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Nutritional potential of three lesser-consumed wild leafy vegetables of the North-West region of Cameroon

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Abstract

The rate of malnutrition stands at 39% in the North West Region of Cameroon. One way of tackling this problem is by promoting the consumption of indigenous wild vegetables. In this study, the nutritional potential of three lesser-consumed wild leafy vegetables (*Xymalos monospora*, *Mentha longifolia* and *Amaranthus* sp.) available throughout the year in the North West Region of Cameroon was investigated using standard methods of analysis. The results showed that *Xymalos monospora*, *Mentha longifolia* and *Amaranthus* sp. were appreciable sources of macronutrients like proteins (12.23 ± 0.82, 10.34 ± 0.31 and 7.81 ± 0.01% dw respectively), lipids (13.32 ± 0.87, 14.67 ± 0.75, 14.16 ± 1.44% dw respectively), and carbohydrates (17.73 ± 0.01, 27.05 ± 3.90, 20.13 ± 1.59% dw respectively). They contained also Vitamin C and exhibited provitamin A activities. The mineral contents in *Xymalos monospora*, *Mentha longifolia* and *Amaranthus* sp. revealed appreciable levels of iron (12.81 ± 1.38, 80.34 ± 1.62 and 55.76 ± 2.74 mg/100gdw), of zinc (4.21 ± 0.23, 8.23 ± 0.08 and 11.57 ± 0.31mg/100gdw), of copper (20.41 ± 1.46, 11.78 ± 1.21 and 15.62 ± 2.88 mg/100gdw) and of sodium (3.05 ± 0.16, 5.52 ± 0.37 and 8.11 ± 0.10 mg/100gdw). The levels of anti-nutrients namely tannins, oxalates, hydrogen cyanides and phytates were far below the toxic levels. *Xymalos monospora*, *Mentha longifolia* and *Amaranthus* sp., these lesser-known and hence lesser-consumed wild leafy vegetables have a good nutritional potential and their consumption should be greatly encouraged to fight against malnutrition.

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Introduction

Micronutrient malnutrition affects more than half of the world's population, particularly in developing countries (WHO, 2009). Millions of people in Sub-Saharan Africa are threatened by hunger and malnutrition and about 265 million of them are undernourished. In Cameroon, the prevalence of vitamin A deficiency and anemia in children below five years of age is 39% and 68% respectively, indicating poor health care and malnutrition (WHO, 2009).

There are about 800 to 1000 species of edible leafy vegetables in Sub-Saharan Africa but only a little percentage is utilized as food meanwhile, African indigenous vegetables are very significant in the food security of underprivileged persons and are valuable sources of energy and micronutrients in the diets of isolated communities (Grivetti and Ogle, 2000). Edible wild vegetables exert great nutritional importance during periods of drought, social unrest or war. They are cheap and are mostly gathered from cultivated fields, fallowed lands and the veldt (Venter *et al.*, 2007). In the North West Region of Cameroon, the rates of malnutrition, stunting and wasting stood at 39, 31 and 8% respectively (Demographic and Health Survey, 2004).There are many wild vegetables in the North West Region of Cameroon, which are available during the dry season when many domesticated varieties are scarce and very expensive. These vegetables could provide alternative yet cheaper sources of nutrients (Venter *et al.*, 2007). However, there is a need to provide scientific information on their nutritional value.

Materials and methods

Survey

The study was conducted in four divisions of the North West Region: Boyo, Bui, Mezam and Momo and two villages were randomly chosen per division. These villages included Anjih of Belo and Mbungongo of Njinikom (Boyo), Kiyan and Wainamah (Bui), Agyati of Bafut and Ntinkah of Mankon (Mezam) and Guzang and Bessi of Batibo (Momo). Two hundred questionnaires (50 per division) were administered. From this survey three lesser-consumed wild leafy vegetables (photograph 1) were selected based on the fact that they were unfamiliar to many and their consumption was limited to particular tribes. These three lesser-consumed wild leafy vegetables were collected from fields and farm lands of the North West Region following a random sampling.

Mentha longifolia

Xymalos monospora

Amaranthus sp.

Photograph 1. Lesser-consumed wild leafy vegetables of the North West Region of Cameroon.

Samples preparation

Young shoots and fresh leaves of each vegetable were collected at maturity early in the morning from surveyed veldts and farm lands. They were sorted out, washed with clean water, left to drain for 7-10min, dried at 45°C for 24h, ground and sieved through a 500µm sieve before being stored in plastic containers for analyses.

Evaluation of proximate composition and Energy value

Moisture content was determined after oven drying to a constant weight at 105°C. Ash, lipids and crude fibers were analyzed according to AOAC (2000). Meanwhile proteins and carbohydrates content were determined respectively as described by Devani *et al*., (1989) and by Fischer and Stein (1961). The total Energy value of the lesser-consumed wild leafy vegetables was calculated according to Iniobong and Uduak (2015).

Evaluation of vitamin C, carotenoids and provitamin A activity

Vitamin C content was evaluated using 2, 6-dichloroindophenol as described by AOAC (2005). Carotenoids were determined after double extraction in a mixture of 50% hexane, 25% acetone, 25% ethanol according to the procedure described by Lemmens *et al*. (2010). After partitioning, the organic layers were combined and read at specific maximum absorption wavelengths corresponding to different carotenoids (444nm for α-carotene, 445nm for lutein, 450nm for β-carotene, 451 nm for β-cryptoxanthin, and 472 nm for lutein).

Provitamin A activity expressed as retinol activity equivalence (RAE) was calculated using the formula described by Nuray and Feryal (2011).

$$\text{RAE (mg \%dw)} = \frac{\beta \text{ carotene content}}{12} + \frac{\alpha \text{ carotene content } + \beta \text{ cryptoxanthin content}}{24}$$

Evaluation of minerals

The procedure described by Antia *et al*., (2006) was employed. After digestion of the samples with concentrated nitric acid, the absorbance was read using atomic absorption spectrometry.

Evaluation of anti-nutrients

Total Phenolics content were assessed using Folin-Ciocalteau reagent as described by Dewantoo *et al.,* (2002). Tannins content was determined by the vanillin-HCl method of Bainbridge *et al*., (1996).

Phytates content was evaluated using Wade solution as described by Gao *et al*., (2007). Oxalates content was determined after titration with potassium permanganate and hydrogen cyanide content assessed after titration with silver nitrate as respectively described by Day and Underwood (1986) and AOAC (1997).

Statistical analyses

The results presented in mean ± standard deviation of triplicate analyses were subjected to a Least Significant Difference test ($p < 0.05$) using Statgraphics Centurion 16.1

Results

Proximate composition of the lesser-consumed wild leafy vegetables

The proximate composition of the three lesser-consumed wild leafy vegetables under study is presented in table 1. The ash content revealing the minerals concentration of the vegetables varied within all the samples, with *Amaranthus* sp. having the highest value and *Xymalos monospora* the least value.

The lipid contents were found to be higher in *Mentha longifolia* and *Amaranthus* sp. than in *Xymalos monospora*.

The carbohydrates which are the primary source of energy in the body were not significantly different ($P > 0.05$) in *Xymalos monospora* and *Amaranthus* sp. but lower than that of *Mentha longifolia*. *Xymalos monospora* registered the highest protein unlike *Amaranthus* sp. which registered the least.

Mentha longifolia provided higher energy, followed by *Xymalos monospora* and *Amaranthus* sp. which exhibited similar energy values.

Evaluation of vitamin C, carotenoids contents and provitamin A activity

The vitamins potential of the three lesser-consumed wild leafy vegetables under study is presented on table 2. There were no significant differences (P >0.05) between the vitamin C contents of *Xymalos monospora* and *Mentha longifolia* and between the carotenoid contents of all the vegetables. *Xymalos monospora* and *Mentha longifolia* had the highest Vitamin C content compared to *Amaranthus* sp.

Table 1. Proximate composition (% dw) and energy value (kcal/100gdw) of three lesser-consumed wild leafy vegetables.

Parameter	*Xymalos monospora*	*Mentha longifolia*	*Amaranthus* sp.
Ash	9.86 ± 0.09^{a}	12.70 ± 0.42^{b}	16.30 ± 1.43^{c}
Lipids	13.32 ± 0.87^{a}	14.67 ± 0.75^{b}	14.16 ± 1.44^{b}
Fibres	22.56 ± 1.15^{a}	5.29 ± 0.96^{b}	1.94 ± 0.73^{c}
Carbohydrates	17.73 ± 0.01^{a}	27.05 ± 3.90^{b}	20.13 ± 1.59^{a}
Proteins	12.23 ± 0.82^{a}	10.34 ± 0.31^{b}	7.81 ± 0.01^{c}
Energy	239.75 ± 8.59^{a}	284.65 ± 17.10^{b}	238.08 ± 2.32^{a}

Values expressed are mean ± standard deviation. Values within the same row with different letters are significantly different at $p < 0.05$.

Table 2. Vitamin C, carotenoids contents and provitamin A activity (mg/100gdw) of three lesser-consumed wild leafy vegetables.

Parameter	*Xymalos monospora*	*Mentha longifolia*	*Amaranthus* sp.
Vitamin C	31.44 ± 0.78^{a}	31.75 ± 0.24^{a}	28.36 ± 0.44^{b}
β-carotene	0.33 ± 0.01^{a}	0.37 ± 0.05^{a}	0.35 ± 0.09^{a}
β- cryptoxanthin	0.37 ± 0.01^{a}	0.37 ± 0.04^{a}	0.45 ± 0.01^{a}
α- carotene	0.30 ± 0.01^{a}	0.26 ± 0.04^{a}	0.26 ± 0.07^{a}
Lycopene	0.25 ± 0.01^{a}	0.27 ± 0.04^{a}	0.24 ± 0.04^{a}
Lutein	0.31 ± 0.05^{a}	0.37 ± 0.02^{a}	0.39 ± 0.03^{a}
Total carotenoids	1.55 ± 0.01^{a}	1.72 ± 0.2^{a}	1.80 ± 0.8^{a}
Provitamin A carotenoids	0.99 ± 0.03^{a}	1.08 ± 0.14^{a}	1.16 ± 0.12^{a}
RAE	0.06 ± 0.01^{a}	0.06 ± 0.01^{a}	0.06 ± 0.01^{a}

Values expressed are mean ± standard deviation. Values within the same row with different letters are significantly different at $p < 0.05$.

Table 3. Mineral contents (mg/100gdw) of three lesser-consumed wild leafy vegetables.

Minerals	*Xymalos monospora*	*Mentha longifolia*	*Amaranthus* sp.
Iron	12.81 ± 1.38^{a}	80.34 ± 1.62^{b}	55.76 ± 2.74^{c}
Zinc	4.21 ± 0.23^{a}	8.23 ± 0.08^{b}	11.57 ± 0.31^{c}
Copper	20.41 ± 1.46^{a}	11.78 ± 1.21^{b}	15.62 ± 2.88^{c}
Sodium	3.05 ± 0.16^{a}	5.52 ± 0.37^{b}	8.11 ± 0.10^{c}

Values expressed are mean ± standard deviation. Values within the same row with different letters are significantly different at $p < 0.05$.

The highest iron content was recorded in *Mentha longifolia*. This was followed by *Amaranthus* sp. while *Xymalos monospora* had the lowest iron content. Zinc content was higher in *Amaranthus* sp. while the lowest value was recorded in *Xymalos monospora*. Copper values of the lesser-consumed wild leafy vegetables varied with the highest being in *Xymalos monospora* and the lowest being in *Mentha longifolia*. *Amaranthus* sp. had the highest sodium content followed by *Mentha longifolia* and then *Xymalos monospora*.

Evaluation of anti-nutrients content

Anti-nutrients in food include phenolic compounds, tannins, phytates, oxalates and hydrogen cyanides. Most of them chelate minerals rendering them unavailable to animals. The anti-nutrient contents of the three lesser-consumed wild leafy vegetables analyzed are shown in table 4. The anti-nutrient contents of the lesser-consumed wild leafy vegetables were significantly different ($P<0.05$) within the species except for the oxalate contents of *Xymalos monospora* and that of *Mentha longifolia* and the hydrogen cyanide contents of all the vegetables which were similar (P>0.05). The results showed that highest total phenolics content was recorded in *Mentha longifolia* while *Amaranthus* sp. recorded the least. Highest tannin value was recorded in *Xymalos monospora* while lowest tannin and oxalate values were recorded in *Mentha longifolia*. *Amaranthus* sp. registered the highest phytate content while *Mentha longifolia* registered the lowest. *Xymalos monospora* and *Mentha longifolia* recorded similar oxalate contents while lowest oxalate values were recorded in *Amaranthus* sp. Hydrogen cyanide contents were similar in the three lesser-consumed wild leafy vegetables under study.

Table 4. Anti-nutrient contents (g/ 100gdw) of three lesser-consumed wild leafy vegetables

Anti-nutrients	*Xymalos monospora*	*Mentha longifolia*	*Amaranthus* sp.
Total phenolics	1.81 ± 0.06^a	2.42 ± 0.03^b	1.67 ± 0.01^c
Tannins	0.72 ± 0.02^a	0.23 ± 0.02^b	0.35 ± 0.03^c
Phytates	0.34 ± 0.01^a	0.14 ± 0.03^b	1.89 ± 0.03^c
Oxalates	0.77 ± 0.04^a	0.77 ± 0.02^a	0.69 ± 0.02^b
Hydrogen cyanide	0.08 ± 0.01^a	0.08 ± 0.01^a	0.08 ± 0.01^a

Values expressed are mean ± standard deviation. Values within the same row with different letters are significantly different at $p < 0.05$.

Discussion

The ash contents of these lesser-consumed wild leafy vegetables concurred with the range of values 9.01, 9.56, 13.01 and 15.55% reported for bush-buck, *Vernonia amygdalina,* scent leaf and *Amaranthus hybridus* (Asaolu *et al.,* 2012). In the same line, the lipid values of these vegetables agreed favorably with 14.02g/ 100g reported for *Amaranthus hibridus* by Asaolu *et al.*, (2012). Fibres add bulk to food thereby preventing constipation as well as reduce the risk of colon cancer (Pillai and Nair, 2013). The fibre concentration of *Amaranthus* sp. was in line with the fibre contents of 1.7 and 1.6% respectively reported for *Amaranthus hybridus and Telfaria occidentalis* by Adeyeye and Folasade (2011). Meanwhile, that of *Xymalos monospora* was similar to 23.08% reported by Afolayan and Jimoh (2009) for *Solanum nigrum*. The carbohydrates contents of the three vegetables under study were higher than those reported by Ajiboye *et al.* (2014) for *Hisbiscus esculenta* (10.6g/100g) and *Solanum macrocarpon* (6.4g/100g) but lower than that of *Vernonia amygdalina* (48.2g/100g). Their protein contents were higher than the range of 4.2 to 6.0g/100gdw reported for other indigenous leafy vegetables but lower than those of *Amaranthus hybridus* and *Telfairia occidentalis* (34.8 and 35.4g/100g respectively) observed by Adeyeye and Folasade (2011). These three lesser-consumed vegetables possessed energy values within the range when compared to 267.66 and 293.66 kcal/100g obtained from some indigenous vegetables namely *Brassica juncea* and *Moringa oleifera* (Saha *et al.*, 2015).

Vitamin C enhances iron absorption (Bakare *et al.*, 2010). The vitamin C contents of the vegetables analyzed were lower than those of some indigenous green leafy vegetables commonly consumed in the North West Region of Cameroon; 277.80mg/100g for *Telfaria occidentalis* (Otitoju *et al.*, 2014) and 62.97 mg/100g for *Solanum nigrum* (Agiang *et al.,* 2017). Carotenoids prevent cancer and cardiovascular diseases (Stahl and Sies, 2005). In the body, some can be converted into vitamin A which plays a vital role in vision, cell division and differentiation (Ramadhan and Ian, 2012). The three leafy vegetables under study exhibited similar levels of total carotenoids, provitamin A carotenoid and activity. Amaranths have been noted to be good vegetable sources of provitamin A carotenoids (FAO, 2001). The α-carotene and β-cryptoxanthin levels of the wild leafy vegetables in this study were respectively similar to those of *Cucurbita maxima*, *Hibiscus cannabinus*, *Moringa oleifera* and *Solanum nigrum* while their β -carotene, lutein and total carotenoid contents respectively were lower than the levels obtained for the same indigenous leafy vegetables (Djuikwo *et al.,* 2011).

The mineral contents of the wild leafy vegetables evaluated were higher than those of some wild leafy vegetables of the Southwest Region of Cameroon; *Amaranthus dubius* (0.06; 0.69 and 0.26mg/100g), *Gnetum africanum* (0.75; 0.02 and 0.71mg/100g) and *Vernonia amygdalina* (0.17; 0.05 and 0.80mg/100g) for copper, iron and zinc respectively (Mih *et al.*, 2017). They were also higher than that of the exotic vegetable cabbage (0.05mg/100g for copper, 2.15mg/100g for iron and 2.11mg/100g for zinc) as reported by Ogbede *et al.*, (2015). Minerals contained in these vegetables could be of great interest for health. In fact, *Mentha longifolia* contributed more to the RDA of iron (803.4-535.6%) unlike *Xymalos monospora* which contributed less (128.1-85.4%). Meanwhile, *Amaranthus* sp. made higher contributions to the RDA of zinc and sodium (96.42-60.89 and 1.62% respectively) unlike *Xymalos monospora* which made most contribution to the RDA of copper (1360.67-680.33%). Nevertheless, the contributions made by the mineral elements in the vegetables under study to RDA were more than those reported for *Telfairia occidentalis* (104-156, 29-46 and 57-115% for iron, zinc and copper respectively), but that of sodium was lower (Idris, 2011).

Phenolic compounds possess antibacterial and antioxidant properties (Alli, 2009). The total phenolics content of the lesser-consumed wild leafy vegetables under study were higher than the 0.35mg/100g reported for *Amaranthus hybridus* L. (Akubugwo *et al.*, 2007) and the range of values (132.32 to 289.37mg/100g) reported for other indigenous vegetables (Acho *et al.*, 2014). Tannins are toxic and hence lethal above 5% with a total acceptable tannin daily intake of 560mg (Habtamu and Negussie, 2014). The levels of tannins in *Xymalos monospora, Mentha longifolia* and *Amaranthus* sp. were far below the established toxic levels hence these lesser-consumed wild leafy vegetables are very safe for consumption. Phytates decrease the bioavailability of essential minerals like calcium, magnesium, zinc, iron and phosphorous (Agbaire and Oyewole, 2012). The daily intake of phytate has been estimated to be 2000-2600mg for vegetarian diets as well as diets of inhabitants of rural areas in developing countries and 1400mg for mixed diets (Golden, 2009), while toxic levels have been established at 6% (Sobowale *et al.,* 2011). The phytate levels obtained in this study were below the established toxic levels. Oxalates chelate calcium, iron and magnesium thereby rendering these minerals unavailable to animals. Intake levels of oxalates in foods is limited to 50-60mg per day (Massey *et al.*, 2001) and toxic levels stand at 25% (Oke, 1996). Oxalate levels in this study were below the established 25% toxic level. Hydrogen cyanide has been implicated in cerebral damage and lethargy in man. Hydrogen cyanide contents in all the lesser-consumed wild leafy vegetables were similar and very lower than the safety limit of 350mg/100g reported by Anhwange *et al.*, (2009).

Conclusion

Xymalos monospora, *Mentha longifolia* and *Amaranthus* sp. are wild leafy vegetables available throughout the year in the North West Region of Cameroon. These lesser-known and therefore lesser-consumed vegetables exhibit appreciable levels of macronutrients, energy, vitamins, minerals and very low levels of anti-nutrients. Therefore, their consumption should be greatly encouraged in the fight against hunger and malnutrition.

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