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Research Article

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Study of the Nutritional Potential of a Solanaceae Endemic to West Cameroon: Solanum Melongena L. Spineless Variety

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Abstract

In Cameroon, Solanum melongena L. spineless variety is found in markets in two forms namely: one dried and the other boiled and dried; This urges us to seek the most nutritious form in order to further enhance its use. The objective of the study was to evaluate the nutritional contribution of the flours of dried, boiled and dried fruits of Solanum melongena L. spineless variety. We carried out nutrient assays according to physico-chemical analysis methods of the AOAC (1990). And we have seen that in 100 g of dried eggplant flour, the major macronutrients are fibers (37.6 ± 0.002 g) followed by lipids (23.26 ± 0.001 g), and proteins (16.46 ± 0.004 g). In 100g of boiled and dried eggplant flour, the major macronutrients are fibers (25.77 ± 0.008 g) followed by lipids (25.44 ± 0.001 g), and proteins (16.62 ± 0.003g). The major micronutrients are: K (1286 ± 0.007 mg) and Na (294.6 ± 0.006 mg) followed by Zn (36.88 ± 0.002 mg) and Fe (11.3 ± 0.004 mg) for 100 g of flour dried eggplants. And in 100 g of dried and boiled eggplant flour the major micronutrients are: K (1232 ± 0.001 mg) and Na (294 ± 0.001 mg) followed by Zn (19.9 ± 0.004 mg) and Fe (8.53 ± 0.002 mg). we can therefore say that, Solanum melongena L. spineless variety, is a fruit used for making several dishes with nutritional properties and therapeutically exploitable.

Keywords: Solanum Melongena L, Eggplant, Nutrients, Flour

1. Introduction

According to the Food and Agriculture Organization of the United Nations **(FAO, 2018),** in 2017 the number of people affected by food insecurity reached approximately 821 million; which represents about one in nine people in the world [1]. Food insecurity appears to be on the rise in almost all sub-regions of Africa, as well as in South America, while the undernourishment situation is stable in most parts of Asia. The food insecurity that we observe today, in addition to contributing to undernutrition, promotes overweight and obesity, which partly explains the coexistence of these different forms of malnutrition in many countries. In 2017, more than 38 million children under five were overweight, with Africa and Asia accounting for 25 and 46 percent of the global total, respectively [1]. According to the report on the state of food security and nutrition in the world in 2018, the prevalence of undernourishment in Central Africa is increasing; i.e. 36.2 million in 2005 and 42.7 million in 2017. However in Cameroon, although high, the prevalence has considerably decreased from 30.6% in 2001 to 7.6% in 2016: i.e. from 4.9 to 1.9 million people [2].The Cameroonian flora ranked 4th in Africa according to its biodiversity is full of many plants that are used both for their culinary and therapeutic properties, which can help in the fight against undernourishment, the prevention and treatment of several human pathologies [3]. Hence the need to promote these plants in order to avoid their disappearance. Thus, in this diversity of plants, the *Solananceae* present themselves as a family of considerable importance.

Eggplant, a plant belonging to the *Solanaceae* family and the *Solanum genus*, is a vegetable that is used in the composition of several dishes and is of economic importance in Mediterranean and Asian countries. As found in America as in Africa, the cultivation of eggplant is possible in very varied climates (temperate, dry or humid tropical). It contains many cultivars which are distinguished in particular by the color, size and shape of the fruits. The most cultivated species are *Solanum macrocarpon Solanum melongena, Solanum aethiopicum gilo and Solanum gilo-anguivi* [4]. In Cameroon, the fruits of the species Solanum melongena L. spineless variety are used in several dishes. Immature eggplants can be eaten raw and in salads, although cooking is recommended to avoid poisoning. When ripe, the fruit pulp is fibrous; it has a fine texture and a bitter taste. In terms of agri-food, they are used in the preparation of many cooked dishes, especially soups and in different forms: stuffed, grilled, gratin, in a pan, on skewers or mashed. It is served with tomatoes, garlic and oil [5]. They are also used as spices in preparations such as yellow sauce and sticky sauce. These sauces originating from the regions of West and North-West of Cameroon, are accompanied respectively by pounded taro (*Colocassia esculenta*) and corn couscous [6].

In addition to culinary properties, *Solanum melongena* L. also has medicinal properties conferred to its metabolites. Eggplant is very low in calories and rich in fiber, it is an ally in the fight against obesity [7]. The present work aims to evaluate the nutritional contributions of fruit flours of *Solanum melongena* L. spineless variety in order to enhance this plant, to avoid its disappearance, to initiate the fight against undernourishment.

2. Materials and Methods

2.1. Study Framework

The studies took place in the following structures and places:

- Biochemistry laboratory of the Faculty of Sciences of the University of Douala for the preparation of fruit flour extracts from *Solanum melongena L.* spineless variety.

- Animal Production and Nutrition Research Laboratory, and Laboratory of the Soil Analysis and Environmental Chemistry Research Unit (URASCE) of the Faculty of Agronomy and Agricultural Sciences (FASA) of the University of Dschang.

2.2. Duration of the Study

The study took place over 6 months, from August 25, 2019 to February 25, 2020.

2.3. Study Material

Plant: *Solanum melongena* L. spineless variety

The plant material in Figure1 used consisted of the fruits of Solanum melongena L. spineless variety identified at the National Herbarium of Yaoundé (Identification by comparison with the botanical collection of Swarbrick N°-2264, registered at the National Herbarium under N°-34757/HNC). These organs were harvested in August 2019 in Bagam in the Bamboutos Division in West Cameroon.

Figure 1: Fruits of Solanum Melongena L. (a) Plant of Solanum Melongena L. (B) [8].

3. Methods: Procedures

3.3.1. Harvesting Fruit and Preparing Eggplant Flour

The fruits collected in Bagam (West Cameroon) in August 2019 were stripped of their husks, part was directly dried in an oven at 45°C and another was previously boiled in water for 15 minutes and oven-dried at 45°C. The dehydrated fruits were transformed into flour using an electronic grinder in order to carry out the various analyzes required by our study.

3.2. Nutrient Analyses

Nutrient analyses were carried out according to the methods of physico-chemical analysis of AOAC (1990).

- Determination of water and total solids: Thermogravimetric method

Principle: heat the sample to remove the water it contains until the mass of the sample remains constant.

Procedure: weigh 1 g of each sample and put in an oven at 60 ° C; Then weigh again 12 hours later. The calculation of the moisture content is done according to this formula:

$$\% H_2O = 100 - \%ST \quad \text{avec} \quad \%ST = \frac{\text{Mass (S.T)}}{\text{Mass (sample)}} \times 100$$

- Determination of ash:

Principle: The AOAC method consists of incinerating the sample at 560°C and in an oxidizing atmosphere until a residue of constant mass is obtained.

Procedure: Put a capsule in the oven at 105 ° C for 24 hours and determine its weight P1. Weigh 1,5 to 2 g of sample into the dish (P2) and place in the muffle oven at 560 ° C for 4 hours. At the exit of the oven, weigh the weight P3 of the capsule containing the ash. Calculate the ash content according to the formula:

$$\% \text{ of ash} = \frac{P_3 - P_1}{P_2 - P_1} \times 100$$

P1 = Empty capsule mass (g)
P2 = Sample mass + capsule (g)
P3 = Mass of capsule plus ash (g)

- Determination of proteins (determination of nitrogen by the Kjeldahl method)

Principle: It is based on the determination of the total nitrogen content by mineralization.

Procedure: Oxidation of nitrogenous organic matter by hot-concentrated sulphuric acid releases nitrogen, which is fixed as ammonium sulphate $(NH_4)2SO_4$. After alkalization with soda ash (NaOH 40%), the ammonia (NH_3) formed is distilled, captured by boric acid and determined by titrimetry.
The nitrogen content is obtained by the following formula:

$$\%N = \frac{(V1 - V0) \times 0{,}14 \times 100}{Ms \times V}$$

Where,
V1: the HCl volume
V0: the volume of descent of the burette
Ms: the mass of the sample used.
The protein content of the samples is obtained by multiplying the percentage of nitrogen by a factor **F = 6,25. % protein= %N x 6.25**

- Lipid determination (IUPAC, 1981), Soxhlet extraction method

Principle: it is based on the solubility of lipids in organic solvents.

Procedure: Weigh Two grams of each sample and place in a cellulose capsule. The samples are extracted continuously with hexane (200 mL) at a boiling (T.E.65°C) resulting in the gradual dissolution of the fat over 8 hours.

The hexane containing the fat in the flask is evaporated on a rotary evaporator (T.E.70°C).
The lipid content in the samples is calculated according to the formula:

$$\%\text{lipid} = \frac{\text{lipide Mass}}{\text{Mass(sample)}} \times 100$$

- Total carbohydrate dosage

Total carbohydrate obtained by difference. From the dry weight, the weight of ash, lipids and proteins is subtracted.

% Total carbohydrate = Ms - % proteins - % lipid - %ash

- Determination of cellulose content (Scharrer method)

Principle: The sample is decarbonated, degreased and treated successively with boiling solutions of sulphuric acid and potassium hydroxide of specified concentrations.

Procedure: Introduce one gram of sample (P0) into a 250 mL Erlenmeyer and 50 mL of Scharrer's reagent are added to dissolve all other organic compounds except cellulose. The assembly is brought to a boil in a heated train for 40 minutes. The contents of the beaker are then vacuum filtered in a filter crucible and the cellulose residue is dried in an oven at 105°C for 24 hours, cooled and weighed (P1). It is calcined in the oven at 450°C for 3 hours, cooled under a moisture analyzer and weighed (P2).

The cellulose content of the sample is calculated by the following formula:

$$\% \text{ cellulose } (\%MS) = \frac{P1 - P2}{P0} \times 100$$

- Mineral determination (Pearson method)

Principle:

- Flame photometry: Some of the ions subjected to the heat of the flame pass into an excited state. The return to the ground state of the electrons of the outer shell takes place with characteristic emission of the ion present.

- UV-visible absorption spectrophotometry is based on the property of matter, and more particularly of certain molecules, to absorb certain wavelengths of the UV-visible spectrum. It makes it possible to carry out dosages thanks to the Beer-Lambert law.

Procedure: Preparation of the solution to be analysed.
The ash obtained is fixed by adding 10 mL of 1 molar nitrite acid and then evaporated on a hot plate until the volume has halved. The remaining solution (5 mL) is filtered using filter paper and then transferred to a 50 mL volumetric flask, and supplemented with distilled water to obtain the solution S. this solution S, a small volume is taken each time for the determination of the desired mineral

- Determination of sodium (Na) and potassium (k) contents:

From the previous solution S, 1 mL is taken and introduced into a test tube, together with 9 mL of hydrochloric acid (0,2 N); emissions are read with an air/propane flame photometer at 768 nm and 589 nm for K and Na, respectively. The emissions of the standard solutions are read at the same time and are prepared at concentrations of: 0; 50; 100; 150; and 200 ppm for potassium and at concentrations of 0; 5; 10; 15 and 20 ppm for sodium. These standard solutions are prepared from stock solutions of 1000 mg K/L and 1000 mg Na/L. The potassium and sodium concentrations of the different samples are obtained from the linear regression equations obtained with the absorbances of the standard solutions of potassium and sodium which have been previously established.

- Determination of iron (Fe) and zinc (Zn) contents

Determination of iron: from the previous solution S, 5 mL are taken and introduced into a beaker to which 1 mL of potassium thiocyanate reagent has been added. The absorbances are read with a UV spectrophotometer visible at 420 nm at the same time with the standard solutions prepared at concentrations of 0; 2,5; 5; and 10 ppm from a 1000 ppm iron stock solution.

Determination of zinc: from solution S, 25 mL are introduced into the 50 mL specimen with 1 mL of HCl and 20 mL of NH4Cl (10%). A drop of sodium sulfite solution (10%) is added and the mixture is stirred lightly after each addition. After a few minutes, 1 mL of potassium ferrocyanide solution (0.5%) is added and then stirred and allowed to stand at darkness for at least 5 minutes and absorbance read with the UV spectrophotometer visible at 650 nm at the same time as the prepared standard solutions at concentrations of 1; 2; 4; and 6 ppm from a 1000 ppm Zn stock solution.

- Determination of manganese (Mn) and copper (Cu) content

Procedure: Manganese and copper are determined by atomic absorption spectrophotometry based on calibration solutions in concentrated hydrochloric acid at a wavelength of 324,75 nm.

3.3. pH Determination

This is a potentiometric method using a glass electrode specific to H+ ions.

Principle: The pH meter measures the potential difference between two electrodes. A glass electrode and a reference electrode are immersed in the solution studied. The assembly constitutes a battery whose electromotive force is measured with an electronic voltmeter of high input impedance and the reading gives directly the pH of the solution.

Procedure: Add four g of samples to 30 mL of distilled water, the mixture is stirred for 15 min followed by filtration. The recovered filtrate is used to determine pH values.

4. Data Analysis

The tests were performed in 3 trials and the results recorded on Microsoft Excel 2016, presented as mean ± standard deviation. The results were subjected to the analysis of variances (ANOVA) and the T TEST was used for the comparison of the means, at the probability threshold of $p < 0.05$ using the software GRAPHPAD PRISM version 7.0.

5. Results

5.1. Percentage Composition and Content of Some Minerals of *SOLANUM Melongena* L. Flours

- **Macronutrient content**

Table 1 shows the content of the macronutrients contained in 100 g of eggplant flour, dried and cooked and then dried.

Macronutrients	**Dried sample (g /100 g of flour)**	**Boiled and dried sample (g /100 g of flour)**
Lipids	23.26 ± 0.001^{a}	25.44 ± 0.001^{b}
Proteins	16.46 ± 0.004^{a}	16.62 ± 0.003^{b}
Total carbohydrates	6.87 ± 0.003^{a}	15.47 ± 0.004^{b}
Ashes	7.46 ± 0.005^{b}	6.11 ± 0.003^{a}
Water content	8.33 ± 0.007^{a}	10.55 ± 0.006^{b}
Cellulose	37.6 ± 0.002^{b}	25.77 ± 0.008^{a}

Table 1: Macronutrient Content of Eggplant Flour from Solanum Melongena L.

In each of the eggplant flour samples, the major macronutrients are fibers (cellulose) followed by lipids, then proteins and finally carbohydrates.

In energy values, for 100 g of sample, we have respectively 1257 KJ for the dried sample and 1486.75 KJ for the boiled and dried sample.

We find that boiling increases the total carbohydrate content considerably, the fat content slightly and the protein content slightly. Figure 2 presents the energy intake of eggplant flours. We observe an influence of boiling on these values: The contents of lipids, proteins and total carbohydrates were higher for boiled and dried flours compared to only dried flours. In addition, the ash and cellulose contents were lower for the boiled and dried flours compared to the contents of the dried flours only.

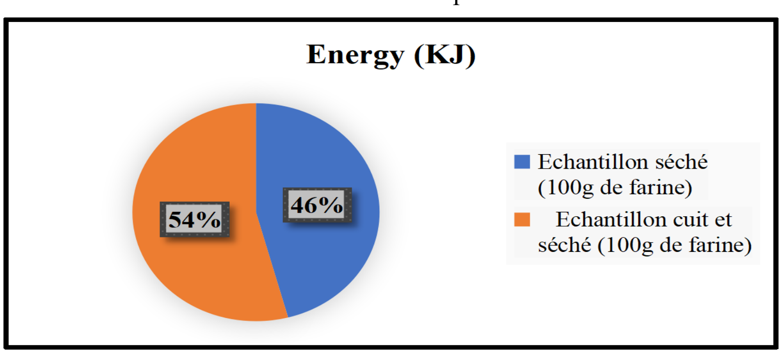

Figure 2: Energy Intake of Eggplant Flour from *SOLANUM Melongena* L.

- **Mineral Content**

Table 2 presents the mineral contents in 100g of eggplant flour.

	Dried sample (mg /100g flour)	Boiled sample (mg /100g flour)
Fe	11.3 ± 0.004^{b}	8.53 ± 0.002^{a}
Cu	0.01 ± 0.002^{a}	0.02 ± 0.001^{b}
Mn	0.02 ± 0.006^{a}	0.02 ± 0.001^{a}
Zn	36.88 ± 0.002^{b}	19.9 ± 0.004^{a}
K	1286 ± 0.007^{b}	1232 ± 0.001^{a}
Na	294.6 ± 0.006^{a}	294 ± 0.001^{b}

Table 2: Eggplant Flour Mineral Content Solanum Melongena L.

The results show that in 100 g eggplant samples the major micronutrients are: K and Na followed by Zn and Fe, finally Cu and Mn.

We observe a decrease in the content of K, Na, Zn and Fe after boiling.

- **Stability: pH**

Table 3 presents the pH values of the different eggplant samples

Dried sample	Boiled and dried sample
5.3 ± 0.008a	6 ± 0.001b

Table 3: pH of Samples from Solanum Melongena L. Spineless Variety

The pH of the dried sample was 5.3 ± 0.008 and lower than that of the boiled sample which was 6 ± 0.001; We note that the pH of eggplant flours increases slightly after boiling.

6. Discussion

According to our study, the content of macronutrients in the sample of boiled then dried flour was more predominant than that of the macronutrients in the sample of dried flour: the major macronutrients were fibers (cellulose) followed by lipids, then proteins. and finally total carbohydrates. And an energy difference was observed that is 1257.23 KJ for 100 g of flour dried flour and 1486.75 KJ for 100 g of boiled and dried flour. On the other hand, according to **Agoreyo *and al*., (2012)**, per 100 g of dry matter is *Solanum melongena* L., we have the following proportions: the ash content was between [0.5-0.6%]; the fiber content was between [2.4-4.2%]; the lipid content was 0.1%; the protein content was between [0.8-1.3%]; the carbohydrate content was between [2-2.8%]; the water content was between [92-94%] [9]. Moreover, the results obtained by T**chiégang *and al*., (2005)** were different: 5.52 ± 0.66 g of ash, 32.46 ± 6.40 g of fiber, 9.16 ± 0.10 g of lipids and 13.43 ± 0.02 g of protein [6].

We observe that fibers are the major components of flours. Thus 100 g of boiled eggplant flour consumed would cover 0.5% in a 55 kg adult and 0.8% in children in the recommended daily protein requirements; 100 g of boiled eggplant flour would cover approximately 0.85% of the daily fiber requirements and therefore would cover approximately 13% and 17% of the daily energy requirements respectively in a man and a woman.

Concerning the micronutrients, the results show that in 100 g samples of eggplant the major micronutrients are: K and Na followed by Zn and Fe, finally Cu and Mn. According to **Koua (2016),** the K and Na contents of 100 g of dry matter of *Solanum melongena* were as follows: K (240 mg) and Na (6 mg) [10]. In addition, the results of the work of **Agoreyo *and al*., (2012),** for 100 g of samples of *Solanum melongena* L., we have the following contents: Fe [1.96 ±0.06 mg-2.75±0.01 mg] and Zn (0.25±0.001 mg). Thus, for 100 g of dried and boiled eggplant flour consumed, the daily iron requirements would be covered in a man; approximately 63% for a woman and 41.85% for pregnant and adolescent women would be covered; On the other hand, for 100 g of dried eggplant flour consumed, 95% of the daily iron needs could be covered in an adult man of 55 kg, 44.38% in a woman and 31.6% in pregnant and adolescent women would be covered. The consumption of eggplant flour could therefore prevent anemia and help the body in the fight against oxidative stress.

For 100 g of dried and boiled eggplant flour consumed, the daily Zn requirements would be largely covered in any individual and can prevent zincopenia, without forgetting its antioxidant contribution. The consumption of 100 g of dried and boiled eggplant flour would respectively cover 27.36% and 26.19% of the daily K requirements in an adult. For a consumption of 100 g of dried and boiled eggplant flour, the daily sodium requirements in adults would be covered by approximately 19.6% respectively. For 100 g of boiled eggplant flour consumed, less than 1% of daily Mn requirements would be covered in adults; It is the same with dried eggplant flour, about 0.8%. For 100 g of dried and boiled eggplant consumed, between 1.1-2.2% of the daily Cu requirements can be covered in adults.

According to our study, the pH of the dried sample was lower than that of the boiled sample (5.3 < 6); Result consistent with the work of **Koua (2016)** situating the pH of *Solanum melongena* between [5-8.3] [10]. This variation in pH can lead to significant differences in taste, freshness and shelf life of a finished eggplant flour product because pH influences the thermal stability of proteins. It can alter the charge distribution between amino acid side chains and can either increase or decrease protein interactions. In addition, a change in pH also makes it possible to regulate the development of microorganisms, which can be beneficial or undesirable.

We can note some differences between the results obtained (Dosage of macronutrients, minerals and stability) and those of previous studies. And these differences observed could be due to the samples (different varieties), the state of the samples (fresh, dried and boiled then dried), to the technological processes used (drying, boiling); the bioaccessibility of each nutrient; then to climatic and environmental factors; Thus, according to **Rouanet (1984),** the sustainability of the crop (content of elements) is linked to the maintenance of soil fertility [11]. However, according to **Bado (2002)** and **Boga (2007),** the strong pressure on agricultural land reduces its availability and causes a significant drop in soil fertility and crop yields [12,13].

7. Conclusion

At the end of our work on the study of the nutritional potential of a *Solanaceae* endemic to West Cameroon *Solanum melongena* L. spineless variety, it appears that: Dried eggplant, boiled and dried eggplant flours have nutrients. We finally note that boiling influences the nutritional properties of eggplant flours.

References

1. World Health Organization. (2018). *L'État de la sécurité alimentaire et de la nutrition dans le monde 2018: Renforcer la résilience face aux changements climatiques pour la sécurité alimentaire et la nutrition*. Food & Agriculture Org..
2. LES RALENTISSEMENTS, E. T., & LES FLÉCHISSEMENTS, É. À. VUE D'ENSEMBLE RÉGIONALE DE LA SÉCURITÉ ALIMENTAIRE ET LA NUTRITION.
3. Programme des Nations Unies pour l'Environnement : Février 1997, Convention sur la biodiversité biologique : centre d'échange d'information sur la biodiversité au Cameroun
4. Théodore, A. K., Lezin, B. E., Généfol, O. U. A. T. T. A. R. A., & Emmanuel, D. A. (2018). Effets de la fertilisation à base des sous-produits de la pelure de banane plantain sur les paramètres agromorphologiques de la variété d'Aubergine F1 kalenda (Solanum melongena) dans la localité de Bingerville en Côte d'Ivoire. *Journal of Animal & Plant Sciences, 38*(3), 6292-6306.
5. Mouawad, C. (2007). *Transfert de matière dans un système solide/liquide" ions/eau/pectine": interactions, partage ionique et simulation par dynamique moléculaire* (Doctoral dissertation, Institut National Polytechnique de Lorraine).
6. Tchiégang, C., & Mbougueng, P. D. (2005). Composition chimique des épices utilisées dans la préparation du Nah poh et du Nkui de l'ouest Cameroun. *Tropicultura, 23*(4), 193-200.
7. Selena Cathy. Mes petites soupes magiques : Fraîches, désaltérantes, ces soupes « nouvelle génération » sauront égayer déjeuners ou dîner d'une touche originale et colorée. *Leduc.s Éditions*, p32
8. Epanda, A. (2021). Photo of Plants. *Fruits and Storage method of Fruits of Solanum aethiopicum L. and Solanum melongena L.*
9. Agoreyo, B. O., Obansa, E. S., & Obanor, E. O. (2012). Comparative nutritional and phytochemical analyses of two varieties of Solanum melongena. *Science World Journal, 7*(1), 5-8.
10. Topé, K. (2016). Comparaison de l'aspect morphologique et biochimique de trois espèces d'aubergines consommées en Côte d'Ivoire. P22
11. Rouanet, G. (1984). Le maïs. Les techniques d'agriculture tropicale. Maisonneuve et Larose, Paris, 142 p.
12. KOUADIO, K. P., YOBOUE, K. E., KOUADIO, K. K. H., BINI, Y. Y. P., & YAO-KOUAME, A. (2010). Caractéristiques morphoèpédologiques des sols d'Ahoué dans la Sous-Préfecture de Brofodoumé, Sud-Est Côte d'Ivoire. *Afrique Science, 15*(5), 140-150.
13. GARANE, A., SOME, K., NiKIEMA, J., OUANGO, K., TRAORE, M., SAWADOGO, M., & BELEM, J. (2019). Effet des fréquences d'apports des engrais minéraux sur la productivité de la tomate (Lycopersicon esculentum Mill.) sous abris en saison pluvieuse dans le centre du Burkina Faso. *Afrique SCIENCE15* (*3*), 190-207.