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Evaluation of the physicochemical properties of four wild leafy vegetables from the Agboville region (Southern Côte d'Ivoire)

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Abstract

Wild leafy vegetables are an integral part of eating habits in Africa and have the advantage of being cheaper and available. This study aimed to determine the physicochemical properties of some leafy vegetables. *Myrianthus arboreus* (Wognonibou), *Sesamum radiatum* (Ahirôh), *Justicia galeopsis* (Assiacriba) and *Solanum americanum* (Débé) have been considered. The parameters determined were water content, fiber, fat, protein, carbohydrate, energy value and minerals. The results showed that they all had high water content (86.88 to 91.43%). *Sesamum radiatum* having the highest moisture content. For the other components, crude fiber ranged from 42.09mg /100 g to 51.78mg/100g, protein from 18.39 to 31.29mg/100g, carbohydrates 13.08 to 25.16mg/100g, fat from 1.18 to 1.35mg /100g. the dietary energy value ranged from 118.43Kcal/100g to 148.9Kcal/100g dry matter. As for minerals, the potassium content varied from 1804.52 to 2433.88mg/100g, calcium from 608.68mg/100g to 1348.78mg/100g, phosphorus content from 231.26mg/100g to 479.50mg/100g, magnesium from 175.55 to 550.56mg/100g, iron from 8.19mg/100g to 36.03mg/100g and zinc from 6.02 to 25.61mg/100g. This study indicates that these leafy vegetables have varied and complementary compositions. It is therefore important to vary their uses and especially to combine them for food in order to fight against malnutrition.

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Introduction

In sub-Saharan Africa, wild plants have an important role in the daily diet of people. Vegetables are a vital food security for many people, especially during the lean season. Wild vegetables have a very important role in income generation and livelihood (Schippers, 2000). These are important products for poor households because their prices are relatively affordable compared to other food products. For a long time, a lot of leafy vegetables are known for their nutritional and health properties. The roots, leaves, fruits and bark of *Myrianthus arboreus* trees are used in traditional medicine. This local knowledge of the attributes of promoting and protecting the health of wild plants is clearly linked to their nutritional and bioactive properties. Spontaneous plants have a long history and continue to make a significant contribution to the dietary intake of vitamins and minerals from local populations. WHO recommends a minimum daily intake of 400g of fruits and vegetables (OMS and FAO, 2003) equivalent to the daily consumption of five (5) servings of 80g of fruit and vegetables (WHO 2004; FAO, 2011).

Some leafy vegetables are an excellent source of minerals such as zinc, iron, magnesium, calcium and potassium. They contribute to the fight against food insecurity (Soro *et al*., 2014).

Recent studies have shown that leafy vegetables contain non-nutritious bioactive phytochemicals that have protective action against cardiovascular and other degenerative diseases. However, at the beginning of the 20th century, wild leafy vegetables were abandoned by the populations in favor of exotic plants (Shumsky *et al*., 2014).

The reasons for the abandonment are related to the lack of information and scientific data that can justify the consumption and preservation of these wild leafy vegetables (Mangambu, 2012).

In Côte d'Ivoire, there is a botanical diversity (Ouattara, 2016). Several studies on the description and use of plants by the populations have been carried out (Ambé 2001, Adou 2006 and Kouamé 2013). However, the study of spontaneous plants used as food has not yet covered all regions of Côte d'Ivoire. Also, the biochemical and nutritional data on these plants are insufficient (Kouamé, 2015).

The objective of this study is to provide biochemical and nutritional data on some wild leafy vegetables consumed in the region of Agboville (southern Côte d'Ivoire). Specifically, it involves assessing their levels of protein, fat, carbohydrate, water, energy and minerals.

Materials and methods

Study setting

This study was concluded in southern Côte d'Ivoire, specifically in the Agboville region. An ethnobotanical survey conducted between September 2016 and July 2017 in three sub-prefectures, namely Azaguié, Attobrou and Aboudémandéké, made it possible to recover four well-known and consumed plants (Wognonibou and Débé) is less well known and badly consumed (Assiacriba and Ahirôh). These four wild leafy vegetables were picked in the fields, in the department of Agboville and more precisely in the localities of Aboudé Kouassikro (*Justicia galeopsis*, *T. Anderson* ex-CBClarke), Azaguié (*Sesamum radiatum* Schum. & Thonn) and Attobrou (*Solanum americanum* L.) and *Myrianthus arboreus* P. Beauv).

Sample preparation

Leafy vegetables were treated according to the method described by Chinma and Igyor (2007). After being sampled in the various fields, the various leafy vegetables were immediately sent to the Yopougon Technical High School Biochemistry Laboratory where they were sorted, cleared of debris, detached from their stem and thoroughly rinsed with distilled water. They were then drained at laboratory temperature (20° C) for 15 to 20 minutes. Laboratory analyzes were carried out on a quantity of 250g and then placed in an oven at 60° C for 72 hours. The leafy vegetables were crushed using a CULATTI micro-grinder (France) equipped with a 10 µm mesh screen and then stored in plastic for analysis.

Assessment of biochemical composition and energy value

The moisture content was determined after oven drying at constant weight at 105°C.

Ash and protein were analyzed according to AOAC (1990). On the other hand, the lipid content was determined according to the method described by AFNOR (1986), using Soxhlet as extractor, the fiber content according to the method of Wolf (1968), total carbohydrates and the energy value according to the method calculated by FAO (2002).

Determination of minerals

The determination of the minerals was carried out according to the method described by CEAEQ (2013) using argon plasma ionizing source mass spectroscopy (ICP-MS). The minerals are atomized and ionized in an argon plasma and the ions produced are analyzed by the spectrometer. The concentration of minerals in the sample is determined by comparison with standard solutions.

Statistical analyzes

The Epi-data 3.1 software was used to enter the survey data. The raw data was then transferred to SPSS version 2.0 software for statistical processing. The data collected was the subject of a descriptive statistical analysis. In addition, the chi-square significance test was used to compare frequency distributions. This test indicates the strength of the relationships between two variables contained in the contingency tables. The differences were considered significant at the 5% level. The average data come from three trials. They were subjected to two types of treatments using Data Mining techniques. Mean comparisons (ANOVA and Turkey test as needed).

Results and discussion

The moisture, ash, fat, fiber, protein, carbohydrate and energy content of the four leafy vegetables are shown in Table 1. The moisture content of the four spontaneous plants is very high. Ahirôh with a rate of 91.43% contains the highest rate. This shows how often leafy vegetables are very perishable (Kouamé, 2013). They must therefore be treated with great care and well preserved (Houndji, 2013). These grades are similar to those reported by Itoua (2015), which found in the leaves of Phytolacca dodecandra 81.87% moisture content. This is why leafy vegetables have to undergo technological treatments to be preserved. This high moisture content facilitates their digestion once in the digestive tract, as well as the absorption of the nutrients they contain (Sriwichai, 2016). Wognonibou had the lowest moisture content (86.88%), while Assiacriba and Débé ranged from 86.88%.to 91.43%. The crude fat content was higher in the leaves of Wognonibou (1.35%) compared to the other three leaves whereas those in Débé had the lowest levels (1.18%). The lipid content of the leaves of Assiacriba was identical to that found in the leaves of Talinum triangulare by Kwenin (2011), by all other values are lower than the fat content in Xanthosoma sagittifolia leaves which corresponds to 3.19% (Kwenin, 2011). These legumes are all poor in fat.

The protein content of volunteer plants ranged from 18.39% to 31.29%. Débé have the highest rate and Assiacriba the lowest. These levels are lower than those of Loukou (2018), which produced 21.11% of protein in the leaves of Assiacriba. This difference could be explained by the fact that the place of origin of the soil is a factor likely to influence the composition of vegetables. On the other hand, the protein content of Débé is higher than that of Atchibri *et al.* (2012), who found 29.9% in the leaves of Débé produced in Port Bouet, a neighborhood of Abidjan. In addition, their work confirms the variation of leaf nutrient content according to the provenance. In fact, analyzes of three groups of leaves of *Corchorus olitorius* have values of 24.89; 19.67 and 32.18%. The consumption of these vegetables could make it possible to vary the sources of proteins and to cover the needs of the organism. Indeed, proteins are involved in the formation of several compounds such as antibodies, enzymes that provide vital functions, but also to ensure the growth of children and replace worn cells. The mineral contents are shown in Table 2. The mineral composition is varied. The amounts of magnesium range from 175.55 ± 1.61 to 450.56 ± 1.78mg/100g, respectively, for Ahirôh and Wognonibou. Magnesium maintains muscle functions and contributes to the proper functioning of nerve functions. It is involved in several reactions during biochemical reactions in the body and in the regulation of blood pressure and heart rate (Rude *et al.,* 2009).

hosphorus was evaluated between 236.26 ± 0.41 for Assiacriba and 479.50 ± 1.48 for Ahirôh. It helps maintain a normal bone structure and contributes to the functioning of cell membranes (Turan *et al.,* 2003). As for potassium, the values are between 1804.52 ± 2.38 for Wognonibou and 2433.88 ± 1.03 for Ahirôh. Potassium is involved in membrane and cell exchange, contributing to regulation of plasma volume, acid-base balance, and muscle contraction (Tchatchambe *et al.,* 2017). Calcium levels ranged from 608.68 ± 1.24mg / 100g for the Débé to 1348.78 ± 1.27mg / 100g for Assiacriba. Calcium is an essential mineral and plays a key role in ossification, muscle function and the transmission of nerve messages, as well as in the dentition (Raghuvanshi *et al.,* 2001). The iron content of these different vegetable leaves was estimated to 8.19 ± 0.11mg / 100g for Assiacriba and 36.03 ± 0.14mg / 100g for Ahirôh, while the zinc content varied from 6.02 ± 0.10 to 25.61. ± 0.21mg /100g respectively for Assiacriba and Ahirôh. Iron is an important constituent of many enzymes needed for energy transfer (xanthine oxidase). It is also found in essential compounds for the transport and use of oxygen (hemoglobin and myoglobin). He also has a role in the system immune (Chappuis, 1995). Zinc is an enzymatic cofactor that plays a role in the processes most important metabolic factors. His presence is indispensable for a normal cell growth as well as for acid synthesis nucleic acids, carbohydrates and proteins. In the elderly, its role on immunity, scars, taste and anti-radical defense makes an important trace element. (Favier, 1994). The iron and zinc contents are higher than those of Ehilé *et al.* (2017) found levels of iron between 0.25 and 0.45mg / 100g and zinc levels between 0.003 and 0.029mg / 100g in five leafy vegetables, *Vernonia amygdalina* (Abovi), *Talinum triangulare* (Anangobrou), *Ximenia americana* (Kogolémrou), *Piper guineense* (Fèfèbrou) and *Ceiba pentandra* (Nanmougou) in Cote d'Ivoire.

Table 1. Content in Ash, Fat, Fiber, protein, Carbohydrate, Energy and Moisture of four wild leafy vegetables.

	Moisture (%MS)	Ash (%MS)	Fats (%MS)	Fiber (%MS)	Proteins (%MS)	Carbohydrate (%MS)	Energy (kcal/100g)
Myrianthus arboreus (Wognonibo)	86.88 ± 0.20^{a}	10± 0.06^{b}	1.35± 0.04^{c}	51.78±0.3^{d}	18.42±0.03 ^{a}	18.45±0.18^{c}	123.96±0.07
Sesamum radiatum (Ahirôh)	91.43 ± 0.15^{d}	9.24±0.09^{a}	1.28± 0.03^{b}	45.93± 0.22^{b}	18.39±0.01 ^{a}	25.16±0.15 ^{d}	147.89±0.13
Justicia galeopsis (Assiacriba)	90.32 ± 0.07^{c}	13.47±0.08^{d}	1.33± 0.05^{bc}	48.04± 0.53^{c}	23.62±0.01 ^{b}	13.54±0.30 ^{b}	118.43±0.08
Solanum americanum (Débé)	89.37± 0.1^{b}	12.36±0.14^{c}	1.18±0.03^{a}	42.09± 0.25^{a}	31.29±0.34 ^{c}	13.08±0.25 ^{a}	134.20±0.15

Mean values ± Standard deviation values. a-d means in same column but with different superscripts differ significantly ($p < 0.05$)

Table 2. Mineral composition of four wild leafy vegetables (mg/100g).

	Mg (mg/100g)	P (mg/100g)	K (mg/100g)	Ca (mg/100g)	Fe (mg/100g)	Zn (mg/100g)
Myrianthus arboreus (Wognonibo)	450.56±1.78^{d}	261.68±0.05^{a}	1804.52±2.38^{a}	1141.20±0.42^{b}	14.83±0.03^{c}	12.93±0.07^{b}
Sesamum radiatum (Ahirôh)	175.55±1.61^{a}	479.50±1.48^{d}	2433.88±1.03^{d}	1186.81±0.60^{c}	36.03±0.14^{d}	25.61±0.21^{d}
Justicia galeopsis (Assiacriba)	194.89±2.22^{b}	236.26±0.41^{b}	1978.2±0.80^{b}	1348.78±1.27^{d}	8.19±0.11^{a}	6.02±0.10^{a}
Solanum americanum (Débé)	423.27±1.10^{c}	432.58±0.46^{c}	2337.94±1.33^{c}	608.68±1.24^{a}	12.43±0.01^{b}	18.88±0.24^{c}

Mean values ± Standard deviation values. a-d means in same column but with different superscripts differ significantly ($p < 0.05$).

These differences could be related to the area of production that can influence the composition of leafy vegetables (Dragovic-Uzelac, 2007). These vegetables can be used to cover minerals and thus help to avoid nutritional deficiencies that affect health, especially for pregnant women, children and the elderly. In addition a combination of these leaves could enhance its nutritional value and have a better health benefit (Institute of Medicine, 2005).

Conclusion

Myrianthus arboreus, Sesamum radiatum, Justicia galeopsis and *Solanum americanum* are wild leafy vegetable generally lesser known and therefore lesser consumed. The analyzis showed that they are rich in several nutrient and could cover RDA and contribute substantially for improving human diet and to fight against nutritional deficiencies.

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