and shrub savannahs (far north).

Site selection and survey

For the country to be sufficiently covered and for an exhaustive biodiversity inventory, 73 villages located in diverse agro-ecological (humid, semi arid, arid) and ethnic zones were randomly selected (Table 1; Fig. 1). Spatial extent of the ethnic zones is highly variable (sometime just a village) and the number of selected villages (which vary from 1 to 10 per zone) was adjusted accordingly (Table 1). Three selected sites (Djougou, Kandi, Satiandiga) are inhabited each by two different communities. Data were collected during expeditions from the different sites through the application of Participatory Research Appraisal tools and techniques such as direct observation, group discussions, individual interviews and field visits using a questionnaire (Adoukonou-Sagbadja et al. 2006). Interviews were conducted with the help of translators from each area. As TLVs is mainly women's affair, they were the potential respondents in the study although men were not excluded. In each site, local women's organisations were involved in the study to facilitate the organisation of the meetings and the data collection. Prior to the meeting, farmers were requested in advance to bring

samples of the vegetables they used or knew about. The particulars of the area (agro-ecological zone, name of location, name of sub-location, name of village, ethnic group) were first collected after detailed presentation of the research objectives to the farmers. Then, farmers were asked to list (vernacular name) and display the different types of TLVs consumed in their village. Through discussion, some key information was recorded on each of species inventoried. These are: status (wild, cultivated), type of plant (tree, shrub, and herb), habitat, season of availability and consumption, degree of consumption (importance of the species), perceived nutritional value, cultural importance and medicinal properties. Scientific names were determined using the Analytic Flora of Benin (Akoègninou et al. 2006) and pictures were taken for catalogue and report. The taxonomy and nomenclature of certain species were updated following Hanelt (2001), Jeffrey (1967), Jeffrey and Hanelt 2004) and Kubitzki (2007). Field (home gardens, cultivated fields, bushes, shallows) visits were conducted to see some of the TLVs under cultivation in their natural habitat.

At each site, the different species identified were classified by the population into two groups (important and less important) according to their degree of consumption. Using the matrix scoring technique (Kamara et al. 1996; Defoer et al. 1997; Chweya and Eyzaguirre 1999; Adoukonou-Sagbadja et al. 2006) and on an individual basis, important species were ranked and the preference criteria were identified and prioritized. At regional (north, centre and south) level, only species that are importantly consumed by all the ethnic groups were considered as important and classified by summing up their various rank positions across ethnic areas within the regions. Species found important for at least one region were considered as of national priority and ranked as described above. Importance of preference criteria was measured by the number of times a criterion was mentioned as an important basis for preferring a species within each site and across ethnic areas and regions. Individual interviews were conducted in each site with 20 women randomly selected in different households.

Data analysis

Data were analysed through descriptive statistics (frequencies, percentages, means, etc.) to generate summaries and tables at different (villages, ethnic

Table 1 Ethnic areas, sites surveyed and their localisation

No.	Ethnic areas	Regions	Number of sites	Selected villages
1	Adja	Southwest	4	Agohoué-Balimè, Avégamè, Lokogba, Voly-Latadji
2	Ani	Northwest	2	Bodi, Pénésoulou
3	Bariba	Northeast	10	Béké, Bétérou, Gbassa, Goro, Gounarou, Kandi, Kossou-ouira, Niaro, Pédarou, Tansé
4	Berba	Northwest	3	Dassari, Satiandiga, Toubougnidi,
5	Boko	Northeast	2	Bensékou, Gbéssaka
6	Cotafon	Southwest	4	Agamè, Atikpéta, Djanglanmè, Ouèdèmè-adja
7	Dendi	North	4	Bodjékali, Djougou, Goroubéri, Kandi
8	Ditamari	Northwest	2	Koussoukoingou, Koutagou
9	Fè	Centre	3	Banon, Djaloukou, Okoutaossé
10	Fon	South and centre	2	Agonhohoun, Za-tanta
11	Gourmantché	Northwest	1	Satiandiga
12	Holly	Southeast	3	Igana, Towé, Yoko
13	Idasha	Centre	2	Magoumi, Sokponta
14	Kotokoli	Northwest	1	Alédjo
15	Lokpa	Northwest	2	Assotè, Badjoudè
16	M'bermin	Northwest	2	Namontiaga, Naouangou
17	Mahi	Centre	3	Agramidjodji, Naogon, Paouignan
18	Natimba	Northwest	2	Nafayaoti, Toukountouna Centre
19	Ouémaingbé	Southeast	3	Damè-wokon, Hétin-sota, Vakon
20	Péda	Southwest	2	Klomè, Ouèdèmè-Péda
21	Peulh	Northeast	2	Lou, Marégourou
22	Saxwè	Southwest	2	Danhoué, Gbakpodji
23	Tchabè	Centre	3	Akongbèrè, Idadjo, Montèwo
24	Toli	Southeast	2	Togoudo, Tori-avamè
25	Wama	Northwest	2	Perpoyakou, Tchakalakou
26	Watchi	Southwest	2	Atchannou, Gbéhoué
27	Xwla	Southwest	1	Gbèffa
28	Yom	Northwest	3	Djougou, Kpassabega, Tépéguilissi
29	Yorouba	Southeast	2	Adja-ouèrè, Omou

areas and regions) levels. Shannon–Weaver diversity index (H) was computed for the whole country following Shannon and Weaver (1948).

To analyse the relationships between peoples in term of species consumed, ethnic groups were considered as individuals and the plant species as variables and scored for each group as 1 when consumed or 0 if not. Using this methodology, 187 variables were created and a binary matrix was compiled. Pairwise distances between ethnic groups were computed by NTSYS-pc 2.2 (Rohlf 2000), using Jaccard coefficient of similarity (Jaccard 1908). Similarity matrix was used to design a dendrogram

using UPGMA cluster analysis (Sneath and Sokal 1973; Swofford and Olsen 1990).

Results and discussions

Species diversity, distribution and degree of consumption

The ethnobotanical surveys revealed a great diversity of plant species used as TLVs in Benin. A total of 187 species (Appendix 1) belonging to 141 genera and 52 families (Table 2) were inventoried and

Table 2 Number of plant genera and species per family

No.	Family	Number of genera	Number of species
1	Acanthaceae	03	03
2	Aizoaceae	01	01
3	Alliaceae	01	01
4	Amaranthaceae	08	12
5	Annonaceae	03	03
6	Araceae	02	02
7	Asclepiadaceae	03	03
8	Asteraceae	17	19
9	Basellaceae	01	01
10	Bombacaceae	03	03
11	Boraginaceae	02	02
12	Brassicaceae	01	01
13	Burseraceae	01	01
14	Capparaceae	02	03
15	Celastraceae	01	01
16	Celtidaceae	02	02
17	Chenopodiaceae	01	01
18	Cochlospermaceae	01	01
19	Combretaceae	03	06
20	Commelinaceae	01	01
21	Convolvulaceae	03	08
22	Cucurbitaceae	08	13
23	Euphorbiaceae	06	07
24	Hydrophyllaceae	01	01
25	Lamiaceae	04	06
26	Leguminosae-Caesalpinioideae	07	09
27	Leguminosae-Papilionoideae	07	07
28	Loganiaceae	02	02
29	Loranthaceae	01	01
30	Malvaceae	04	06
31	Melastomataceae	01	01
32	Moraceae	02	08
33	Moringaceae	01	01
34	Myrtaceae	01	01
35	Nyctaginaceae	01	03
36	Onagraceae	01	01
37	Passifloraceae	01	01
38	Pedaliaceae	02	02
39	Poaceae	01	01
40	Polygalaceae	01	01
41	Portulacaceae	02	02
42	Rubiaceae	05	05
43	Sapindaceae	02	02
44	Solanaceae	04	09

Table 2 continued

No.	Family	Number of genera	Number of species
45	Sphenocleaceae	01	01
46	Sterculiaceae	04	05
47	Tiliaceae	02	06
48	Urticaceae	01	01
49	Verbenaceae	04	04
50	Violaceae	01	01
51	Vitaceae	02	03
52	Zygophyllaceae	01	01

documented. Among the 52 families, the five most important were the Asteraceae (19 species), the Cucurbitaceae (13 species), the Amaranthaceae (12 species), the Leguminosae-Caesalpinioideae (nine species) and the Solanaceae (nine species). The remaining 47 families have from only one (Basellaceae) to eight species (Convolvulaceae). Species found are composed of 29 trees (15.50%), 37 shrubs (19.78%) and 97 erect, creeping or climbing herbs (64.78%). This result highlighting the dominance of herbaceous plants is similar to those reported in Botswana, Cameroon, Kenya, Senegal and Zimbabwe (Chweya and Eyzaguirre 1999) and in Togo (Batawila 2005).

Out of the 187 species inventoried, 47 (25.13%) were cultivated in the fields or in the home gardens and 140 (74.87%) were gathered wild in the bushes, forests, savannahs and shallows. With regard to the results published by Chweya and Eyzaguirre (1999), the diversity of TLVs found in Benin appeared much higher than those of Cameroon (25 species) and Senegal (38 species) but lower than that of Kenya (220 species). The high dominance of wild species within the TLVs used indicates that in many regions of Benin life is still traditional and, in term of food, local communities remain dependant on nature. Within the total number of species consumed per ethnic group, the relative proportions of the wild and cultivated species were also variable but on average appeared almost the same. This result confirms once again the importance of wild TLVs in the household nutrition.

The number of TLVs recorded per ethnic group varies from 15 (Toli tribe) to 58 (Mahi tribe) with an average of 36 species (Table 3). A positive correlation seems to exist between the numbers of species

Table 3 Number of species consumed per ethnic group

No.	Ethnic groups	Total	Wild	Cultivated	Number of priority species		
					Total	Wild	Cultivated
1	Adja	42	23	19	27	10	17
2	Ani	54	36	18	23	11	12
3	Bariba	39	20	19	20	06	14
4	Berba	29	14	15	11	04	07
5	Boko	35	17	18	19	06	13
6	Cotafon	47	26	21	26	10	16
7	Dendi	33	15	18	10	02	08
8	Ditamari	45	23	22	15	08	07
9	Fè	37	20	17	23	09	14
10	Fon	52	26	26	20	03	17
11	Gourmantché	37	19	18	21	08	13
12	Holly	39	16	23	17	05	12
13	Idactha	44	24	20	27	11	16
14	Kotokoli	29	16	13	12	05	07
15	Lokpa	25	09	16	08	03	05
16	M'bermin	32	13	20	09	04	05
17	Mahi	58	32	26	23	06	17
18	Natimba	32	13	19	11	02	09
19	Ouémaingbé	19	09	10	10	01	09
20	Péda	27	07	20	18	02	16
21	Peulh	31	15	16	10	03	07
22	Saxwè	44	25	19	28	10	18
23	Tchabè	49	23	26	29	12	17
24	Toli	15	04	11	10	02	08
25	Wama	49	23	26	19	06	13
26	Watchi	37	20	17	18	06	12
27	Xwla	19	06	13	13	03	10
28	Yom	35	19	17	08	04	04
29	Yorouba	21	08	13	13	03	10

consumed by a given ethnic group and the importance of the vegetation that exist in the area where it is located. For example, the lower values were recorded with peoples located in the relatively most developed zones (Ouémaingbé, Toli) or along a lake (Xwla, Péda) while the highest values were found with the tribes situated in vegetation rich zones like the Ani and the Mahi.

Within species variability was reported for eight TLVs (*Amaranthus cruentus*, *Celosia argentea*, *Ceratotheca sesamoides*, *Corchorus olitorius*, *Gynnanthemum amygdalinum*, *Solanum aethiopicum*, *Solanum macrocarpon*) used only for their leaves. Germplasm collection and characterization focusing

on these species should be conducted to explore exhaustively this intraspecific diversity.

The distribution and the degree of consumption of the species (Appendix 1) highly vary across ethnic areas. Certain species like *Celosia argentea*, *Cleome gynandra* and *Colocasia esculenta* are consumed by many (at least 50 pc of the tribes) ethnic groups while some like *Alternanthera sessilis* and *Basella alba* are used by few ethnic groups. Many others like *Aspilia africana* and *Manihot glaziovii* are even ethnospecific. Taking into account the various degrees of consumption of the species throughout the ethnic areas where they were known, it appeared that certain species are globally highly consumed while some are

of low importance. Sometimes, what is a favoured vegetable in one area may be virtually unknown in that capacity elsewhere, even though it might be found there. Combining these two levels of consideration (number of tribes consuming and degree of consumption), the species inventoried can be classified into four groups (A, B, C, D; Appendix 1) following the Four Squares Analysis approach described by Brush (2000), Tuan et al. (2003):

Group A: Species known as TLVs by many ethnic groups and highly consumed.

Group B: Species known as TLVs by many ethnic groups but lowly consumed.

Group C: Species known as TLVs by only few ethnic groups but highly consumed.

Group D: Species known as TLVs by only few ethnic groups and also lowly consumed.

The first (A) groups together 17 species (Appendix 1) while six (*Abelmoschus esculentus*, *Colocasia esculenta*, *Ocimum basilicum*, *Senna occidentalis*, *Solanum scabrum* and *Talinum triangulare*) fall into group B, 33 into group C and 131 into D (Appendix 1). From the biodiversity conservation viewpoint, TLVs of groups A and C (50 in total) are not threatened whereas those of group B and mostly D are endangered. Even if the species of this groups (predominantly wild) are not disappearing, the indigenous knowledge pertaining to their production, harvest, preparation, cooking and use as leafy vegetables is seriously eroding. Because TLVs of group C are linked to some few particular ethnic groups, they are geographically well localised with regard to the three regions of the country. Hence, seven species are found every where while nine, five, four, six and two are specific respectively of the north, centre, south, south and centre, centre and north (Appendix 1).

At village or community level, TLVs were identified by their vernacular names. These names however vary from an ethnic area to another and rarely between villages within ethnic area. Frequently many ethnic groups use the same name to designate a particular species. For example *Alternanthera sessilis* is called Agoèman in Cotafon, Ouémaingbé, Saxwè, Watchi, and Yorouba. Sometime, the same name is given to two different species. Adjobodo means *Amaranthus cruentus* in Fè and *Celosia argentea* in Mahi and Tchabè. Both species are known under Affônou in Bariba. A total of 1,015 different vernacular names of TLVs were

recorded and can be obtained free of charge from the authors on request. For all the species inventoried, samples were collected and herbarium built up. In addition, seeds of the herbaceous species (mostly the cultivated ones) were also collected for further research. Short botanical descriptions of all the species are found in Akoègninou et al. (2006) while full and detailed descriptions of 74 species (marked with asterisk in Appendix 1) are available in Schippers (2002) and online in PROTA's free web-database (www.prota.org).

Priority species and ranking

From the study it was clear that many but not all of the species consumed were of high priority to the communities. The relative proportion of priority species which is about 48 pc on average varies from 28.12 pc with the M'bermin in the northwest to 68.42 pc with the Xwla in the southwest (Table 3). These values simply depend on the eating habits of the people in different areas as no clear correlation is observed between region (north, centre and south), agroecological (arid, semi arid, humid) zones and the proportions of priority species per ethnic group. Within the priority leafy vegetables, the number of cultivated species is, as expected, higher than that of the wild species in all the ethnic areas apart from the Yom area in which wild and cultivated species appeared in the same proportions (Table 3).

Ten species in the south, 11 in the centre and 11 in the north were identified as regional priority species and ranked as described above (Table 4). Although priority species differ more or less from one zone to another, about 40 pc of similarity is found between zones. In the south, apart from *Corchorus olitorius* which gives soup of slimy consistency, all the priority species are spinach. In the centre, three species out of the 11 identified are "slimy". In the north, four species of this nature were among the priority ones and even ranked first before all the spinach. These results are not surprising when one considers the eating habits of the people of these areas. In fact, central and mostly northern Benin are high yam producing and consuming zones and it is known (Dansi 2001; Mignouna and Dansi 2003), that pounded yam goes better with sauces of slimy consistency.

A total of 18 species of TLVs (Table 4) were considered as of national priority and classified into

Table 4 Species of national and regional importance and their ranking

Species	Zone rank			Overall rank
	South	Centre	North	
Class A				
<i>Solanum macrocarpon</i>	1	1	5	1
<i>Corchorus olitorius</i>	2	2	4	2
<i>Amaranthus cruentus</i>	6	4	6	3
<i>Gymnanthemum amygdalinum</i>	3	3	11	4
Class B				
<i>Ceratotheca sesamoides</i>	n.a.	5	3	5
<i>Vigna unguiculata</i>	4	n.a.	9	6
<i>Ocimum gratissimum</i>	9	6	n.a.	7
<i>Vitex doniana</i>	n.a.	8	8	8
<i>Celosia argentea</i>	7	n.a.	10	9
<i>Manihot esculenta</i>	8	9	n.a.	10
Class C				
<i>Adansonia digitata</i>	n.a.	n.a.	1	11
<i>Sesamum radiatum</i>	n.a.	n.a.	2	12
<i>Moringa oleifera</i>	5	n.a.	n.a.	13
<i>Crassocephalum rubens</i>	n.a.	7	n.a.	14
<i>Hibiscus sabdariffa</i>	n.a.	n.a.	7	15
<i>Launaea taraxacifolia</i>	10	n.a.	n.a.	16
<i>Solanum aethiopicum</i>	n.a.	10	n.a.	17
<i>Corchorus tridens</i>	n.a.	11	n.a.	18

n.a. = Not applicable

three classes (A, B and C) according to the number (3, 2 or 1) of zones in which they were considered as priority species. Class A gathers together four species (*Solanum macrocarpon*, *Corchorus olitorius*, *Amaranthus cruentus*, *Gymnanthemum amygdalinum*) that can be considered as the leafy vegetable of top high national priority. Many of the national priority species found in Benin are also known as such in other African countries (Chweya and Eyzaguirre 1999).

Preference criteria and ranking

Twelve preference criteria were identified through the comparison matrix exercise and are listed in Table 5. Although they are the same in all the ethnic areas, their relative importance however varies significantly according to the regions (Table 5). In the north for example, availability is the most important criterion but this is ranked third in the centre and

Table 5 Preference criteria and ranking

Criteria	Percentage of responses			Overall rank
	South	Centre	North	
Taste	26.12	20.61	20.44	1
Easy to prepare (less time)	27.54	22.33	13.26	2
Availability	8.52	18.18	22.51	3
Takes fewer condiments	10.5	14.85	16.25	4
Nutritional value (farmers' perception)	11.25	6.18	7.95	5
High market value	7.50	6.17	2.66	6
Gives soup of slimy consistency	0.40	4.78	10.05	7
Odour	2.51	3.25	1.66	8
Medicinal value	1.65	1.13	1.44	9
Taboos	2.20	0.19	1.50	10
Easy digestion and defecation	1.69	1.23	0.84	11
Goes with many starch foods	0.12	1.10	1.44	12

comes in fifth position in the south. The perceived nutritional value of the species which is somehow less important in central and northern Benin was classified third in the south. At national level, four criteria (taste, ease of preparation, availability and quantity of condiments required) out of 12 listed appeared as the most important and represent, all together, more than 72 pc of responses.

Taste is habitually the first criterion sought-after for all types of foods. Its first ranking here in the preference of leafy vegetables is not surprising.

Ease of preparation (ranked second) highlighted the lack of time with the women who are generally very busy by their daily occupations (field works, market, art and craft, etc.). Back in the house and already exhausted they no more have enough time to devote to cooking and prefer species such as *Adansonia digitata*, *Ceratotheca sesamoides*, *Corchorus olitorius* and *Sesamum radiatum* which are very easy to prepare.

Availability (ranked third) can be a key criterion in preferring TLVs as species are generally seasonal. For example, consumable fresh leaves of *Vitex doniana* and *Corchorus tridens* appear respectively only in the dry season and in the rainy season while certain species like *Adansonia digitata*, *Amaranthus cruentus*, *Ceratotheca sesamoides*, *Corchorus olitorius*, *Sesamum radiatum* and *Solanum macrocarpon* are available and generally free of charge (cultivated

in home gardens or gathered wild) all the year round in the fresh or dried form.

The quantity of condiments required (ranked fourth) to get a tasty sauce is a criterion highly linked to the poverty level of the communities. In the rural zones, households are quite often of high size and poor. In those conditions, preference goes for leafy vegetables that are free of charge and when cooked only with pepper, salt and traditional mustard can be eaten with appetite.

Due to intense activities of numerous NGOs, peoples in the south seem to be more aware of health in relation to nutrition than those in the centre and in the north and this may explain the importance given to the nutritional value in preferring TLVs in this region. Taboos without being true criteria related to the qualities of the species play an important role in the ethnic areas where animism is developed. In the southwest for example, the simple fact that a member of a household is a disciple of the divinity “Sakpata” is enough for the other members of this household to never prepare *Launaea taraxacifolia* even if it is their most preferred leafy vegetable. The other criteria are relatively less important and highlighted only in particular circumstances.

Preparation, nutritional and medicinal value of the TLVs

Despite the diversity of species used as leafy vegetable, they are all basically consumed in the same way. Sauces are the main type of preparation and involve all the species. However, it appeared from the surveys that the vegetables are prepared differently. Leaves are generally consumed fresh but also in dried form. In the north, where drying of vegetables is a common practice, leaves of *Adansonia digitata*, *Ceratotheca sesamoides* and *Sesamum radiatum* are dried, pounded and sieved into powder in the rainy season when they are abundant for use during the dry season when fresh leaves are scarce. Globally three types of preparation of fresh leaves were reported.

- (1) Leaves are shredded, cut up, washed thoroughly by crushing between the hands to get out some of the bitterness or acidity, boiled in water to which potash has been added, rinsed sometimes more than once depending on the bitterness and the acidity of the leaves and cooked in tomato,

egusi, groundnut or bean base sauce. Species concerned are *Cyanthillium cinereum*, *Gymnanthemum amygdalinum* and *Hibiscus* sp.

- (2) Leaves are washed by rubbing between the hands, sliced and cooked in soups with a little potash to give slimy consistency. Species concerned are *Abelmoschus esculentus*, *Ceratotheca sesamoides*, *Corchorus* spp. and *Sesamum radiatum*
- (3) Leaves (of variable quantity depending on the species) are washed by rubbing between the hands, sliced, boiled (with or without potash) or directly ground into paste and put into tomato, egusi, groundnut or bean base sauces to thicken, enrich, garnish and/or to give a particular taste and aroma. This last mode is applied to all the remaining species such as *Amaranthus* spp., *Asystasia gangetica*, *Cleome gynandra*, *Crassocephalum rubens*, *Ocimum basilicum* and *Vitex doniana*. When cooked, the leafy vegetables are served as the main accompaniment to the starchy staple (rice, pounded yam, pounded cassava, paste of sorghum, millet, maize, yam and cassava chips etc.).

In Benin, many TLVs are believed (farmers' perception) to possess special nutritional qualities. In the south, *Cleome gynandra* is eaten by breast-feeding mothers to stimulate milk production and regain lost blood during deliverance and *Moringa oleifera* is regularly consumed by the pregnant women to prevent anaemia. In the north and in the centre, *Adansonia digitata*, *Ceratotheca sesamoides* and *Sesamum radiatum* are said, when regularly consumed, to give stoutness and facilitate good growth, dentition and bones' solidification in the children.

According to communities, some TLVs have curative, regulative and stimulative properties besides food qualities and are sometimes used as nutraceutical. Soups of *Cissus populnea*, *Hibiscus sabdariffa* and *Launaea taraxacifolia* were said to be aphrodisiac. *Adansonia digitata* regularises women's menstrual cycle and heart beat, *Acmella uliginosa* facilitates the elimination of blood clots in women after delivery. Diseases cured through regular consumption of specific leafy vegetable and reported through the survey include sores (*Basella alba*, *Heliotropium indicum*), stomach ache (*Grewia lasiodiscus*), intestinal worms (*Acmella uliginosa*, *Ocimum gratissimum*), anaemia (*Cassia occidentalis*), coughs and cold (*Hibiscus sabdariffa*), measles (*Momordica charantia*), blood

pressure (*Lippia multiflora*), post-delivery infection (*Acmella uliginosa*, *Ocimum gratissimum*), diarrhoea (*Grewia lasiodiscus*, *Hybanthus enneaspermus*), stomach ulcer (*Ehretia cymosa*), vomiting (*Momordica charantia*), icterus (*Jatropha curcas*), variola (*Cassia occidentalis*), varicella (*Cassia occidentalis*), constipation (*Hibiscus asper*, *Gymnanthemum amygdalinum*), diabetes (*Moringa oleifera*, *Ocimum gratissimum*). Leafy vegetables therefore contribute to both household nutrition and health.

Cultural significance of some TLVs

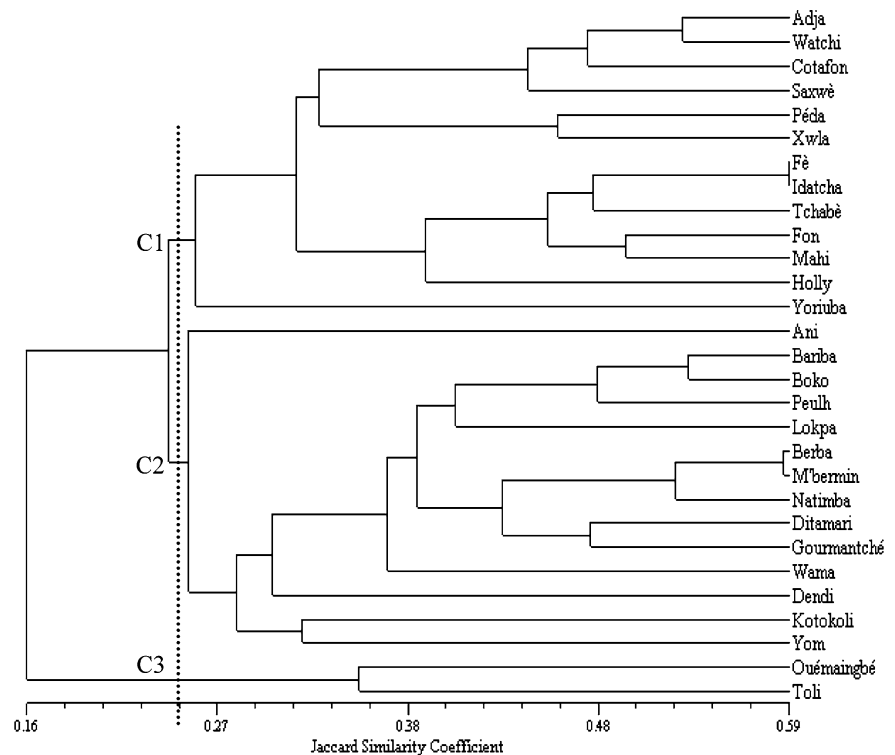
In southern and northwestern Benin where fetishism (traditional religion) is well developed, certain TLVs are prohibited to the followers of some divinities. Species reported were *Ipomea aquatica* (Divinity Dan), *Solanum nigrum* (Divinity Hèvioisso), *Corchorus tridens* and *Launaea taraxacifolia* (Divinity Sakpata). With the Adja, Cotafof and Saxwè tribes, a patient affected by measles should never eat *Bidens pilosa* (which is though a species of high priority for these tribes) as this may aggravate the sickness. In the northwest, hunters and men having supernatural power should not eat soup of *Cerathoteca sesamoides*.

According to the elders, this TLV reduces considerably visual acuity and the force of the occult powers. If this declaration holds true, some biochemical analyses may be necessary to search for the eventual presence of substance that may be dangerous for the good functioning of eyes as the species is widely consumed in the north.

Relationship between ethnic groups

At a cut-off point of 25 pc of similarity, the dendrogram drawn from a hierarchical cluster analysis yielded three clusters C1, C2 and C3 (Fig. 2). C2 detaches all the northern tribes from those of the centre and of the south grouped together in C1 apart from Toli and Ouémaingbé classified in cluster C3. Under C1 and C3 some groupings based on common geographical localisation, cultural identity and/or historical linkages are observed. Hence, the six tribes (Adja, Watchi, Cotafof, Saxwè, Péda and Xwla) sharing the southwest and having moreover the same origin (Ghana and Togo) according to Adam and Boko (1993) appeared together. The same reasons justify the subgroup constituted by the peoples Berba, M'bermin, Natimba, Ditamari and Gourmantché

Fig. 2 Relationship between ethnic groups as revealed by UPGMA cluster analysis



originated from both Republic of Togo and Burkina Faso (Adam and Boko 1993) and inhabiting the far northwest of Benin. Central Benin is also well identified by the subgroup composed of the tribes Fè, Idatcha, Tchabè, Fon and Mahi. The presence of the ethnic groups Holly and Yorouba of the southeast in the cluster C1 and mostly with those of central Benin was expected considering the origin and the evolution of these peoples. Fè, Idatcha, Tchabè and Holly are all derived from the mother group Yorouba originated from Oyo (Nigeria) and which, from the southeast, migrated to, scattered and diversified in, central Benin (Adam and Boko 1993). Ouémaingbé and Toli are the two native tribes of the southeast and also culturally very close. It was expected that they consumed almost the same types of TLVs and therefore cluster together. Within the compartment of the northern tribes, the people Ani seems to be little different. They are in fact characterised by 10 species (Appendix 1) that they do eat, in one way or another, as neutraceutical TLVs mainly for the mothers' and the children's health.

Conclusion

The study revealed the existence in Benin of a high diversity (187 species) of plants (both wild and cultivated) used as TLVs and which contributes highly to household nutrition and health. The species consumed and their degrees of consumption on one hand and the most preferred species and the criteria used to define this preference on the other hand are all functions of the tribes and vary from one region to another. Multivariate cluster analysis has shown similarity between ethnic groups, in term of species consumed, based on shared geographical space but also on the cultural linkages. The study focuses on diversity inventory and analysis. However, more research is still needed to come up with data on variation within TLVs species as this was not exhaustively explored. Given the quantity of large

evidence of the importance of these species, from this and other studies, there should be a systematic effort to improve their understanding and their uses to reduce if not alleviate rural poverty and malnutrition in Benin. Some pertinent areas of research should include:

- Nutritional study and the toxicological analysis of the species
- Morphological characterisation and agronomic evaluation of varieties within polymorphic species
- Detailed ethnobotanic and socioeconomic surveys to document indigenous knowledge pertaining to, and prioritise factors affecting, the production, storage, conservation of biodiversity, marketing and utilisation of the TLVs
- Study of the ongoing domestication process of *Cleome gynandra* and *Corchorus tridens* and domestication trials on the wild but important herbaceous species such as *Alternanthera sessilis*, *Ceratotheca sesamoides*, *Crassocephalum rubens*, *Launaea taraxacifolia* and *Talinum triangulare*
- Development of appropriate agronomic practices (plant densities, time of planting, number of harvests; type, quantities and time of application of fertilisers, etc.) for intensive production and diversification among farmers of *Justicia tenella*, *Sesamum radiatum*, *Solanum scabrum* and *Telfairia occidentalis*.

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Appendix 1

List of the plant species used as leafy vegetable in Benin

Nos.	Scientific names	Families	NE	DC	TP	Status	PA
Group A							
01*	<i>Adansonia digitata</i> L.	Bombacaceae	24	High	Tree	Wild	RS
02*	<i>Amaranthus cruentus</i> L.	Amaranthaceae	29	High	Herb	Cultivated	AS
03*	<i>Celosia argentea</i> L.	Amaranthaceae	24	High	Herb	Cultivated	AS
04*	<i>Ceratotheca sesamoides</i> Endl.	Pedaliaceae	22	High	Herb	Wild	RS
05*	<i>Cleome gynandra</i> L.	Capparaceae	18	High	Herb	Cultivated	RS
06*	<i>Corchorus olitorius</i> L.	Tiliaceae	29	High	Herb	Cultivated	AS
07*	<i>Corchorus tridens</i> L.	Tiliaceae	22	High	Herb	Cultivated	RS
08*	<i>Gymnanthemum amygdalinum</i> (Delile) Walp.	Asteraceae	29	High	Shrub	Cultivated	AS
09*	<i>Hibiscus sabdariffa</i> L.	Malvaceae	18	High	Herb	Cultivated	RS
10	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	25	High	Shrub	Cultivated	AS
11*	<i>Moringa oleifera</i> Lam.	Moringaceae	23	High	Tree	Cultivated	AS
12	<i>Ocimum gratissimum</i> L.	Lamiaceae	28	High	Herb	Cultivated	AS
13*	<i>Sesamum radiatum</i> L.	Pedaliaceae	15	High	Herb	Cultivated	RS
14*	<i>Solanum aethiopicum</i> L. Group Shum.	Solanaceae	19	High	Herb	Cultivated	AS
15*	<i>Solanum macrocarpon</i> L.	Solanaceae	29	High	Herb	Cultivated	AS
16*	<i>Vigna unguiculata</i> (L.) Walp.	Leguminosae- Papilionoideae	24	High	Herb	Cultivated	RS
17	<i>Vitex doniana</i> Sweet	Verbenaceae	22	High	Tree	Wild	DS
Group B							
18*	<i>Abelmoschus esculentus</i> * (L.) Moench	Malvaceae	26	Low	Herb	Cultivated	RS
19*	<i>Colocasia esculenta</i> (L.) Schott	Araceae	17	Low	Herb	Cultivated	RS
20	<i>Ocimum basilicum</i> L.	Lamiaceae	17	Low	Herb	Cultivated	AS
21	<i>Senna occidentalis</i> (L.) Link	Leguminosae- Caesalpinioideae	16	Low	Herb	Wild	RS
22*	<i>Solanum scabrum</i> Mill.	Solanaceae	18	Low	Herb	Cultivated	RS
23*	<i>Talinum triangulare</i> (Jacq.) Willd.	Portulacaceae	22	Low	Herb	Wild	RS
Group C							
24 S	<i>Acalypha ciliata</i> Forssk.	Euphorbiaceae	02	High	Herb	Wild	RS
25*N	<i>Acmella oleracea</i> (L.) Jansen	Asteraceae	05	High	Herb	Cultivated	RS
26*SC	<i>Alternanthera sessilis</i> (L.) R.Br. ex Roth	Amaranthaceae	08	High	Herb	Wild	AS
27*	<i>Amaranthus dubius</i> Mart. ex Thell.	Amaranthaceae	12	High	Herb	Wild	RS
28*CN	<i>Anogeissus leiocarpa</i> (DC.) Guill. et Perr.	Combretaceae	02	High	Tree	Wild	RS
29*	<i>Bidens pilosa</i> L.	Asteraceae	04	High	Herb	Cultivated	RS
30	<i>Blighia sapida</i> König	Sapindaceae	08	High	Tree	Wild	AS
31 SC	<i>Bombax costatum</i> Pellegr. et Vuillet	Bombacaceae	06	High	Tree	Wild	RS
32*N	<i>Brassica oleracea</i> L.	Brassicaceae	01	High	Herb	Cultivated	AS
33*S	<i>Capsicum annuum</i> L. (Chillies Group)	Solanaceae	02	High	Herb	Cultivated	RS
34	<i>Cissus populnea</i> Guill. et Perr.	Vitaceae	12	High	Herb	Wild	RS
35*SC	<i>Cleome ruidosperma</i> DC.	Capparaceae	05	High	Herb	Wild	RS
36*	<i>Crassocephalum rubens</i> (Juss. ex Jacq.) S. Moore var. <i>rubens</i>	Asteraceae	11	High	Herb	Cultivated	RS
37 C	<i>Dalbergia saxatilis</i> Hook. f.	Leguminosae- Papilionoideae	02	High	Shrub	Wild	RS

Appendix 1 continued

Nos.	Scientific names	Families	NE	DC	TP	Status	PA
38 SC	<i>Deinbollia pinnata</i> (Poir.) Schumach. et Thonn.	Sapindaceae	05	High	Shrub	Wild	RS
39	<i>Ficus abutilifolia</i> (Miq.) Miq.	Moraceae	02	High	Tree	Wild	RS
40 C	<i>Ficus asperifolia</i> Miq.	Moraceae	02	High	Tree	Wild	RS
41 N	<i>Ipomoea triloba</i> L.	Convolvulaceae	01	High	Herb	Wild	RS
42 N	<i>Isobertinia doka</i> Craib et Stapf	Leguminosae- Caesalpinioideae	01	High	Tree	Wild	RS
43 CN	<i>Justicia tenella</i> (Nees) T. Anderson	Acanthaceae	11	High	Herb	Wild	RS
44	<i>Laportea aestuans</i> (L.) Chew	Urticaceae	05	High	Herb	Wild	RS
45*SC	<i>Launaea taraxacifolia</i> (Willd.) Amin ex C. Jeffrey	Asteraceae	13	High	Herb	Wild	RS
46*N	<i>Lepistemon owariense</i> (P. Beauv.) Hallier f.	Convolvulaceae	01	High	Herb	Wild	RS
47 C	<i>Lippia multiflora</i> Moldenke	Verbenaceae	05	High	Shrub	Wild	RS
48 N	<i>Luffa aegyptiaca</i> Mill.	Cucurbitaceae	02	High	Herb	Wild	RS
49 S	<i>Macrosphyra longistyla</i> (DC.) Hiern	Rubiaceae	02	High	Shrub	Wild	RS
50 C	<i>Manihot glaziovii</i> Müll. Arg.	Euphorbiaceae	01	High	Shrub	Cultivated	AS
51 N	<i>Milicia excelsa</i> (Welw.) C.C. Berg	Moraceae	01	High	Shrub	Wild	RS
52 S	<i>Mirabilis jalapa</i> L.	Nyctagynaceae	01	High	Herb	Wild	AS
53 N	<i>Pandiaka involucrata</i> (Moq.) Hook. f.	Amaranthaceae	01	High	Herb	Wild	RS
54 C	<i>Securidaca longepedunculata</i> Fresen.	Polygalaceae	01	High	Shrub	Wild	RS
55 N	<i>Sida garckeana</i> Pol.	Malvaceae	01	High	Herb	Wild	RS
56*SC	<i>Telfairia occidentalis</i> Hook. f.	Cucurbitaceae	09	High	Herb	Cultivated	RS
Group D							
57	<i>Aerva lanata</i> (L.) Juss. ex Schult.	Amaranthaceae	01	Low	Herb	Wild	RS
58	<i>Azelia africana</i> Sm.	Leguminosae- Caesalpinioideae	02	Low	Tree	Wild	RS
59	<i>Ageratum conyzoides</i> L.	Asteraceae	01	Low	Herb	Wild	RS
60	<i>Allium cepa</i> L.	Alliaceae	01	Low	Herb	Cultivated	AS
61	<i>Alternanthera brasiliana</i> (L.) Kuntze	Amaranthaceae	02	Low	Herb	Wild	RS
62*	<i>Amaranthus spinosus</i> L.	Amaranthaceae	09	Low	Herb	Wild	RS
63	<i>Annona senegalensis</i> Pers.	Annonaceae	04	Low	Tree	Wild	RS
64	<i>Aspilia africana</i> (Pers.) Adams	Asteraceae	01	Low	Herb	Wild	AS
65*	<i>Asystasia gangetica</i> (L.) T. Anders.	Acanthaceae	06	Low	Herb	Wild	RS
66*	<i>Basella alba</i> L.	Basellaceae	06	Low	Herb	Cultivated	RS
67*	<i>Boerhavia diffusa</i> L.	Nyctaginaceae	10	Low	Herb	Wild	AS
68*	<i>Boerhavia erecta</i> L.	Nyctaginaceae	03	Low	Herb	Wild	RS
69*	<i>Caesalpinia bonduc</i> (L.) Roxb.	Leguminosae- Caesalpinioideae	01	Low	Shrub	Cultivated	AS
70*	<i>Cajanus cajan</i> (L.) Millsp.	Leguminosae- Papilionoideae	01	Low	Shrub	Cultivated	RS
71	<i>Capsicum frutescens</i> L. Groupe piment oiseau (Bird Pepper Group)	Solanaceae	07	Low	Shrub	Cultivated	RS
72	<i>Ceiba pentandra</i> (L.) Gaertn.	Bombacaceae	11	Low	Tree	Wild	RS
73*	<i>Celosia trigyna</i> L.	Amaranthaceae	14	Low	Herb	Wild	RS
74	<i>Celtis toka</i> (Forssk.) Hepper et J.R.I. Wood	Celtidaceae	01	Low	Tree	Wild	RS
75*	<i>Centrostachys aquatica</i> (R.Br.) Wall.	Amaranthaceae	01	Low	Herb	Wild	RS
76	<i>Chassalia kolly</i> (Schumach.) Hepper	Rubiaceae	02	Low	Shrub	Wild	RS
77	<i>Chenopodium ambrosioides</i> L.	Chenopodiaceae	01	Low	Herb	Cultivated	AS

Appendix 1 continued

Nos.	Scientific names	Families	NE	DC	TP	Status	PA
78	<i>Chromolaena odorata</i> (L.) R.M. King	Asteraceae	01	Low	Herb	Wild	RS
79	<i>Chrysanthellum indicum</i> DC. ssp. <i>afro-americanum</i> B.L. Turner	Asteraceae	03	Low	Herb	Wild	RS
80	<i>Cienfuegosia heteroclada</i> Sprague	Malvaceae	01	Low	Herb	Wild	RS
81*	<i>Cissus palmatifida</i> (Baker) Planch.	Vitaceae	01	Low	Herb	Wild	RS
82	<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	04	Low	Herb	Cultivated	RS
83*	<i>Citrullus lanatus</i> (Thunb.) Matsum. et Nakai	Cucurbitaceae	03	Low	Herb	Cultivated	RS
84	<i>Cochlospermum planchonii</i> Hook. f.	Cochlospermaceae	01	Low	Herb	Wild	RS
85	<i>Cola millenii</i> K. Schum.	Sterculiaceae	01	Low	Tree	Wild	AS
86	<i>Combretum collinum</i> Fresen.	Combretaceae	01	Low	Tree	Wild	AS
87	<i>Combretum comosum</i> G. Don var. <i>hispidum</i> (M.A. Lawson) Jongkind	Combretaceae	01	Low	Tree	Wild	AS
88	<i>Combretum racemosum</i> P. Beauv.	Combretaceae	01	Low	Tree	Wild	RS
89*	<i>Commelina benghalensis</i> L.	commelinaceae	04	Low	Herb	Wild	RS
90	<i>Commiphora africana</i> (A. Rich.) Engl. var. <i>africana</i>	Burseraceae	01	Low	Shrub	Wild	RS
91*	<i>Corchorus aestuans</i> L.	Tiliaceae	02	Low	Herb	Cultivated	RS
92	<i>Crateva adansonii</i> DC. ssp. <i>adansonii</i>	Capparaceae	04	Low	Shrub	Wild	AS
93	<i>Croton lobatus</i> L.	Euphorbiaceae	05	Low	Herb	Wild	RS
94*	<i>Cucumeropsis mannii</i> Naud.	Cucurbitaceae	03	Low	Herb	Cultivated	RS
95*	<i>Cucurbita maxima</i> Duchesne	Cucurbitaceae	02	Low	Herb	Cultivated	RS
96*	<i>Cucurbita moschata</i> Duchesne	Cucurbitaceae	06	Low	Herb	Cultivated	RS
97*	<i>Cucurbita pepo</i> L.	Cucurbitaceae	05	Low	Herb	Cultivated	RS
98	<i>Cyanthillium cinereum</i> (L.) H. Rob.	Asteraceae	02	Low	Shrub	Cultivated	AS
99	<i>Cymbopogon giganteus</i> (Hochst.) Chiov.	Poaceae	06	Low	Herb	Wild	RS
100*	<i>Cyphostemma adenocaula</i> (Steud.) Desc.	Vitaceae	09	Low	Herb	Wild	DS
101	<i>Daniellia oliveri</i> (Rolfe) Hutch. et Dalziel	Leguminosae-Caesalpinioideae	01	Low	Shrub	Wild	RS
102	<i>Dialium guineense</i> Willd.	Leguminosae-Caesalpinioideae	01	Low	Shrub	Wild	DS
103	<i>Dyschoriste perrottetii</i> (Nees) Kuntze	Acanthaceae	01	Low	Herb	Wild	RS
104	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	01	Low	Herb	Wild	RS
105	<i>Ehretia cymosa</i> Thonn. ex Schumach. var. <i>cymosa</i>	Boraginaceae	01	Low	Shrub	Wild	RS
106	<i>Emilia praetermissa</i> Milne-Redh.	Asteraceae	03	Low	Herb	Wild	RS
107	<i>Euphorbia hirta</i> L.	Euphorbiaceae	01	Low	Herb	Wild	RS
108	<i>Ficus artocarpoides</i> Warb.	Moraceae	01	Low	Tree	Wild	RS
109	<i>Ficus ingens</i> (Miq.) Miq.	Moraceae	02	Low	Tree	Wild	RS
110	<i>Ficus polita</i> Vahl	Moraceae	04	Low	Tree	Wild	RS
111	<i>Ficus sur</i> Forssk.	Moraceae	05	Low	Shrub	Wild	RS
112	<i>Ficus sycomorus</i> L.	Moraceae	03	Low	Shrub	Wild	RS
113	<i>Gardenia ternifolia</i> Schumach. et Thonn.	Rubiaceae	02	Low	Shrub	Wild	RS
114*	<i>Gmelina arborea</i> Roxb.	Verbenaceae	01	Low	Tree	Wild	RS
115	<i>Gomphrena celosioides</i> Mart.	Amaranthaceae	01	Low	Herb	Wild	RS
116	<i>Grewia carpinifolia</i> Juss.	Tiliaceae	01	Low	Tree	Wild	RS
117	<i>Grewia lasiodiscus</i> K. Schum.	Tiliaceae	04	Low	Shrub	Wild	RS
118*	<i>Grewia mollis</i> Juss.	Tiliaceae	07	Low	Shrub	Wild	RS

Appendix 1 continued

Nos.	Scientific names	Families	NE	DC	TP	Status	PA
119	<i>Gymnanthemum coloratum</i> (Willd.) H. Rob. et B. Kahn	Asteraceae	05	Low	Shrub	Wild	AS
120	<i>Gymnosporia senegalensis</i> (Lam.) Loes.	Celastraceae	01	Low	Shrub	Wild	RS
121	<i>Hallea stipulosa</i> (DC.) J.-F. Leroy	Rubiaceae	01	Low	Shrub	Wild	RS
122*	<i>Heliotropium indicum</i> L.	Boraginaceae	13	Low	Herb	Wild	RS
123	<i>Hexalobus monopetalus</i> (A.Rich.) Engl. et Diels	Annonaceae	01	Low	Shrub	Wild	RS
124*	<i>Hibiscus asper</i> Hook. f.	Malvaceae	14	Low	Herb	Wild	RS
125	<i>Hoslundia opposita</i> Vahl	Lamiaceae	02	Low	Herb	Wild	RS
126	<i>Hybanthus enneaspermus</i> (L.) F. Muell.	Violaceae	01	Low	Herb	Wild	RS
127	<i>Hydrolea ghabra</i> Schum. et Thonn.	Hydrophyllaceae	01	Low	Herb	Wild	RS
128	<i>Hyptis lanceolata</i> Poir.	Lamiaceae	04	Low	Herb	Wild	RS
129*	<i>Ipomoea aquatica</i> Forssk.	Convolvulaceae	09	Low	Herb	Wild	AS
130*	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	11	Low	Herb	Cultivated	RS
131*	<i>Ipomoea eriocarpa</i> R. Br.	Convolvulaceae	02	Low	Herb	Wild	RS
132	<i>Ipomoea mauritiana</i> Jacq.	Convolvulaceae	01	Low	Herb	Wild	RS
133	<i>Ipomoea vagans</i> Baker	Convolvulaceae	03	Low	Herb	Wild	RS
134*	<i>Jacquemontia tamnifolia</i> (L.) Griseb.	Convolvulaceae	05	Low	Herb	Wild	RS
135*	<i>Jatropha curcas</i> L.	Euphorbiaceae	01	Low	Shrub	Cultivated	AS
136	<i>Lagenaria breviflora</i> (Benth.) Roberty	Cucurbitaceae	01	Low	Herb	Wild	RS
137*	<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae	11	Low	Herb	Cultivated	RS
138*	<i>Leptadenia hastata</i> (Pers.) Decne.	Asclepiadaceae	08	Low	Herb	Wild	AS
139*	<i>Ludwigia decurrens</i> Walt.	Onagraceae	01	Low	Herb	Wild	RS
140*	<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae	01	Low	Herb	Wild	RS
141*	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	12	Low	Herb	Cultivated	AS
142	<i>Melanthera scandens</i> (Schumach. et Thonn.) Roberty	Asteraceae	01	Low	Herb	Wild	RS
143	<i>Melastomastrum segregatum</i> (Benth.) A. et R. Fern.	Melastomataceae	01	Low	Herb	Wild	RS
144*	<i>Melochia corchorifolia</i> L.	Sterculiaceae	03	Low	Herb	Wild	AS
145	<i>Mikania chenopodiifolia</i> Willd.	Asteraceae	01	Low	Herb	Wild	RS
146	<i>Momordica charantia</i> L.	Cucurbitaceae	08	Low	Herb	Wild	RS
147	<i>Momordica cissoides</i> Planch. ex Benth.	Cucurbitaceae	02	Low	Herb	Wild	AS
148	<i>Ocimum americanum</i> L.	Lamiaceae	04	Low	Herb	Cultivated	AS
149	<i>Ormocarpum semnoides</i> (Willd.) DC. ssp. <i>hispidum</i> (Willd.) Brenan et J. Léonard	Leguminosae-Papilionoideae	01	Low	Herb	Wild	RS
150	<i>Passiflora foetida</i> L.	Passifloraceae	04	Low	Herb	Wild	AS
151*	<i>Pentodon pentandrus</i> (Schumach. et Thonn.) Vatke	Rubiaceae	01	Low	Herb	Wild	RS
152	<i>Pergularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae	04	Low	Herb	Wild	RS
153	<i>Phaseolus vulgaris</i> L.	Leguminosae-Papilionoideae	01	Low	Herb	Wild	RS
154	<i>Phragmanthera kamerunensis</i> (Engl.) Balle	Loranthaceae	01	Low	Shrub	Wild	RS
155	<i>Phyllanthus amarus</i> Schumach. et Thonn.	Euphorbiaceae	02	Low	Herb	Wild	RS
156	<i>Physalis angulata</i> L.	Solanaceae	01	Low	Herb	Wild	RS
157	<i>Piliostigma reticulatum</i> (DC.) Hochst.	Leguminosae-Caesalpinioideae	01	Low	Shrub	Wild	RS
158	<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh.	Leguminosae-Caesalpinioideae	01	Low	Shrub	Wild	RS
159	<i>Platostoma africanum</i> P. Beauv.	Lamiaceae	01	Low	Herb	Wild	RS

Appendix 1 continued

Nos.	Scientific names	Families	NE	DC	TP	Status	PA
160*	<i>Portulaca oleracea</i> L.	Portulacaceae	04	Low	Herb	Wild	RS
161	<i>Psidium guajava</i> L.	Myrtaceae	01	Low	Tree	Cultivated	RS
162*	<i>Psophocarpus palustris</i> Desv.	(Leguminosae- Papilionoideae)	01	Low	Shrub	Wild	RS
163	<i>Pterocarpus santalinoides</i> L'Hér. ex DC.	Leguminosae-Papilionoideae	01	Low	Tree	Wild	RS
164	<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae	01	Low	Herb	Wild	RS
165	<i>Sclerocarpus africanus</i> Jacq. ex Murr.	Asteraceae	01	Low	Herb	Cultivated	RS
166	<i>Secamone afzelii</i> (Schult.) K. Schum.	Asclepiadaceae	01	Low	Herb	Wild	RS
167*	<i>Senna obtusifolia</i> (L.) H.S. Irwin et Barneby	Leguminosae- Caesalpinioideae	04	Low	Herb	Wild	RS
168	<i>Sida rhombifolia</i> L. ssp. <i>rhombifolia</i>	Malvaceae	01	Low	Herb	Wild	RS
169*	<i>Solanum americanum</i> Mill.	Solanaceae	01	Low	Herb	Wild	RS
170*	<i>Solanum dasyphyllum</i> Schumach. et Thonn.	Solanaceae	01	Low	Herb	Wild	RS
171	<i>Sphenoclea zeylanica</i> Gaertn.	Sphenocleaceae	01	Low	Herb	Wild	AS
172	<i>Spigelia anthelmia</i> L.	Loganiaceae	01	Low	Herb	Wild	RS
173	<i>Stachytarpheta indica</i> (L.) Vahl	Verbenaceae	09	Low	Herb	Cultivated	RS
174	<i>Sterculia setigera</i> Delile	Sterculiaceae	01	Low	Tree	Wild	RS
175	<i>Sterculia tragacantha</i> Lindl.	Sterculiaceae	08	Low	Tree	Wild	DS
176*	<i>Sparaganophorus sparganophora</i> (L.) C. Jeffrey	Asteraceae	07	Low	Shrub	Wild	AS
177	<i>Strychnos spinosa</i> Lam.	Loganiaceae	01	Low	Shrub	Wild	RS
178	<i>Stylochaeton lancifolius</i> Kotschy et Peyr.	Araceae	01	Low	Herb	Wild	RS
179	<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	01	Low	Herb	Wild	RS
180	<i>Terminalia glaucescens</i> Planch. ex Benth.	Combretaceae	01	Low	Tree	Wild	RS
181	<i>Terminalia superba</i> Engl. et Diels	Combretaceae	01	Low	Tree	Wild	RS
182	<i>Trema orientalis</i> (L.) Blume	Celtidaceae	01	Low	Shrub	Wild	RS
183*	<i>Trianthema portulacastrum</i> L.	Aizoaceae	01	Low	Herb	Wild	RS
184	<i>Tribulus terrestris</i> L.	Zygophyllaceae	01	Low	Herb	Wild	RS
185	<i>Tridax procumbens</i> L.	Asteraceae	01	Low	Herb	Wild	RS
186*	<i>Triplochiton scleroxylon</i> K. Schum.	Sterculiaceae	01	Low	Tree	Wild	RS
187	<i>Uvaria chamae</i> P. Beauv.	Annonaceae	01	Low	Shrub	Wild	RS

NE: Number of ethnic group consuming the species; DC: degree of consumption; TP: type of plant; PA: period of availability of the consumable fresh leaves; RS: rainy season; DS: dry season; AS: all season; * described in PROTA database and/or Schippers (2002); N: north; S: south; C: centre

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