

# Study of Physicochemical Properties of Some Traditional Vegetables in Ivory Coast: Seeds of *Beilschmiedia mannii* (Lauraceae), Seeds of *Irvingia gabonensis* (Irvingiaceae) and *Volvariella volvaceae*

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## ABSTRACT

Samples of fresh *Volvariella volvaceae*, dry seeds of *Irvingia gabonensis* and dry seeds of *Beilschmiedia mannii*, three traditional vegetables found on the market in Abidjan were studied in relation to their nutrients composition (protein, fat, carbohydrates), energy value, moisture, ash and minerals (Ca, Na, K, Mg, Fe). The results show that: *Volvariella volvaceae* is mushroom distinguished by its high rate of moisture ( $81\% \pm 0.530\%$  fresh matter), high carbohydrate content ( $79.440\% \pm 0.24\%$  dry matter) and protein content ( $17.010\% \pm 0.04\%$  dry matter) very significant. Mineral composition contains more Na ( $1.880\% \pm 0.02\%$  dry matter) and K ( $1.260\% \pm 0.12\%$  dry matter). Seed of *Irvingia gabonensis* is rich in lipid ( $63.610\% \pm 0.70\%$  dry matter) but it also contains appreciable levels of carbohydrates ( $23.250\% \pm 0.17\%$  dry matter), protein ( $7.230\% \pm 0.80\%$  dry matter) and mineral matter ( $5.910\% \pm 0.30\%$  dry matter). These seeds of *Irvingia gabonensis* contain more K ( $0.678\% \pm 0.01\%$  dry matter) and Ca ( $0.452\% \pm 0.09\%$  dry matter). Seed of *Beilschmiedia mannii* is rich in carbohydrates ( $92.080\% \pm 1.20\%$  dry matter), and has a significant protein content ( $7.160\% \pm 0.11\%$  dry matter), its mineral composition contains more than K ( $0.872\% \pm 0.05\%$  dry matter).

**Keywords:** Vegetables; Mushroom; *Volvariella volvaceae*; *Irvingia gabonensis*; *Beilschmiedia mannii*; Seeds

## 1. Introduction

Three categories of meats contribute to food in tropical Africa: the staple foods that provide the bulk of the energy ration, accompaniment foods that modify the taste qualities and provide essential elements (minerals, vitamins, supplements protein) and booster foods that take a leading role in wards or famine. Vegetables are classified in the second category, namely that of accompaniment foods. The word vegetable is any edible part of a plant, mushroom or algae, which is not sweet to taste. Also the plants supplying the condiments and herbs are included under this name [1].

In Africa about 4000 plant species have the potential to produce food crops [2]. African traditional or local vegetables are one part. They are more and more known for their importance in contributing to food security of millions of Africans in rural and urban areas [3]. These are the vegetables that the rural African population produces for consumption as local foods. According Rubaihayo [4] they are considered as traditional vegetables for at least two reasons:

- Although some of these plants are cultivated, others are easily found and harvested in their natural habitat.
- Many of these plants have been consumed for many generations, reflecting their importance in local culture.

Traditional vegetables contribute significantly the food security of rural and urban populations in many African countries. They have a very high nutritional value. They contain vitamin A, B and C, proteins and minerals such as iron, calcium, phosphorus, iodine and fluorine in varying amounts but adequate for health [5]. Traditional vegetables bring to the populations who have at their disposal only some few meat or fish, necessary proteins [6]. Our study focuses on the physico-chemical characterization of three traditional vegetables found on the market in Abidjan. These are samples of *Volvariella volvaceae* (mushroom) seeds of *Beilschmiedia mannii* and seeds of *Irvingia gabonensis*.

## 2. Material and Methods

### 2.1. Vegetal Material

For this study we used samples of traditional vegetables,

fresh *Volvariella volvaceae* (mushrooms) dry seeds of *Irvingia gabonensis* (Irvingiaceae) and dry seeds of *Beilschmiedia mannii* (Lauraceae), bought in Abidjan market (Ivory Coast).

## 2.2. Chemical Analysis

The moisture content was determined by drying in an oven at 105°C for 24 h to constant weight [7] the ash content was determined by incineration at 650°C muffle furnace [7] the protein content was determined by the Kjeldahl method using as a conversion factor 6.25 [8] the lipid content was determined by Soxhlet extraction with ether [8]; the total carbohydrate content was determined by difference according to the equation {100 – (% protein + % lipid + % ash + % water)}. The energy value was calculated using the equation {(4 × protein) + (9 × fat) + (4 × carbohydrate content)}[9]; mineral elements Ca Na K Mg Fe were determined with atomic absorption spectrophotometer Varian 5, after digestion of the ash in acid.

## 3. Results

### 3.1. The Composition of the Three Traditional Vegetables Samples Is Given in Table 1

*Volvariella volvaceae* is a species of mushroom with high rate of moisture (81.00% ± 0.53%) and in carbohydrate (79.440% ± 0.24% d.m), its protein contents (17.010% ± 0.04% d.m) and fat content (3.440% ± 0.02% d.m) are remarkable, its mineral content (0.110% ± 0.01% d.m) remains scarce. its energy value (397.930 ± 4.82 cal/ 100 g d.m) is appreciable.

Seeds of *Irvingia gabonensis* contain carbohydrates (23.250% ± 0.17% d.m), protein (7.230% ± 0.80% d.m) and ashes (5.910% ± 0, 30% d.m) with appreciable levels

and a significant quantity of fat (63.610% ± 0.70% d.m). The energy value (707.680 ± 3.19 cal/100 g d.m) of these seeds is high.

*Beilschmiedia mannii* seeds contain a big quantity of carbohydrates (92.080% ± 1.20% d.m), of average rates of protein (7.160% ± 0.11% d.m), of ashes (3.89% ± 0.24% d.m) and of a small quantity of lipids (0.610% ± 0.04% d.m). The Energy value (379.610 ± 1.90 cal/100 g d.m) is appreciable.

### 3.2. The Composition of Mineral Elements of Traditional Vegetables Is Given in Table 2

*Volvariella volvaceae* contains more Na (1.880% ± 0.02% d.m), K (1.260 ± 0.12% d.m), slightly less Ca (0.120% ± 0.04% d.m), Mg (0.130% ± 0.01% d.m) and very little iron (0.010% ± 0.00% d.m).

*Irvingia gabonensis* seeds contain more K (0.678% ± 0.01% d.m), Ca (0.452% ± 0.09% d.m), slightly less Mg (0.213% ± 0.01% d.m) and very little Na (0.061% ± 0.00% d.m), Fe (0.012% ± 0.00% d.m).

*Beilschmiedia mannii* seeds contain more K (0.872% ± 0.05% d.m), slightly less Ca (0.104% ± 0.02% d.m) and very little Na (0.061% ± 0.01% d.m), Mg (0.071% ± 0.00% d.m), Fe (0.029% ± 0.00% d.m).

## 4. Discussion

*Volvariella volvaceae* is a species of fungus that has high carbohydrate content (79.440% ± 0.24% d.m). This value is above that one given by Parent and Thoen [10] for species *Cantharellus cibalus* (64% d.m) and *Russula* sp (55% d.m) picked in D.R of Congo. And it approaches the value found by Azema [11] in the inedible species *polyporus sulfureus* (73% d.m).

**Table 1. Composition of vegetable samples.**

Samples	Moisture (% f.m <sup>**</sup> )	Proteins (% d.m <sup>*</sup> )	Lipids (% d.m)	Carbohydrates (% d.m)	Ashes (% d.m)	Energy value (Cal/100 g of d.m)
<i>Volvariella volvaceae</i>	81.000 ± 0.53	17.010 ± 0.04	3.440 ± 0,02	79.440 ± 0.24	0.110 ± 0.01	397.930 ± 4.82
<i>Irvingia gabonensis</i>	4.970 ± 0.50	7.230 ± 0.80	63.610 ± 0.70	23.250 ± 0.17	5.91 ± 0.30	707.68 ± 3.19
<i>Beilschmiedia mannii</i>	11.400 ± 0.72	7.160 ± 0.11	0.610 ± 0.04	92.080 ± 1.20	3.890 ± 0.24	379.610 ± 1.90

The indicated values represent the average of three determinations (n = 3). % d.m<sup>\*</sup>: % dry matter % f.m<sup>\*\*</sup>: % fresh matter.

**Table 2. Mineral composition of vegetables samples.**

Samples	Ca (% d.m <sup>*</sup> )	Na (% d.m)	K (% d.m)	Mg (% d.m)	Fe (% d.m)
<i>Volvariella volvaceae</i>	0.120 ± 0.04	1.880 ± 0.02	1.260 ± 0.12	0.130 ± 0.01	0.010 ± 0.00
<i>Irvingia gabonensis</i>	0.452 ± 0.09	0.061 ± 0.00	0.678 ± 0.01	0.213 ± 0.01	0.012 ± 0.00
<i>Beilschmiedia mannii</i>	0.104 ± 0.02	0.061 ± 0.01	0.872 ± 0.05	0.071 ± 0.00	0.029 ± 0.00

The indicated values represent the averages of three determinations (n = 3); % d.m<sup>\*</sup>: % dry matter.

The appreciable protein content  $17\% \pm 0.04\%$  d.m is between those of mushrooms *Cantharellus cibalus* (15% d.m) and *Russula* sp (29% d.m) that were given by Parent and Thoen [10].

The rate of fat,  $3.44\% \pm 0.02\%$  d.m is lower than those of fungi *Cantharellus cibalus* (6% d.m) and *Russula* sp (6% d.m) of Parent and Thoen [10]. Contrariwise, the species *Clitopilus prunulus* (0.00% d.m) and *Fistulina hepatica* (0.06% dm) studied by Azema [11] contain less fat. With  $0.11\% \pm 0.01\%$  d.m.

The rate of mineral matter is scarce, it is outside the range 1.76% d.m (*Clitocybe gigantea*) - 34% d.m (*Cortinarius praestans*) of different fungi's contents studied by Azema [11].

The high value of moisture content ( $81\% \pm 0.53\%$ ) shows that the *Volvariella volvaceae*, like all mushroom specimens with hat (50% to 90%) according Azema [11], is also rich in moisture.

*Volvariella volvaceae* contains high concentrations of Na ( $1.880\% \pm 0.02\%$  d.m) and K ( $1.260\% \pm 0.12\%$  d.m).

These values are higher than those of ears Fungus (Na: 0.985% d.m; K: 0.310% d.m). The contents of Ca ( $0.120\% \pm 0.04\%$  d.m) and iron (Fe) ( $0.010\% \pm 0.00\%$  d.m) are lower than those of ears Fungus (Ca: 0.310% d.m) (Fe: 0.042% d.m).

**Seeds of *Irvingia gabonensis*** contain lots of fat ( $63.610\% \pm 0.70\%$  d.m). A value close to those found by Ekpe *et al.* [12]  $66.600\% \pm 0.80\%$  d.m and by Kouamé and Gnahoua [13]  $65.840\%$  d.m.

The protein content ( $7.230\% \pm 0.80\%$  d.m) is also significant. Its value lies between those given by Ekpe *et al.* [12]  $7.600\%$  d.m and Womeni *et al.* [14]  $8.400\%$  d.m. But it remains below the rate of  $5.830\%$  dm found by Kouamé and Gnahoua [13].

The total carbohydrate content ( $23.250\% \pm 0.17\%$  d.m) is also significant in this traditional vegetable. With a slightly higher rate of carbohydrate to that given by Womeni *et al.* [14]  $19.200\%$  d.m.

The seeds of *Irvingia gabonensis* have a remarkable mineral content ( $5.910\% \pm 0.30\%$  d.m). Its value is lower than that one found by Ekpe *et al.* [12]  $9.500\% \pm 0.30\%$  d.m, it is above the data of Kouamé and Gnahoua [13]  $2.31\%$  d.m. The energy value ( $707.680 \pm 3.19$  cal/100 g d.m) of seeds of *Irvingia gabonensis* is remarkable. That could be explained by the relatively high levels of fat, protein and total carbohydrate.

Seeds of *Irvingia gabonensis* contain more K ( $0.678\% \pm 0.01\%$  d.m) and Ca ( $0.452\% \pm 0.09\%$  d.m), a little less of Mg ( $0.213\% \pm 0.01\%$  d.m), very little Na ( $0.061\% \pm 0.00\%$  d.m) and Fe ( $0.012\% \pm 0.00\%$  d.m). These different contents are in approximate proportion to those given by Kombou and Joseph [15] related to the kernel of *Irvingia gabonensis* in Cameroon Fe: 0.060% d.m; Mg:

0.63% d.m; Ca: 0.600% d.m.

**Seeds of *Beilschmiedia mannii*** contain high level of carbohydrates ( $92.080\% \pm 1.20\%$  d.m). This value is slightly above that given by Leung *et al.* [16]  $88.76\%$  d.m.

The protein content ( $7.160\% \pm 0.11\%$  d.m) has a value between those found by Kouamé and Gnahoua [13]  $6.670\%$  d.m and by Leung *et al.* [16] (1968)  $8.920\%$  d.m. This vegetable has a low fat content ( $0.610\% \pm 0.04\%$  d.m), a lower result than that of Kouamé and Gnahoua [13]  $2.040\%$  d.m, but close to that given by Leung *et al* [16]  $0.590\%$  d.m.

The rate of mineral matter ( $3.890\% \pm 0.24\%$  d.m) has a value less than that given by Kouamé and Gnahoua [13] ( $5.700\%$  d.m).

The energy value  $379.610 \pm 1.90$  cal/100g d.m of this vegetable is also significant and is similar to that given by Leung *et al.* [16]  $389$  cal/100 g d.m. Seeds of *Beilschmiedia mannii* contain more K ( $0.872\% \pm 0.05\%$  d.m), a little less Ca ( $0.104\% \pm 0.02\%$  d.m), very little of Mg ( $0.071\% \pm 0.00\%$  d.m), Na ( $0.061\% \pm 0.01\%$  d.m) and Fe ( $0.029\% \pm 0.00\%$  d.m).

Leung *et al.* [16] gives a calcium content of the *Beilschmiedia mannii* seeds equal to Ca: 0.258% d.m. A value greater than that found in our study Ca:  $0.104\% \pm 0.02\%$  d.m.

## 5. Conclusions

The *Volvariella volvaceae* (mushroom) have high water content, high carbohydrate content and significant protein content. This mushroom is relatively rich in Na and K.

The seeds of *Irvingia gabonensis* are rich in fat and contain a level of carbohydrates, protein and mineral matter equally remarkable. The seed of *Irvingia* contains less Na and more K, Ca, Mg.

*Beilschmiedia mannii* seeds are a food rich in carbohydrates with significant protein content. The seed of *Beilschmiedia mannii* contains less Na, Mg and K, Ca.

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