



Ethnobotanical and Socio-economics of *Dracaena camerooniana* Baker in Uíge Province, Northern Angola

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Authors' contributions

This work was carried out in collaboration among all authors. Author MM collected data, performed the statistical analysis and wrote the first draft of the manuscript. Author DCA collected the data. Author LN supervised the study and participated in editing the manuscript. Author NKN managed the literature searches. Authors LL participated in editing of the paper. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The aim of this research was to contribute to the survey of ethnobotanical knowledge on the use of *Dracaena camerooniana* by the local communities' bordering the tropical forests of Uíge province.

Study Design: The data collections were carried out using the semi-structured interview method. The approach methods are an ethnobotanical and socio-economics surveys populations of the study area.

Place and Duration of Study: The study was undertaken in the province of Uíge, Republic of Angola, from April 2016 to March 2018, period that covers the dry and rainy season.

Methodology: The surveys consisted in drafting a questionnaire beforehand to apprehend the knowledge and multiples uses of *D. camerooniana* among the surrounding population. The interview were conducted in Kikongo language and in Portuguese according to the mastered by the people surveyed.

Results: The findings show that tropical forest zones of Congolese guinea/Zambian located in Uíge Province, is full of high value non-wood forest products (NWFPs) including *D. camerooniana* Baker (locally called *Nzala bakala* or *Nsala bakala*). This plant species is a wild green vegetable essence appreciated by the local population and is an additional source of financial income for subsistence farmers and Hunter-gatherers. Knowledge of *D. camerooniana* consumption was transmitted from generation to generation by oral tradition. The study also shows that *D. camerooniana* is well known and used by the local communities of Uíge. Finally, the consumption and commercialization of NWFPs, such as the leaves of *D. camerooniana* contribute in strengthening nutrition, health, food diversity, income and livelihoods.

Conclusion: Despite its importance in food security and socioeconomic terms in both rural and urban areas, few scientific researchers have been fully interested in its valorization. In addition, the phytochemical studies should be carried out to discover the nutritional, toxic, and medicinal properties of this plant.

Keywords: *Dracaena camerooniana*; economic value; ethnobotany; Northern Angola; Uíge province.

1. INTRODUCTION

Forests act as a source of food, medicine and fuel for more than a billion people. In addition to helping to respond to climate change and protect soils and water, forests hold more than three-quarters of the world's terrestrial biodiversity, provide many products and services that contribute to socio-economic development, and are particularly important for hundreds of millions of people in rural areas, including many of the world's poorest [1]. More than half of Africa's population depends on natural forest resources [2]. Regarding to Brian et al., [3] therefore, non-timber forest products may offer sources of income and opportunities for poverty alleviation in both rural and urban areas. They assessed the total amount of foods produced from trees, the wild foods gathered and animals hunted from forests, and the forest resources used in generating non-farm income and wage employment and estimated that between 60 and 70% of the population in developing countries live and work near forested areas, and many households subsist, in part, by collecting forest products. According to the Food and Agriculture Organization of the United Nations (FAO) [4] Non-wood Forest Products (NWFPs) are a real treasure trove, both nutritionally (in terms of carbohydrate, protein, fat, vitamins and minerals) and medicinally. NWFPs help contributing to food self-sufficiency [5] and

security [6]. In Angola, more precisely in the northern province of Uíge, NWFPs continue to ensure the survival of thousands of community members living in poverty, especially those in the rural areas and also in peripheral-urban neighborhoods [7].

Forests of Uíge Province in northern Angola are full of high value NWFPs, including *Dracaena camerooniana* Baker, a wild vegetable appreciated by the local population, and an additional source of financial income for subsistence farmers and hunter-gatherers. Furthermore, they constitute a reservoir of firewood for heating [8], handicrafts [8,9], building materials and furniture [8], instruments of music folkloric and religious [8]; edible [8,9], medicinal plants [8,9], rituals [9] and wild animals [8].

D. camerooniana is a monocotyledon plant belonging to the family Asparagaceae [10] and grows in African tropical forests [11]. As for its use, there are only two references for it in the literature. The leaves are used to cover ulcers in Liberia helping sores to heal [11]. According to Biloso and Lejoly [12], the leaves are edible and sold in the Democratic Republic of Congo (DRC).

As far as Angola is concerned, there are no ethnomedicinal or socio-economic studies based on this wild plant, notwithstanding its high value

as a food in the province of Uíge. Furthermore, local communities threaten this species with extinction due to uncontrollable clearing of land for subsistence agriculture. This has led to its gradual disappearance from tropical forests. The aim of this research was to document the ethnobotanical knowledge related to the use of *D. camerooniana* by local communities in the tropical forests of Uíge. This was done by looking specifically at the indigenous knowledge of the local population related to harvest techniques, ways of preparation and preservation. In addition, this study also looked at identifying the difference stakeholders of *D. camerooniana* (gatherer, vendor, and consumer) chain in the research area. Lastly, it evaluated the socio-economic importance of the harvest of the *D. camerooniana* in the livelihood of subsistence farmers and hunter-gatherers. This investigation is important to promote wild food biodiversity and the endogenous know-how of local communities of Uíge province and also to fill the gaps in the bibliography on the food use of wild plants in this part of Angola.

2. MATERIALS AND METHODS

2.1 Study Area

The study area of Uíge Province (Fig. 1) was chosen after a pre-survey that confirmed the existence of wild growing *D. camerooniana* in this region. Uíge Province is located in Northern Angola and has a population of over 1.4 million inhabitants [13] and 11 ethnic Bakongo sub-groups: Bacongós, Gingas, N'golas, Muzombos, Muxicongos, Maiacas, Mahungos, Sossos, Massucos, Pombos and Punas [14]. According to the Köppen climate classification, the province has a tropical wet or dry or savannah climate Aw [15,16]. This Guineo-Congolian rainforest climate is characterized by a rainy

season, which lasts more than six months. A precise description of the region was defined by White [17] who classified Angola as north, between the Guineo-Congolian and the Zambezi Regions, calling it the Guinea-Congolia/ Zambezi regional transition zone. The hydrography of Uíge is one of the richest in Angola, composed of rivers, streams, lagoons and marshy areas. According to Monizi et al., [8], the relief consists of plains (Loge Valley, for example) and mountainous areas (e.g. Pingano mountain range, Kananga mountain range). Barbosa [18] differentiated the area into six vegetation zones characterized by the mosaic of dense forests, gallery forests, mosaic of forests and savanna, semi-deciduous rainforests, cloud forest, etc. Most of the population depend widely of shifting agriculture on slash-and-burn as the main source food, employment, and income, filling their daily needs. However, about 85 – 90% of the rural population in Angola depends entirely on subsistence farming, hunting and gathering of natural resources such as insects [19]. The opinion on the shifting agriculture has been supported by researches carried out by, [7 –9,20-22] in this province during their relative researches related to medicinal and edible plants and NWFPs. According to Göhre et al., [21], beside deforestation reported uncontrolled burning caused by growing agriculture activities. Under the anthropogenic activities, the forests give way to certain invasive species, such as *Chromolaena odorata*, *Inga edulis*, *Tithonia diversifolia*, grass genus (*Hypparrhenia*), etc. [7,9,21,23]. The gathering was never the main source of food, employment and income of the rural households of Uíge, it is practiced occasionally. Uíge province benefits from edaphoclimatic (vast arable lands and excellent rainfall) and it has also a dense hydrographic network which waters the region.

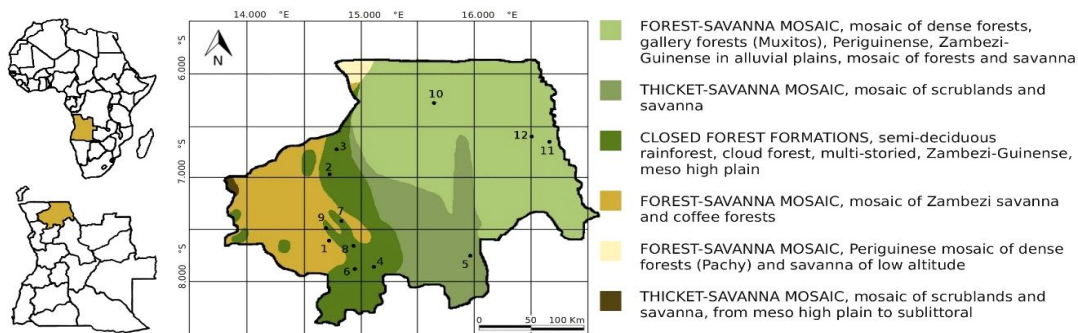


Fig. 1. Phytogeographic location of the host forest of the *D. camerooniana* in Uíge province.
 Legend: 1. Kanga; 2. Ngandu; 3. Nengembwa; 4. Ambuila-quitexe; 5. Kazundu; 6. Zonda; 7. Toma kuiza; 8. Pigano; 9. Nzenze; 10. Matadi; 11. Kibanda; 12. Mansema

2.2 Plant Material Collection and Identification

The collection of the plant materials on the field was done on the wild plants of *D. camerooniana* (Fig. 2a) commonly called in Kikongo language “Nsala bakala (Maiacas), Nsala yakala (Maiacas, Sossos), Nzala bakala (Muxicongos), Nsala bayakala (Muxicongos), Nsala batata (Muzombos), Nsala munsambu (Muzombos), Nkulala (Muzombos) or still Nsala bakento (Muzombos)” collected in humid rain forests in the Guinea-congolia/Zambeian zone of Uíge province. The organs exploited from this plant for food purposes are the leaves (Fig. 2b), and the tuberous roots (Fig. 2c). The specimen was taxonomically identified and at the Institute of Botany, Technische Universität Dresden, where a voucher specimen (No. 056361) of *D. camerooniana* was deposited.



Fig. 2a: *D. camerooniana* plant



Fig. 2b: Leaves of *D. camerooniana*



Fig. 2c: Tuberous roots of *D. camerooniana*

2.3 Methods

2.3.1 Population study

The target population was selected based on their availability and their interest to this study. The method opted is the ethnobotanical survey applied by [24-27] and the study design was a purposive sampling. It consists firstly, to write a questionnaire which allowed to understand the multiple uses of the *D. camerooniana* among the population of Uíge province. Data collection was done through direct observation, according to Biloso and Lejoly [12] and semi-structured interviews, either individually or in focus groups. In the case of group interviews the method described by Wentholt et al., [28] was applied, which consists of questioning men and women separately. The questionnaire was submitted orally to 285 respondents, whereby 175 were consumers, 75 gatherers and 35 sellers all inhabitants of this study community. The field survey was carried out between April 2016 and March 2018, period which covers the dry and rainy season.

2.3.2 Questionnaire

The questionnaire was divided into three sections: (i) personal information (including age, gender, marital status, education level, location and main activity); (ii) plant material (including plant vernacular); (iii) food practice (including preference in human food, preparation and consumption mode, mode and place of selling, cost, consumption and conservation mode, income generation).

2.3.3 Ethnobotanical and socio economic survey

Ethno-botanical information about the plant species reported in this study was obtained by interviewing informants on the use of different parts of the plant during field trips conducted in Uíge province. The aim was to know the usefulness of the parts of this plant as human food, the consumption and preparation mode, the consumption preference, the mode and location of selling. In total, 285 informants at twelve sites (Fig. 1) were interviewed. Informants were selected for their authentic knowledge on the utilization of medicinal plants. Local languages Kikongo and Portuguese were used during anthropological interviews. The selection criteria of the surveyed people was based on the age of informants (between 20 and 65 years old) who had sufficient knowledge on the species under investigation and uses this plant in their daily lives, and who were available at the time of the survey.

2.3.4 Data analysis

The collected ethnobotanical data were analyzed using descriptive statistics. Microsoft Excel and SPSS (Statistical Package for Social Sciences) version 19.0 software were used for the analysis.

3. RESULTS AND DISCUSSION

3.1 Profile of the Respondents of *D. camerooniana* Chain in Uíge

The NWFP chain in Uíge province consists of three main types of stakeholders (gatherer, seller, and consumer). The latter ones are part of all the social strata of the local community. According to the collected results, the age of *D. camerooniana* chain stakeholders, it can be seen that the ages of the respondents as gatherers is higher (47 years old) than all the other stakeholders, which ranges between 41 and 38 years for sellers and consumers respectively (Table 1).

The Table 1 summarizes the data about the typology of the respondents of *D. camerooniana* chain in Uíge province, located in Northern Angola.

The analysis of the results in Table 1 shows that in Uíge province, men and women are actively involved in gathering NWFPs, including *D. camerooniana* leaves. But, it happens that in this activity, men are the greatest craftsmen (87%) than women (Fig. 4b), who occupy less than 1/4 in the joint of gatherers, that's 13 percent. This can be explained to the fact that the majority of men who practice the gathering of *D. camerooniana* are hunters (Fig. 3). This later often conduct the gathering alone, during the hunting with guns or when checking out animal traps. On the other hand, women very seldom do their gathering in accompaniment of their husbands; they would have gone with a relative or acquaintance for safety, because forests are isolated places and dangerous due to the presence of wild animals.

Moreover, the results of the Table 1 shows that the gathering; the commerce, and consumption of the NWFPs whose *D. camerooniana* leaves attract the attract the educated as well as those who have never attended any school with respectively 75.67 and 24.33%. These results are in accordance with the those by Monizi et al. [16], which showed that the great part (95 percent) of NWFPs stakeholders whose chain

Raphia wine in Northern Angola is integrated by literate people.



Fig. 3. Hunter-gatherers of *D. camerooniana*

In Northern Angola, particularly in Uíge Province, the commerce empire of the NWFPs is won over by women. The commercialization of the NWFPs is assured by the family members of the exploiters who are in general their spouses or sons.

Moreover, the commercialization of NWFPs which are destined for food whose *D. camerooniana* is in majority won over by women with 92 percent. Men only occupy less than one-tenth of the total workforces that is 8 percent. These remarks are closer to the ones by Monizi et al. [20] in Uíge province in Northern Angola, that 83 percent of NWFPs sellers especially *Raphia wine* are women. Whereas in Congo Brazzaville, Loubelo [6], showed that NWFP sellers are in majority women. While in Cameroon, N'doye et al. [29], showed that 94 percent of the people who work in commercial sector of NWFPs are feminine gender. Still in Cameroon, Tchatat et Ndoye [30]; Betti et al. [31] attest that the commercialization of NWFP is an activity in majority practiced by women. Finally, these remarks are in agreement with those reported by FAO [4] that in Central Africa the commercial sector of NWFP is dominated over 80 percent by women.

It was also revealed that the commercialization of *D. camerooniana* leaves is done in short and long marketing network. In relation with the consumption of wild NWFPs for food, the *D. camerooniana* leaves are enjoyed by the all social strata of the local population of Uíge; from villagers or city-dwellers, to the odd-job man, public servant, from young to the oldman, from women to the men, illiterate to the literate and all the social strata.

In Uíge, the gathering activity was never the main source of income, employment and livelihoods of the rural households because the

gathering activity is practiced occasionally. On the other hand; the main activity of the gatherers is the shifting agriculture on slash and burn. This last one assures the food self-sufficiency, food security and diversity, and generate employments and income from the sells of the excedents crop products on the rural, suburbs and urban markets. These facts are in accordance with the ones by FAO [4] that in Central Africa the agriculture is in general of livelihoods destined to self-consumption and the selling of the excedents in rural, semi-rural and urban markets. According to Mawunu et al. [7] the agriculture constitutes the main source of income (95%) of the rural population of Ambuila Municipality in Northern Angola and the other sources of income are hunting and commerce which supplies respectively 4 and 1 percent. Following the same line of ideas, Kuedikuenda and Miguel [32], showed that in Angola the shifting agriculture is the main source of income and food in the rural communities. According to INE [13], showed that agriculture and fishing are the economic representative activities in Angola.

The results of this research have equally showed that apart from agriculture, other activities are practiced by the local communities of Uíge as a source of income and employment not only for rural households, suburbs and urban vulnerable.

3.2 Transfers of Knowledge and Know-how

The results revealed that the knowledge and the indigenous know-how on *D. camerooniana* are transmitted orally. Accordance with the works of Monizi et al. [20], the knowledge and techniques on the use of NWFPs are transmitted orally from mouth to the ear. In Cameroon, Kahane et al. [33], showed that the knowledge and traditional know-how “connected to food in tropical countries” are transmitted from generation to generation without written trace. In DRC, Liengola [34], reported that knowledge on the wild plants was slowly developed and accumulated, later kept and delivered from one generation to another, therefore the knowledge is at risk to disappearance because it is mainly transmitted orally.

3.3 D. camerooniana Collection Techniques

In Uíge province, the leaves of *D. camerooniana* are exploited by the population who live near

larger forest areas. The gathering of *D. camerooniana* leaves is done using uncovered hands, following two different ways:

The first technique consists of collecting only the large leaves of the stem and the smaller ones are left on the plant whereas the second technique consists of cutting the plants followed by leaf gathering. Scientifically this second technique is not sustainable and can contribute to the dead of the plant. However, the collectors are preferring it in order to gain time. According to Mawunu et al. [7], the local population of the municipality of Ambuila (Northern Angola) uses various techniques for gathering wild plant products: from picking only selected plant parts, through to pulling off the whole plant, peeling off the bark or felling trees. Some of these techniques as the felling and pull off plants are not sustainable and can cause a growing pressure on the remaining individuals, genetic erosion, and a decline of income.

In which concerns the keen interest of the local population on wild leafy vegetables as *D. camerooniana*, makes that in certain localities in Uíge province to collect a great quantity of leaves for sale, the gatherers spend many hours and walk long distances in the forests.

According to the people surveyed, the collected quantity of leaves varies from one gatherer to another, as well as from dry to rainy season, and it also depends on the quantity of plant individuals found.

D. camerooniana leaves are used for self-consumption as well as for sale. Our results are closer, elf-consumption (67%) and sales (33%) to those presented in Togo by Adjatan [35], that nearly 90% of the production or gathering is destined to self-consumption and the remaining are sold not only in rural but also urban markets.

According to the data of our surveys, the quantity of bundles of *D. camerooniana* leaves gathering in Uíge province varies from one to several tens. When farmers or hunter-gatherers collected one or two bundles, this quantity is reserve for self-consumption. In addition, beyond the two, the harvested products are destined for marketing. A bundle contains is on average 150 leaves and weighs an average of 1596 grams. Strong attraction due to Market value of *D. camerooniana* leaves in the region, the gatherers start cutting the plants, some do this unconsciously, whereas the others do this

for greed because one wants to collect great quantity of leaves in short time and make lots of Money. If collectors do not change their gathering techniques plant will disappear, the income will disappear. Official collection restrictions and limitations are needed. According to Loubelo [6], the intensity of the exploitation is a function of the domestic demand and commercial value of the product.

3.4 Means of Transportation of *D. camerooniana* Leaves

The gatherers of *D. camerooniana* leaves in Uíge province used vehicles as medium of transportation with the mean value of 71%, motorbike taxi 17 percent and carrying on heads (12%). These results are in accordance with Mawunu et al. [7] and Monizi et al. [20] who worked in the same region (Northern Angola) and showed that the transportation of NWFP is assured by many different transportation means. The vehicle is predominant, followed respectively by motorbike taxi, head and bicycle.

3.5 Ethno-nutritional Value of *D. camerooniana*

The data of our survey revealed that, the food use of *D. camerooniana* in Uíge province goes back to the 1950s period corresponding to the recruitment and training of the first anti-colonialist troops for the liberation of the country. During this war of independence, the soldiers used many wild NWFPs for their shelter, medication and food. The succulent tuberous roots of *D. camerooniana*, formerly called *Madioko ma mfinda* (Kikongo language), were consumed raw; at that time, the leaves of this plant were not yet used for human food.

However, the food use of *D. camerooniana* leaves as leafy vegetable goes back to the 1960s.

Currently, the local population of Uíge knows and consumes more the leaves than the roots of *D. camerooniana*.

The results of our ethno-botanical survey shows that only less than 1% percent among the surveyed people know the existence and the usage of *D. camerooniana* roots. They only consumed raw by men in form of snack after peeling, very often in forests to alleviate hunger and thirst. The roots are also consumed due to its presumed aphrodisiac virtue, which originated the name *Nsala bakala*, literally translated “*Masculine work*” that means strengthening the masculine sexual activity. *Nzala bakala* can also mean literally translated “*They were hungry*”, so due to the lack of foods they had to eat this wild leafy vegetable.

The leaves of *D. camerooniana* are cooked in water an average time of 30 to 45 minutes. They are very appreciated by the local population of Uíge due to its organoleptic characteristics (taste, texture, digestibility etc.). When compared to the cooked *Mfumbwa* (*Gnetum africanum*) leaves, the leaves of *D. camerooniana* are softer, more digestible and more appetizing. Our results also show that the use of wild food plants in daily life are part of socio-cultural patrimony of the Bakongo group of Uíge province. According to Bonnehin [36], the local forest plants are still used in Africa. Numerous quantitative and qualitative assessments on the use of these plants have been addressed to demonstrate their importance in the life of rural populations [7,8,20,37,38].

Table 1. List of the profile of the respondents of *D. camerooniana* chain in Uíge province

Gender	Parameters (%)	Gatherers (n=75)	Sellers (n=35)	Consumers (n=175)
	Male	87	13	53
	Female	13	87	47
Academic level	Literate	66	72	89
	Illiterate	44	18	11
Main activities	Civil service	1	0	43
	Agriculture	16	48	31
	Hunting	80	12	16
	Others	4	37	7
Area of Residence	Urbain and Nearby	14	68	49
	Rural	86	32	51

We noted that in Uíge province, sometimes in the preparation (cooking) of *G. africanum* leaves, some housewives voluntarily mix the *D. camerooniana* leaves with *G. africanum* leaves in order to soften this latter mentioned. In contrast, some ill intentioned retailers mix the leaves of *G. africanum* with some leaves of *D. camerooniana* with the purpose of increasing the quantity of *G. africanum* heaps seeing that *D. camerooniana* leaves are cheaper than *G. africanum* ones.

3.6 Place and Selling Modes of *D. camerooniana* Leaves

The commerce of NWFPs like *D. camerooniana* leaves takes place in rural peri-urban (Fig. 4a) and urban markets, at the roadsides, or even at home of the gatherers. The leaves are sold in bundles of 150 leaves on average or heap cut into small pieces, ready for further preparation steps (Fig. 4b).



Fig. 4a. Peri Urban market of food products in Uíge



Fig. 4b. Selling modes of *D. camerooniana* leaves

The leaves destined for sale are basins or plastic sacks stretched out on the land (Fig. 4a). Concerning the volume and number of leaves on the bundle vary from one bundle to another, and from one gatherer to another but also from the seasonality, it means that the volume of bundle and therefore the number leaves decrease in the dry season but increase in rainy season. This can be explained by the fact that during the rainy season, plants easily grow and leaves are well developed, reason why the bundles are of a bigger volume than in the dry season.

3.7 Economic Value of *D. camerooniana* Leaves

The commercialization of NWFPs destined for human food, medicine, crafts, for house construction etc. in Uíge province constitutes a lucrative activity in that part of the country.

In this study, it was observed that, one bundle of *D. camerooniana* leaves costs on average 175 AOA (USD 1.06) in urban zones and 80 AOA (USD 0.49) in rural zones. The average monthly income per gatherer is USD 24.50, whereas the urban sellers' income is three times higher (USD 65.20). The exchange rate was calculated based on AOA 165.097 being equivalent to USD 1. Our results are lower than those of Biloso and Lejoly [11], who showed that the monthly receipts of the *D. camerooniana* exploiters in Kinshasa (DRC) are around USD 75.55.

The big difference observed between Kinshasa and Uíge city can be related firstly to the methods used to calculate the prices based on surveys at the market of the selling price of wild food plants in both studies. The prices of the wild food plants will certainly vary according to their availability, which is linked to seasonality and sustainable use of these natural resources.

The difference in selling prices can also be explained by the development level of the two cities. Kinshasa is the political and economic capital of DRC. Uíge is the capital city of Uíge province (Angola). Uíge is less developed and has a relatively low cost of living compared to Kinshasa.

The other explanation is in relation to the geographic location of these two cities. In RDC, Mutambwe [39] explains that the price of the NWFPs depends on the supply and demand, which in turn is influenced by the seasonality of the products. In additional, Mutambwe [39], also

mentions that the price of the NWFPs depends on its quality (deteriorating conditions), the dimension or size of the products as well the cost of transportation and the place where the product is sold. These observations agree with Betti et al. [31] in Cameroon that, the price of NWFPs will certainly vary according to their availability, which is also linked to the season.



Fig. 5. Sun – dried cut leaves of *D. camerooniana*

3.8 Income Generation from the Exploitation of *D. camerooniana* Leaves

The commercialization of *D. camerooniana* leaves is an additional income generating activity for subsistence farmers and hunter-gatherers. Fig. 6 shows the allocation percentage of the income from the sales of *D. camerooniana* leaves according to the gender of exploiters in Uíge province.

In regard to the data in (Fig. 6), it can be seen that money received from the sales of NWFPs, including *D. camerooniana*, contributes in part to the basic need for products or food security, buying school materials, clothes and cosmetic products, health care, telecommunication and other items. However, the allocation of the income differs according to the gender of the exploiter. The money used to solve the immediate needs of the household is by far the largest volume (in total 74%): 41% is saved to buy the most needed products or to reinforce the basic goods needed, food, soap, kerosene lamp oil, batteries for flashlights etc.; 18% are allocated for children's schooling and 15% for family health care. Furthermore, 9% are allocated for clothes and cosmetic products, 12% for personal needs: telecommunication (6%), alcoholic beverage (4%), and tobacco (2%). In relation to the other aspects, they

occupy 7% of money received by women (for help to relatives and friends, for funerals, marriages, donations for church, savings etc. According to Armand Asseng [40], in Cameroon, NWFPs collected by men are firstly sold for tobacco or alcohol. In Uíge province, men use the majority (58%) of the income firstly for personal needs (hobbies and passions): 29% for buying manufactured or traditional alcoholic beverages; 15% for tobacco and *Cannabis sativa*, 14% for telecommunications). The household benefits only 39% from money where 16% are allocated to food security; 13% for school; 6% family health care, and 4% for clothes and cosmetic products; and other aspects (shot for hunting, agricultural materials, helping parents) only benefit of 3%.

The difference observed between the two genders which concerns the allocation of income from the sale of *D. camerooniana* leaves seems to be attributable to the fact that among Bakongo people of Uíge, women are the guardians of the households and they worry much more about the wellbeing of their family. In other words, in Angola particularly in Uíge province women play the role of guardians of the households, which is the reason why they spend a great part of their income for the well-being of their households. According to [41-46] women have a greater tendency than men to care about the health, education, food and a general interest in the well-being of the households.

From the above it can be seen that the sales of NWFPs such as the *D. camerooniana* leaves generates income, which contributes to the reinforcement of food security, school, clothes, cosmetic products, health care, telecommunication etc. Our results are in partial or total accordance with various authors. For example, according to FAO [4] in Central Africa, the commercialization of NWFPs gives opportunity to many households to earn money, which allows the diversification of income and acquisition of goods and vital services. The NWFPs represent an important source of income and a network of food security in Central Africa. According to Loubelo [6], in Congo Brazzaville, the commercialization of NWFPs provide food, health, employment and generate income to the stakeholders involved in its exploitation and commercialization. In Cameroon, IITA [47] and Batchep [48], showed that the income generated from the sale of vegetables contributes to the food security and

access to family health care. In DRC, Biloso and Lejoly [12], showed that the population fully exploit the NWFPs for their vital needs and to cope with problems of everyday life.

In Angola, Monizi et al. [8] and Monizi et al. [20], noted that income from sales of NWFPs serves in the acquisition of basic needs, school materials, health care, clothes, etc. Finally, the data of our study also show that part of the income from the sales of *D. camerooniana* leaves are saved. This kind of *tontine*, locally called *Dikelemba*, in Kikongo language and *Quixikila* in Angolan Portuguese. It is "a kind of capital investment and informal agreement or association of individuals contributing to a fund, the amount of money allocated is given in turn to each of them according to a plan previously established by mutual agreement". The sellers of *D. camerooniana* leaves do not like to keep their money in the banks because they find it takes a long time to take their money out and sometimes when they need it, there are no funds available. The other reason is that the income from NWFP is often not enough to deposit, so they prefer saving their money at home.

3.9 Mode of Consumption and Conservation

D. camerooniana leaves are chopped and cooked in water before consumed, for an average time of 30 to 45 minutes. The leaves are first picked or bought, washed and cut into small strips. Cooking the *D. camerooniana* leaves as a traditional dish depending on the culinary art of the housewife and the ingredients used. Once gathered or purchased at the market

the fresh leaves are divided into heaps (Fig. 7a), after they are cut or chopped into small slices with a sharp knife. Next, the slices are washed and put into a pot to boiling along with the ingredients (butter of peanuts "*Mwamba nguba*, in Kikongo language" as the main ingredient, red palm oil, tomato and onion, etc.

The addition of ingredients such as smoked meat, fresh or smoked fish, and smoked caterpillars depends on the financial ability or the physical availability of the households. The contribution of protein from animals and the other ingredients makes this *D. camerooniana* traditional dish a complete meal. Our results regarding the preparation mode and consumption of this wild African leaves are closer to those of Itoua Okouango et al. [49], who showed that in Brazzaville, *Phytolacca dodencadra* (wild spinach), is consumed cooked and, the preparation of this vegetable is garnished either with meat and fresh or smoked fish, or dried caterpillars. The consumption of these foods is influenced by the financial factor. Concerning the mode of preparation, our results are in accordance with those of Manirakiza et al. [50], in Congo-Kinshasa, who showed that the preparation of leafy vegetables such as *Gnetum spp.*, with peanuts and red palm oil occupy over half of the ingredients used. Van der Hoeven [51], in South Africa, showed that the ingredients used in preparation of vegetable dishes may vary and include oil, peanut butter, coconut, sodium bicarbonate, tomato and onion. Finally, Manduna & Vibrans [52], in Zimbabwe, the wild vegetables were cooked as spinach and served as a relish with the main staple, sadza. Tomatoes, onions, and peanut butter would be added to make a sauce.

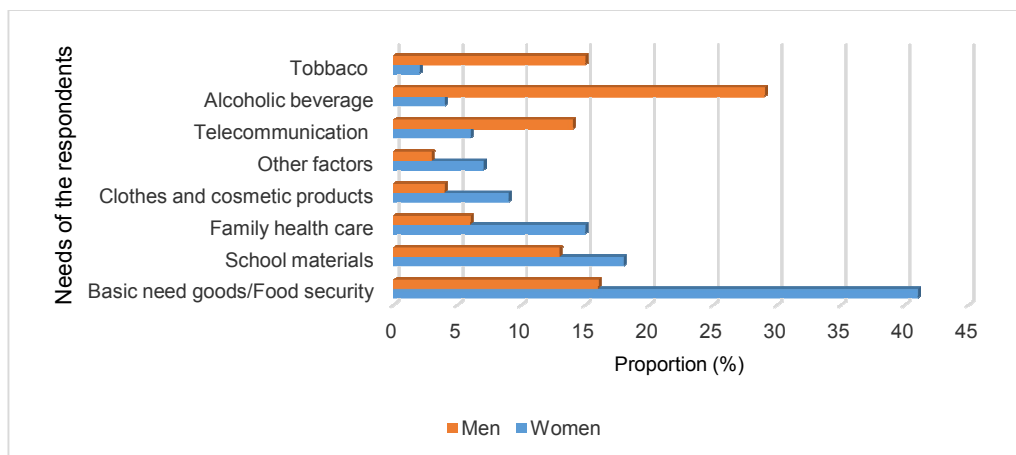


Fig. 6. Income generation from the exploitation of *D. camerooniana* leaves

About the preparation of chopped and dry leaves of *D. camerooniana*, these are washed and then boiled. Once boiled, the leaves are drained and then added to the ingredients mentioned above. Finally, the sauce is made with clean water.



Fig. 7a: *D. camerooniana* fresh cut leaves

For conservation of *D. camerooniana* chopped leaves, women in rural and peri-urban areas have developed a traditional conservation technique, which consists of drying chopped leaves (Fig. 7b) under the sun and then keeping them in preferably cotton sacks for many months.



Fig. 7b: Sun-dried cut leaves of *D. camerooniana*

3.10 Classification of the Preference Factors of *D. camerooniana* Consumption

Many factors can influence food in a community such as food habits, social and cultural customs, environment and economy. The consumers of *D. camerooniana* leaves in Uíge province do not escape to this rule. As it can be observed, when people emigrate from the villages to the cities, they usually take their lifestyles with them,

including their food and sociocultural habits, which can be considered a kind of "ruralization of cities". It was observed in this study that, city dwellers who consume *D. camerooniana* leaves are mostly former villagers or their descendants. This can be explained by the fact that, many times, the lifestyle, food and sociocultural habits of families or communities are transmitted from parents to children. Figure 8 shows the main factors, which motivate the consumption of *D. camerooniana* leaves by the local population of Uíge.

It is evident (Fig. 8) that, the main factors which motivate the consumption of *D. camerooniana* leaves within rural and urban areas in Uíge province are organoleptic proprieties (87%), physical and financial availability (81%), valorization of local products (72%), ease of digestion (59%), food curiosity (21%), and other factors (food diversity, food habit, the choice of husband, and the medicinal role) only occupy 9%. The results of this study are closer in part with those presented by FAO [53] and Rubaihayo [54], which showed that the local leafy vegetables are cheap and easily accessible to numerous communities in rural, peri-urban and urban zones. According to Gupta and Wagle [55], leafy vegetables present an economic and social interest not negligible due to their relatively low cost.

3.11 Opportunities and Constraints Related to the Access, Gathering and Commercialization

The results of our survey of the population of the study area show that the gathering of wild leafy vegetable such as *D. camerooniana*, is done freely in the forest, that is to say, it is not subject to prior authorization of the owner of the forest. These facts agreed with the study done in Central Africa by FAO [4], which showed that the access to the forest resources is free, as in case of *Gnetum spp* in DRC and in Cameroon.

Nowadays, there is a rise in anthropogenic activities in tropical rainforests of Uíge province, the natural habitats of *D. camerooniana*. These activities are responsible for dwindling forests in that part of the country. There are multiple factors responsible for the massive loss of tropical forests in Uíge province. The activities of timber companies, shifting agriculture or slash and burning are the main causes of deforestation resulting in natural habitat destruction, loss of vegetation cover, reduction

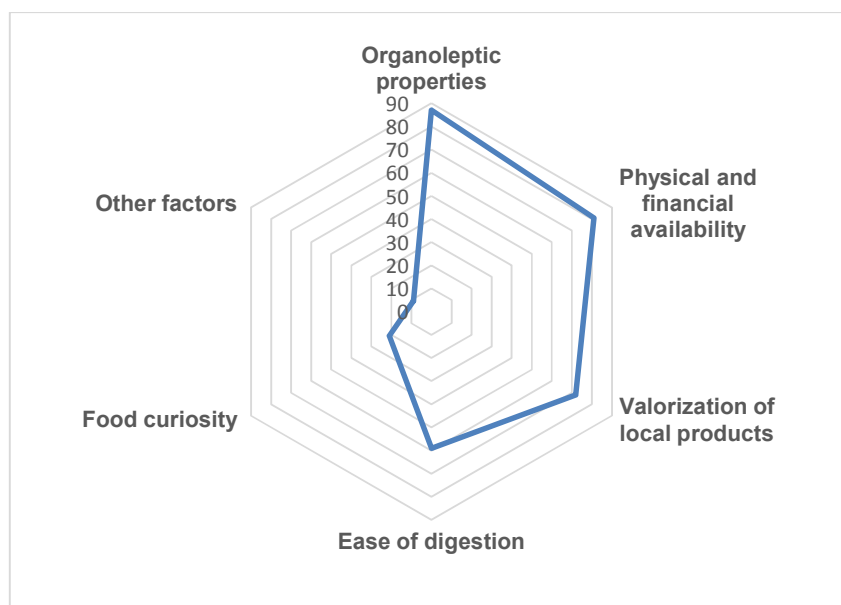


Fig. 8. Motivating factors in the consumption of *D. camerooniana* leaves in Uíge province

of vegetal biodiversity and, also of many other species of vital interest in this part of the country. Other causes of deforestation are extraction of firewood, construction of roads, urbanization and construction materials, mechanized agriculture, felling wood for furniture, etc.). This study also shows that many constraints influence the access to the exploitation of NWFPs including seasonality, bad condition of secondary and tertiary roads and the distance to the gathering zone. Finally, there is no farmer organization in the region, which works in defence, either to teach or legislate to control the exploitation of NWFPs.

4. CONCLUSION AND RECOMENDATIONS

The study contributes to the traditional knowledge, the importance and the socioeconomic value of *D. camerooniana* by the population of local communities in Uíge province. *D. camerooniana* is however, threatened by many factors such as poor harvesting techniques due to greed, or anthropic pressures caused by shifting agriculture in tropical rainforests. Domestication of the plant should be carried out to ensure its preservation both *in situ* and *ex situ*. Also, methods of collections should improve and the exploitation of the roots and stem bark of the plant should not be involved, as it is detrimental to the sustenance of the plant. In addition, the

phytochemical studies should be carried out to discover the nutritional, toxic, and medicinal properties of this plant. This should be done with the support of local farmers because they know the techniques in this field. Finally, conservation should also be carried out to conserve this wild forest leafy vegetable. This should start with *in vitro* micro propagation as long as the genetic diversity that it represents is still available in its natural habitat.

CONSENT

Informants were interviewed on a voluntary basis according to principles laid out in the Declaration of Helsinki.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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