Proximate and Mineral Composition of Nsala Bakala (*Dracaena camerooniana* Baker) Leaves, Stems and Roots from Nzenze Forest in Uíge Province, Angola

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ABSTRACT

The aim of the present work was to perform nutritional analysis of *Dracaena camerooniana* Baker. Nutrient determination was carried out according to standard methods. The nutritional profile of the leaves, roots and stems of *D. camerooniana* showed that these organs are rich in fibre (14.20-53.65%), proteins (4.47-18.58%), lipids (1.53-5.42%) carbohydrates (23.67-70.94%), ash (2.17-15.59%) and mineral elements, namely, K (535.07-1690.00 mg/100 g), Ca (315.87-1459.97 mg/100 g), Mg (95.41-498.83 mg/100 g), P (76.72-149.56 mg/100 g), Na (105.83-113.60 mg/100 g), Se (75.87-128.51 mg/100 g), Fe (40.88-228.30 mg/100 g), Mn (7.41-11.39 mg/100 g), Zn (2.94-5.83 g/100 g), Cu (2.30-2.80 mg/100 g), and Co (0.65-2.80 mg/100 g). The different levels of nutrient contents observed in the analyzed organs of *D. camerooniana* would be attributed to the accumulative capacities of the plant organs. It is therefore recommended (desirable) that further studies be conducted to determine the content of anti-nutritional factors in this plant on the one hand and to evaluate its pharmaco-biological properties on the other. Domestication of the plant should be done to ensure its conservation with the support of local farmers. Thus, the use of biotechnology would allow the availability of healthy plant material for both present and future generations.

Keywords: *Dracaena camerooniana*, nutritional and mineral composition, Uíge Province, Angola.

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I. INTRODUCTION

Food and Agricultural Organization (FAO) reports that at least one billion people are thought to use wild foods in their diet [1]. Forests provide livelihoods and food for some 300 million people in the form of non-timber forest products (NTFPs). In general, food security and NTFPs are strongly interlinked in rural communities, especially for the most vulnerable groups [2], even among agricultural communities [3]. Urban communities also rely on wild foods [4].

Wild edible plants (WEPs) refer to species that are neither cultivated nor domesticated but are available from their wild natural habitat and used as sources of food [5].

Wild edible plants (WEPs) are one of the alternative sources of healthy and nutritious food, and they are vitally important in supporting the global food basket in all parts of the world in general and in sub-Saharan Africa in particular. Wild edible plants are those plants with edible parts that grow naturally on farmland and on fallow or uncultivated land [6]. Ancient times, wild edible plants have sustained human populations in each of the inhabited continents.

Dietary use of wild fruits, nuts, seeds, and leaves appearing numerous historical records [7]. According to Sekeroglu *et al.* [8], different wild edible plants have played a significant role in different geographical regions of the world throughout human history.

These wild edible plants have played a significant role in supplying food and nutritional requirements and increasing the health status of poor communities in many rural parts of the world [9].

Wild edible plants are of vital importance in all regions of the world to support the global food basket [10]. Wild edible plants play an important role in the daily lives of local people in terms of food and income and also, they can be important commercial products in local and regional markets and as such contribute to local cash income and to the improvement of people's well-being. In addition, employment can be obtained through the sale or exchange of their fruits, roots, seeds, bark, leaves, hoots, juices, and local drinks [11]-[14].

Studies reveal that, wild edible plants are rich in minerals, vitamins, carbohydrates, proteins, fats, and fiber and in addition they are used as remedy for various diseases [15] and their nutritional values may be superior to those domesticated varieties [16], [17]. From the nutritional perspectives, wild edible plants are sources of many micronutrients commonly lacking in staple-dependent diets in developing countries, which are important for human health and development [18]. Minerals with critical significance in human nutrition and health are essential nutrients for normal physiological functions of the body [19].

The wild flora of Northern Angola abounds in numerous plants with multiple uses for human and his habitat. These plants are used for food, human and animal health, handicrafts, furniture, house construction and others [20].

The forests serve as a prime habitat for many wild edible plants [11] that fulfill the needs of the communities throughout the year. Many of these inexpensive edible plants are consumed by the local communities yet many remains unutilized, and the nutritional potential of these species are yet to be studied. Therefore, there is an urgent need to conserve adopting possible strategies and advocate sustainable utilization of these wild edible plants for future generation. At the same time, it is also essential to explore the nutritional content of this wild edible plant so as to validate the scientific basis of consumption of this species.

Comprehensive data on the composition of foods is an essential first step towards the enhancement and preservation of wild foods and their natural habitats. This is the reason for this study.

The aim of the study is to determine the proximate and mineral composition of *Dracaena camerooniana* leaves, stems and roots.

Besides, we have evaluated the functional properties of this plant to better understand its importance in human's nutrition. The results and parameters could then provide fundamental bases for the nutritive exploitation, reducing food insecurity, and malnutrition problems and also increasing dietary diversity within local communities and beyond.

II. MATERIALS AND METHODS

A. Plant Material

Fresh plant material of this plant species, mentioned in Monizi *et al.* [12] was collected in the Nzenze (Songo) forest, in the Angolan province of Uíge, cleaned, immediately dried in a drying cabinet (HTD 100 Bench Top, LinTek) at 30 °C,

then vacuum-sealed, stored in a freezer and later sent to Kinshasa, RDC, for analysis. At the same time, herbarium voucher of the plant species mentioned was prepared, identified, and stored in the Herbarium Dresdense (DR, voucher no. 056361). The organs exploited for food purposes are the leaves (Fig. 1 a) the tuberous roots (Fig. 1 b) and the Plant (leafy stem) of *D. camerooniana* (Fig. 1 c).

Fig. 1. Photo of *D. camerooniana*: (a) leaves, (b) roots, (c) stems.

B. Analytical Methods

1) Moisture

The determination of moisture (g/ 100 g) was performed by weight loss using method previous described [21].

2) Crude Protein

Total nitrogen and proteins contents were determined according to Kjeldahl method [21].

3) Estimation of Total Fibers

Crude fibers the raw materials or cellulosic fibers were measured following Kurschner method based on attack under reflux condenser of sample powder by mixing acetic and nitric acids [21].

4) Total Lipids

Total lipids were extracted by organic solvent (n-hexane) under heat and measurements (g/100 g sample) using Soxhlet method [21].

5) Estimation of Total Carbohydrates

The total percentage of carbohydrate content in the sample of *D. camerooniana* was determined by the modified method of Asaduzzaman *et al.* [22] after deproteinized and delipidized.

This method involved adding the total values of crude protein, lipid, crude fiber, residual moisture, and ash constituents of the sample and subtracting it from 100. The value obtained is the percentage carbohydrate constituent of the sample. Thus:

$$\% \text{ carbohydrate} = 100 - (\% \text{ residual moisture} + \% \text{ crude fiber} + \% \text{ protein} + \% \text{ lipid} + \% \text{ ash})$$

6) Ash Content and Mineral Composition

The total ash was determined by incinerating a known amount of the sample in an electric muffle furnace until obtaining a white ash. Briefly, 5 g of each sample was weighed in a silica crucible and heated in muffle furnace for about 5-6 hours at 500 °C. It was cooled in a desiccator and weighed. It was heated again in the furnace for half an hour, cooled and weighed. This was repeated consequently till the weight became constant (ash became white or grayish white). Weight of residue gave the ash content [21].

The mineral contents were determined by Inductively Coupled Argon Plasma Optical Emission Spectrometry (ICP-OES) [Optima 8300 Perkin Elmer, USA] as previously reported by [23]. Briefly, the sample (0.3 g) was dissolved in 5 mL of distilled water placed in PM60 Teflon bombs (Analytik Jena 40 Bar) and heated at 60 °C and 10 mL of nitric acid (HNO₃ 65%) (Merck) was then added.

The resulting mixture was incubated at room temperature for 30 minutes to allow the oxidation to occur and later the bombs were covered first with caps and then stripped with HNO₃/H₂O (v/v, 1:1). The bombs were placed in the high frequency microwave mineralizer (Analytikjena AG Top wave: 2.5 Ghz, Germany) controlled by microcomputer by choosing the vegetable leaves, roots, and stems mode as a digestion mode at 180 °C, 50 bars for an hour. At the end of mixing, the digester was stopped by letting the bombs rest for 3 hours until completely cooled. The cooled analyte was thus carefully transferred by filtration on Whatman filter paper, bombs to 50 mL volumetric flasks previously stripped. The calibration of the ICP-OES was performed using the working standard prepared from the commercially available standard multi-element solution 3 at two points (1 mg/L and 2.5 mg/L, Perkin Elmer, USA). The most appropriate wavelength, gaseous argon flow, plasma stabilization and other ICP-OES instrument parameters for minerals were selected and measurements were made in the linear range of the working standards used for calibration. The operating conditions were Power of Rf (1500 Watt); Plasma gas flow (Ar): 8 L/min; Nebulizer (0.70 L/min); Auxiliary gas flow (Ar): 0.2 L/min; Viewing size (5-22 mm); Copy and playback time: 1-5s (maximum 45 s); Flow time: 1s (maximum 10 s); View: Radial.

7) Estimation of Energy Value

The energy value of the samples was determined by multiplying the protein content by 4, carbohydrate content by 4 and fat content by 9 [24].

$$\text{Energy Value} = (\text{Crude protein} \times 4) + (\text{Total carbohydrate} \times 4) + (\text{Crude fat} \times 9)$$

C. Statistical Analysis

All assays were carried out in triplicate and the values were obtained by calculating the average of three experiments and data are presented as Mean.

III. RESULTS AND DISCUSSION

A. Chemical Composition

1) Physico-chemical Composition of *D. camerooniana* Organs

Table I shows the physico-chemical composition of the three organs analyzed (leaves, roots, and stems) of *D. camerooniana*.

TABLE I: PHYSICO-CHEMICAL COMPOSITION (%) AND ENERGY VALUE (KCAL) OF *D. CAMEROONIANA* ORGANS

Physico-chemical parameters	Content (%) of organs of <i>D. camerooniana</i>		
	Roots	Stems	Leaves
Moisture	81.78	77.73	86.89
Residual moisture	8.95	10.25	4.77
Ashes	2.17	3.90	15.59
crude fat	1.53	1.76	5.42
Crude proteins	4.47	6.77	18.58
Crude fibres	11.94	53.65	14.20
Carbohydrates	70.94	23.67	41.44
Energy (kcal)	315.41	137.60	288.86

Mean values of three experiments.

The leaves of *D. camerooniana* had a higher moisture content (86.89%) than the roots (81.78%) and stems (77.73%).

The moisture content found in this study is higher than that reported by Iloibia *et al.* [25] for *D. mannii* (leaves: 67.05±0.33%; stem: 15.01±0.48%; roots: 16.08±0.16%) and *D. arborea* species (leaves: 69.07±0.45%; stem: 30.15±0.39%; roots: 20.16±0.43%). When food is consumed, some of the water it contains is absorbed by the body. According to the Food and Nutrition Board [26], water is an essential component of many foods, with 20% of total water consumption coming from food. Dorosz [27] reports moisture values of 70-90% for leafy vegetables while Depesay [28] reports moisture content in the range 85-95%.

The latter correspond to those found in this study. The data of the present study reveal that the analyzed organs of *D. camerooniana* are rich in water. The high water content found in the leaves and roots of *D. camerooniana* indicates that these organs are more vulnerable to spoilage as foods with high water content are more perishable [29].

Foods with a water content of 50-95% are called high water content foods [30].

The organs of *D. camerooniana* analyzed in this study are rich in water.

The leaves of *D. camerooniana* are richer (15.59 DM) in ash than the stem (3.90%) and roots (2.17%). The ash value

reported by Shukla *et al.* [31] on *Dracaena reflexa* leaves ($8.02 \pm 0.25\%$) is lower than that found in the present study. Compared to other edible leaves in the region, the ash content found in this study is higher than those reported by Mawunu *et al.* [17] for *Mondia whitei* (12.93%) and *Pyrenacantha klaineana* (6.74%) leaves. The ash content is a good indicator for the concentration of minerals in food. Minerals in feed are necessary for good growth and health of humans and livestock. Indeed, feeds with a high ash content are rich in mineral constituents [16].

Moreover, these mineral elements are necessary for human biological processes: they regulate osmotic pressure and protect against many diseases, such as cancer and cardiovascular disease; they are ingredients of the skeleton and enzyme systems [32]. Thus, the leaves and roots of *D. camerooniana* are an excellent source of mineral elements for pregnant women, the elderly, teenagers, and growing children, while the stems can be used as fodder for livestock [33].

The results on lipid content reveal a difference between *D. camerooniana* leaves ($5.42 \pm 0.07\%$ DM), stem ($1.76 \pm 0.12\%$) and roots ($1.53 \pm 0.11\%$), respectively. Furthermore, the lipid content found in this study is higher than those reported by Ilodibia *et al.* [25] for leaves ($0.80 \pm 0.25\%$), stem ($0.50 \pm 0.15\%$), roots ($0.02 \pm 0.23\%$) of *D. mannii* and leaves ($0.76 \pm 0.32\%$), stem ($0.79 \pm 0.92\%$), roots ($0.05 \pm 0.59\%$) of *D. arborea*.

Furthermore, Shukla *et al.* [31] reported a lipid content of $0.97 \pm 0.39\%$ in the leaves of *Dracaena reflexa*.

Furthermore, Shukla *et al.* [31] reported a lipid content of 0.97% in the leaves of *Dracaena reflexa*. Compared to other edible leaves in the region, the lipid content found in this study is higher than those reported by Mawunu *et al.* [17] for *Mondia whitei* ($2.95 \pm 0.06\%$) and *Pyrenacantha klaineana* ($1.13 \pm 0.11\%$) leaves. The present results also indicate that *D. camerooniana* leaves are richer in lipids than those of *Gnetum africanum* ($2.45 \pm 0.15\%$) [34]. *D. camerooniana* is therefore an energetic leafy vegetable. Its lipids can increase palatability by absorbing and retaining flavours [25].

The protein content of three organs of *D. camerooniana* varied between 4.47% and 18.58% DM (Table I). The protein results show a significant difference at the Tukey test ($P < 0.05$). The leaves of *D. camerooniana* had the highest protein content (18.58%) compared to the stems (6.77%) and roots (4.47%). Thus, the protein contents found in this study are higher than those reported by Ilodibia *et al.* [25] for leaves (0.60%), stem (0.21%), roots (0.16%) of *D. mannii* and leaves (0.51%), stem (0.09%), roots (0.10%) of *D. arborea*. Compared to other leaves consumed in the region, *D. camerooniana* leaves have a higher protein content (Table I) than those reported by Mawunu *et al.* [17] for *Mondia whitei* (16.48% DM) and *Pyrenacantha klaineana* (14.93%) leaves. On the other hand, Mbemba *et al.* [34] found a protein content of 4.86% for the leaves of *Gnetum africanum*. Also, this protein content is higher than that of *Manihot esculenta* (7.0%) [35].

Protein is an important source of amino acids and is necessary for the development and maintenance of the body [36]. The results of this study on protein content are encouraging, as children of growing age, pregnant women, lactating mothers, and the elderly to compensate for the

protein deficiency of the population especially in rural areas could consume *D. camerooniana* leaves.

Furthermore, the present results (Table I) show that the leaves, roots, and stems of *D. camerooniana* contain dietary fiber. The stems contained more dietary fiber (53.65%) than the leaves (14.20%) and roots (11.94%).

However, the dietary fiber content found in this study is lower than those reported by Ilodibia *et al.* [25] for leaves (35.08%), stem (52.00%), roots (55.01%) of *D. mannii* and leaves (33.00%), stem (42.06%) and roots (30.09%) of *D. arborea*.

Compared to other leaves consumed in the region, *D. camerooniana* leaves had a lower dietary fiber content than that reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* leaves (40.45%). In addition, *D. camerooniana* leaves had a higher dietary fiber content than that reported by Mawunu *et al.* [17] for *Mondia whitei* leaves (13.16%) and Shukla *et al.* [31] for *Dracaena reflexa* leaves (1.31%). An adequate amount of dietary fiber makes it a good food since foods with high dietary fiber content facilitate digestion [35]. A good amount of fiber could have a considerable influence in the human digestive process to control constipation. Indeed, dietary fiber reduces the transit time of food in the intestine, which is why it is recommended for the local management of blood sugar, hypertension, and constipation. Also, fiber contributes to the prevention of type 2 diabetes, increases stool volume, stimulates colonic motricity and intestinal contraction, accelerates digestive transit by promoting the development of the microbiota and the production of intra-colonial gas, which is partly at the origin of several pathologies affecting the colon, including stomach and colorectal cancer [37]. In addition, fiber has a positive effect on accelerating satiety, delaying the feeling of hunger, and thus limiting the risk of overeating, which helps prevent obesity [38]. Dietary fiber consumption also softens stools and reduces plasma cholesterol levels in the body [38], improves glycemic status and lipid profiles (mainly soluble fiber), reduces body weight and abdominal adiposity; chronic inflammation, cardiovascular risk, mortality; improves gut microbiota; colonic health and integrity and colonic motility [39].

Furthermore, the present results allow to classify the leaves, roots, and stems of *D. camerooniana* as plants rich in fiber; this makes *D. camerooniana* a food that could be interesting to participate in the prevention of digestive system cancers.

The carbohydrate content of the three organs studied in *D. camerooniana* ranged from 33.92% to 79.89% DM (Table I). The results on carbohydrates revealed a significant difference by Tukey's test ($P < 0.05$). Roots contained the highest carbohydrate content (79.89%) compared to leaves (73.37%) and stems (33.92%) of *D. camerooniana*. The carbohydrate content found in the present study is lower than that reported by Shukla *et al.* [31] for *D. reflexa* leaves (86.01%).

On the other hand, the carbohydrate content in this study is higher than that reported by Ilodibia *et al.* [25] for leaves ($67.08 \pm 0.66\%$), stem ($41.10 \pm 0.73\%$), roots ($30.05 \pm 0.15\%$) of *D. mannii* and leaves ($69.07 \pm 0.53\%$), stem ($50.00 \pm 0.62\%$), roots ($32.06 \pm 0.74\%$) of *D. arborea*, respectively.

Carbohydrates are important sources of energy for the brain, which depends on them for its proper functioning, just like many other organs in the body [40].

A high carbohydrate content indicates that the food is high in energy [17]. According to Yisa *et al.* [41], the main function of carbohydrates in the body is to provide energy for vital daily activities.

As for the amount of energy (kcal), the results in Table I show that the roots of *D. camerooniana* are more energetic (315.41 kcal) than the leaves (288.86 kcal) and the stems 137.60 kcal. The analysis on energy content (kcal) was revealed difference. Shukla *et al.* [31], found an energy content of about 367.56 kcal in *D. reflexa* leaves. Mawunu *et al.* [17] analyzed the leaves of *Mondia whitei* and *Pyrenacantha klaineana* and found an energy content of 310.37 kcal and 217.77 kcal, respectively.

Furthermore, the high energy content of the leaves and roots of *D. camerooniana* (edible parts) makes this plant a suitable source of energy for rural populations in northern Angola. In addition, the stems of *D. camerooniana* can be used as fodder for animals. It should be noted, however, that *D. camerooniana* leaves alone do not constitute a complete diet, hence, the need for diversification of the diet and combination of feeds. This observation corroborates that of other researchers such as Kahane *et al.* [42] who state that leafy vegetables are rarely consumed alone as such. This inseparable combination of a carbohydrate dish and a vegetable-based sauce has not only social and economic but also nutritional significance.

Furthermore, the high amount of energy found in the vegetative organs of *D. camerooniana* would be attributable to the high carbohydrate content [17]. The variability in the content of physico-chemical compounds reported in this study may be due to the harvesting season and the assimilative capacity of the different organs.

2) Mineral Composition of *D. camerooniana* Organs

2.1) Macro-elements Composition

Fig. 2 shows the results (mg/100 g dry matter (DM)) of five macronutrients analyzed in leaves, roots, and stems of *D. camerooniana*.

Fig. 2. Content of different organs of *Dracaena camerooniana*.

It can be seen from Fig. 2 that the sodium (Na) content found in the leaves, roots, and stems of *D. camerooniana* varied from 105.83 to 113.60 mg/100 g dry matter.

The leaves of *D. camerooniana* had the highest Na content (113.60 mg/100 g) compared to roots (106.30 mg/100 g) and stems (105.83 mg/100 g).

The analysis on sodium content was revealed difference.

The leaves of *D. camerooniana* had the highest Na content (113.60 mg/100 g) compared to roots (106.30 mg/100 g) and stems (105.83 mg/100 g).

The Na content found in *D. camerooniana* leaves is higher than that reported by Mawunu *et al.* [17] for *Mondia whitei* leaves (101.57 mg/100 g), but lower for *Pyrenacantha klaineana* leaves (126.77 mg/100 g) Sodium plays an essential role in the conduction of nerve impulses alongside potassium [43].

Compared to the other main elements (K, P, Ca, and Mg) analyzed in this study, their sodium content was considered relatively low (Fig. 2). However, the sodium content determined in this study is comparable to previous work by Kibar and Temel [44].

On the other hand, excessive sodium intake is conducive to the induction of hypertension. An adequate intake of sodium is 1.2 to 1.5 grams per day [26].

The potassium (K) content found in the leaves, roots, and stems of *D. camerooniana* varied between 535.07±0.20 and 1690.00±0.17 mg/100 g dry matter.

The analysis on potassium content was revealed difference. The leaves of *D. camerooniana* have the highest K content (1690.00 mg/100 g) than the roots (945.97 mg/100 g) and stems (535.07 mg/100 g).

Compared to other leaves consumed in the region, *D. camerooniana* leaves had a higher K content than *Mondia whitei* leaves (1149.83 mg/100 g), but lower than *Pyrenacantha klaineana* (2459.20 mg/100 g) and *Mondia whitei* (1149.83 mg/100 g) [Mawunu *et al.* In the present results, potassium was found to be the most highly abundant mineral element (Fig. 2). As in most plant products the predominant mineral compound is potassium [45]. Similar conclusions were made by Mawunu *et al.* [17] and Özer and Aksoy [46]. According to Palmer [47], potassium plays an important role in the body, including the maintenance of body fluid balance and osmotic balance as well as the regulation of nerve signals and muscle concentrations.

The calcium (Ca) content found in the leaves, roots, and stems of *D. camerooniana* varies between 315.87 and 1459.97 mg/100 g dry matter. The analysis on calcium content was revealed difference.

D. camerooniana leaves had the highest Ca concentration (1459.97 mg/100 g) compared to roots (546.80 mg/100 g) and stems (315.87±0.07±0.20 mg/100 g). Compared to other leaves consumed in the region, *D. camerooniana* leaves had a higher calcium content than those reported by Mawunu *et al.* [17] for *Mondia whitei* leaves (844.87±0.09 mg/100 g), but lower (2126.33±0.09 mg/100 g) for *Pyrenacantha klaineana* leaves. It should also be noted that the calcium content found in *Dracaena camerooniana* leaves is higher than that reported by Mbemba *et al.* [48] for *Gnetum africanum* (520 mg/100 g). Calcium is the most important mineral for humans and constitutes a major proportion of bones and teeth, human blood, and extracellular fluid [49].

It is required for normal functioning of the heart muscles, blood clotting and regulation of cell permeability. Calcium also plays a role in the transmission of nerve impulses and in

the mechanism of the neuromuscular system [49]. Calcium contributes to the formation of strong, healthy bones and teeth [50]. However, calcium deficiency can lead to rickets, bone pain and muscle weakness [51].

D. camerooniana leafy vegetables can help to meet the daily calcium requirement of 260 mg per day [52]. The data from this study on the Ca content of this wild plant could be an adequate source of Ca for human nutrition.

The magnesium (Mg) content found in leaves, roots, and stems of *D. camerooniana* ranged from 95.41 to 498.83. The analysis on magnesium content revealed difference.

D. camerooniana leaves had the highest Mg concentration (498.83 mg/100g) compared to roots (234.13 mg/100 g) and stems (95.41±0.10 mg/100 g).

Compared to other leaves consumed in the region, *D. camerooniana* leaves have a higher Mg content than those reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* (241.93 mg/100 g) and *Mondia whitei* (219.90 mg/100 g), and also for *Manihot esculenta* (31 mg/100 g) [53]. On the other hand, the Mg content of *Gnetum africanum* (160 mg/100 g) is higher than that of *Dracaena camerooniana* leaves [48]. Leaves are the main sites of photosynthesis in higher plants. Moreover, magnesium is an integral part of chlorophyll. This could justify the high Mg content in leaves rather than in other organs.

In addition, magnesium helps relax the muscles along the airways, allowing asthmatics to breathe with ease [54]. According to Elinge *et al.* [55], magnesium is a major constituent of bones and teeth alongside calcium and phosphorus; it is also necessary for tissue respiration, the release of parathyroid hormone and its action in the spine, intestine, and kidneys. Thus, consumption of *D. camerooniana* leaves may help prevent magnesium-related health problems.

The phosphorus (P) content found in the analyzed organs (leaves, roots, and stems) of *D. camerooniana* varied between 76.72 and 149.56 mg/100 g dry matter. The analysis on phosphorus content reveals a difference in tree organs. The P content found in the roots of *D. camerooniana* (149.56 mg/100 g) is close to that of the stems (149.00 mg/100g) and the lowest content observed is in the leaves (76.72 mg/100g). Compared to other leaves consumed in the region, *D. camerooniana* leaves have a lower P content than that reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* (239.90±0.06 mg/100 g) and *Mondia whitei* (175.89±0.17 mg/100 g); by Mbemba *et al.* [48] for *Gnetum africanum* (1340 mg/100 g); [53] for *Manihot esculenta* (84 mg/100 g).

Phosphorus is the most abundant mineral element in the body after calcium. Phosphorus regulates various physiological functions, including skeletal development, energy transfer through mitochondrial metabolism and blood plate aggregation [49]. The phosphorus content observed in this study varies between different organ types. Finally, the results of this study suggest that *D. camerooniana* leaves are a significant source of phosphorus for people who consume them.

2.2) Oligo Elements Composition

Fig. 3 shows the trace elements composition of different organs (leaves, roots, and stems) of *D. camerooniana* in mg/100 g dry matter (DM).

Figure 3: Content of different organs of *Dracaena camerooniana*

Fig. 3. Content of different organs of *Dracaena camerooniana*.

The analysis on copper content was revealed difference. The copper (Cu) content found in the organs of *D. camerooniana* varied between 2.30 and 2.80 mg/100 g dry matter. The results in Fig. 3 show that the roots of *D. camerooniana* are richer in copper (2.80 mg/100 g) compared to the leaves (2.65 mg/100g) and stems (2.30 mg/100 g). Compared to other leaves consumed in the region, *D. camerooniana* leaves had a lower copper content than those reported by Mawunu *et al.* [17] for *Mondia whitei* (3.14±0.04 mg/100 g) and *Pyrenacantha klaineana* (2.84±0.04 mg/100 g) leaves.

Copper is a trace element necessary for the activity of several key enzymes, including cytochrome oxidase and superoxide dismutase. In addition, copper is involved in the host cell defence mechanism, maturation of white and red blood cells, myocardial contractility, and brain development [56]. The results of this study indicate that *Dracaena camerooniana* leaves can be used as a source of copper in the human diet.

The cobalt (Co) content found in the organs of *D. camerooniana* varied between 0.65 and 2.80 mg/100 g dry matter. The analysis on cobalt content was revealed difference. The stems of *D. camerooniana* are richer in cobalt (2.80 mg/100 g) compared to roots (1.50 mg/100 g) and leaves (0.65 mg/100 g).

Compared to other leaves consumed in the region, *D. camerooniana* leaves have a lower Co content than those reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* (2.84±0.2 mg/100 g) and *Mondia whitei* (2.73±0.05 mg / 100 g) leaves. Cobalt is an integral part of vitamin B12 [57] and is therefore essential for cell function. It is also involved in the production of red blood cells and antibacterial and antiviral compounds that prevent infections [58]. Cobalt also plays a key role in the metabolism of fats and carbohydrates and in the synthesis of folate in its active form. Cobalt ensures optimal absorption of iron by the cells. In the nervous system, cobalt is responsible for the prevention of demyelination leading to multiple sclerosis, which is a condition that causes

damage to the membrane covering the nerve fibrils in the brain and spinal cord. This prevention ensures the efficient transmission of nerve impulses [57], [58].

The cobalt content found in *D. camerooniana* makes this wild edible plant a food for both humans and livestock. Consumption of this plant can be used to prevent diseases related to cobalt deficiency.

The analysis on selenium content was revealed difference. The selenium (Se) content found in the three analyzed organs of *D. camerooniana* varied between 75.87 and 128.51 mg / 100 g dry matter.

The leaves of *D. camerooniana* are richer in selenium (128.51 mg/100 g) than the roots (104.69 mg/100 g) and stems (75.87 mg/100 g). Compared to other leaves consumed in the region, *D. camerooniana* leaves have higher selenium content than those reported by Mawunu *et al.* [17] for *Mondia whitei* (87.80±0.12 mg/100 g) and *Pyrenacantha klaineana* (77.86±0.11 mg/100 g) species.

Selenium is an element in trace form that is essential for life, it protects the cells against free radicals and participates in the detoxification of heavy metals and in the regulation of the immune and reproductive system [59]. Selenium also supports the thyroid gland and the body's antioxidant defense mechanism [59].

The richness of selenium found in *D. camerooniana* leaves makes this leafy vegetable a food that could be interesting to participate in the prevention of cardiovascular diseases through its antioxidant properties.

The manganese (Mn) content found in the vegetative organs of *D. camerooniana* varied from 7.41 to 11.39 mg / 100 g dry matter. The leaves of *D. camerooniana* are more concentrated in Mn (11.39 mg/100 g) in relation to the roots (9.44 mg/100 g) and stems (7.41 mg/100 g). The analysis on manganese content was revealed difference.

Compared to other leaves consumed in the region, *D. camerooniana* leaves had higher manganese content than those reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* leaves (6.14 mg/100 g) and *Mondia whitei* (5.11 mg/100g DM).

The zinc (Zn) content found in the analyzed organs of *D. camerooniana* varied between 2.94 and 5.83 mg/100 g dry matter. The present results (Fig. 3) show that, the roots of *D. camerooniana* are richer in zinc (5.83 mg/100 g) compared to leaves (3.65 mg/100 g) and stems (2.94 mg/100 g). The analysis on zinc content was revealed difference. Compared to other leaves consumed in the region, *D. camerooniana* leaves have higher zinc content than those reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* (3.47 mg / 100 g) and *Mondia whitei* (1.42 mg) leaves According to Bello *et al.* [54], zinc is mainly related to protein synthesis, the catalytic activity of several enzymes and to rapid growth and development during infancy, adolescence, and wound healing. In addition, zinc is a stabilizer and stimulator of the immune response. However, its deficiency leads to growth retardation and poor development of gonadal function [60].

The iron (Fe) content found in the different organs analyzed of *D. camerooniana* varies between 40.88 and 228.30 mg/100 g dry matter. The analysis on iron content was revealed difference. Roots had the highest iron content (228.30 mg/100 g) compared to leaves (84.98 mg/100 g) and stems (40.88 mg/100 g).

Compared to other leaves consumed in the region, *D. camerooniana* leaves had higher iron content than those reported by Mawunu *et al.* [17] for *Pyrenacantha klaineana* (21.69 mg/100 g), *Mondia whitei* (14.21 mg/100 g); by Mbemba *et al.* [48] for *Gnetum africanum* (20.38 mg/100 g) and *Manihot esculenta* (1.8 mg/100 g), respectively. According to Elinge *et al.* [55], iron has several important functions in the body including blood formation and transport of oxygen and carbon dioxide to tissues [54]. Moreover, wild green leafy vegetables increase the amount of blood in the body, which probably refers to the high iron content of many wild green vegetables [61]. Iron plays a role in the synthesis of chlorophyll [62]. The high iron content of *D. camerooniana* leaves could be a strong argument for recommending them as a health food to combat diseases associated with iron deficiency (anaemia).

The variation in mineral content observed in the leaves, roots, and stems of *Dracaena camerooniana* would be attributed to the assay capabilities of each plant organ and the geological environment of the habitat. El Hajajil *et al.* [63] reported that significant variations in tissue mineral content can occur depending on the organs analyzed (roots, bark, flowers, fruits, and leaves) of the plant.

Furthermore, Jarrige *et al.* [18] concluded that the mineral content of the plant depends on the soil, the availability of each element to the plant, and the efficiency of root uptake to the aerial organs of the plant.

IV. CONCLUSION AND RECOMMENDATIONS

The present study was aimed at conducting a nutritional study of *Dracaena camerooniana* Baker.

The results of this study showed that:

- The leaves contain water (86.89%), ash (15.59%), lipids (5.42%), protein (18.58%) and the energy value are estimated at 416.59 kcal (1743.013 kilojoules).
- The leaves are richer in potassium (1690.00 mg / 100 g), calcium (1459.97 mg/100 g), magnesium (498.83 mg/100 g), selenium (128.51 mg/100 g) and manganese (11.39 mg/100 g). However, the stems are richer in fiber (53.65%) and cobalt (2.80 mg / 100 g). On the other hand, the roots are richer in carbohydrates (79.89 %), phosphorus (149.56 mg / 100 g), zinc (5.83 mg/100 g) and iron (228.30 mg / 100 g).
- The richness of various nutrients contained in the organs of *D. camerooniana* proves that the consumption of this wild plant can contribute to the improvement of the nutritional status of the population, especially in anaemic people.
- Also, phytochemical studies and bioassays need to be conducted to discover the medicinal properties of this plant. Domestication of the plant should be done to ensure its conservation both in situ and ex situ with the support of local farmers. Thus in vitro micro-propagation would make healthy material available for domestication while the genetic diversity it represents is still available in its natural habitat.

COMPETING INTERESTS DISCLAIMER

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of scientific knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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