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Nutritional study of *Pachira glabra* seeds from the Brazzaville Prefecture in the Republic of Congo

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Abstract: *The aim of this study was to evaluate nutritional quality of Pachira glabra seeds, food plant an underutilized. Using the standard methods, The contents of moisture, protein, fat, carbohydrates, ash, fiber and some minerals; as well as the energy value were determined. The results this study, showed that the seeds of Pachira glabra contain a low moisture content (7.21 ± 0.2 %), which would favor their conservation at room temperature. The Pachira glabra seeds contain high contents lipids (39.35 ± 0,25 %), carbohydrates (21.59%) and proteins (24.71±0.50%). The fiber, ash and energy contents are not negligible. The total ashes of these seeds contain the elements minerals such as: Phosphorus (1.46 ± 0.02%), Calcium (1.57 ± 0.04%), Magnesium (0.095% ± 0.003%) and Iron (0.01%), the calcium and phosphorus are the majority minerals. In view of these results, the seeds of Pachira glabra present an appreciable nutritional quality, the consumption of this seed could constitute a solution to the problem of protein-calorie malnutrition. These seeds could also be used in the food industry.*

Key words: *Pachira glabra, nutritional quality, seeds, elements minerals.*

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I. Introduction

The Congo's economy is based on petroleum, which unfortunately is experiencing huge problems with the fall in the price per barrel. For this purpose, the diversification of the Congolese economy is necessary through the development of agricultural sectors and the valorization of underutilized food tree plants.

Central African countries such as Cameroon, the Central African Republic, Congo, Gabon and Tchad have significant and varied agricolepotential thanks to their equato-tropical climate. Unfortunately, this capital is insufficiently exploited and makes the countries dependent on food imports to meet the food needs of their populations. This dependence is pronounced in the field of fats and proteins, which are not accessible to all social classes. This situation leads to the phenomenon of protein-energy malnutrition, affecting mostly the women of childbearing age and the children, but also prevents the country from making progress towards achieving the Millennium Development Goals (MDGs). One way to address these problems is to promote local food products that are accessible to all social classes.

The local development of these agricole resources through simple processes that are particularly well mastered at the local level could also make it possible to achieve this development objective. These sectors have a large reservoir of vegetable raw materials, leading to products with high added value by implementing transformation processes adapted to local technological capacities.

Among these underutilized native arboreal plants are *Pachira glabra*,a perennial plant, belonging to the phylum Plantae, the subclass Dillenidae, the family Malvaceae, the subfamily Bombacoideae and genus Pachira, which includes about 50 species [1, 2]. It is fromAmerica, Africa and India. This species has been introduced as an ornamental plant but also used for its edible seeds in many tropical regions. It is adaptable to different soil types and grows naturally along rivers. It begins to bear fruit at about the age 4 to 5 years of. The fruit is a smooth, green capsule, 10 to 20 cm in length that splits open naturally when maturity [3]. The berries contain 10 to 25 rounded seeds, and peeled seeds can be eaten raw, roasted, boiled, fried or ground into flour for baking bread in Nigeria [4]. *Pachiragabra* is one of the plants that grow wild or domesticated in Congo-Brazzaville,has onlybeen used for usual culinary applications.

In Congo, where agriculture is not a predominant activity, the *Pachiragabra*species has not yet reached its apogee, nor has it been investigated, to our knowledge.Its seedscould particularly be a great asset if their nutritional qualitywasdetermined.

This work will provide the preliminary information on the nutritional potential of*Pachira glabra* seeds in order to consider their valorization.

II. Materials And Methods

2.1 Plant material

Seeds of *Pachira glabra*were collected in the Brazzaville City, precisely along the Djiri River in the Kintele zone.

Figures (1, 2, 3and4)show respectively the fruit or pod, whole seeds, shelled seeds plus husks and the crushed Pachira glabra seeds.

Methods for determining nuts, moisture content, fat, protein, ash and mineral content, carbohydrate content,

Figure 1: Fruit of*Pachira glabra*

Figure 2: Whole seeds, extracted from the fruits of *Pachira glabra*

Figure3 : Shelled seeds and the husks of *Pachira glabra* seed

Figure 4: Dry and crushed seeds of *Pachira glabra*

2.2 Methods

fiber content and energy value were describedbelow.

Determination of moisture content

The moisture content was determined according to the AOAC method (2005) [8]. 2g of crushed seeds were placed in a previously weighed capsule and were put in the oven (Memmert, Germany) at 70 ° C until the mass becomes constant.

Determination of fat content

The lipids in 5 g of crushed and dried seeds were extracted using Soxhlet (NF ISO 82 62 - 3, 2006) per 200 mL of hexane for 6 hours. The solvent excess was evaporated at the rotavapor. (IKA HB 10 basic).

Determination of protein content

About 0.1 g of dried and crushed dehulled seeds were used to determine the crude protein content from the determination of total nitrogen by the method of Kjeldhal [5]. The protein content was obtained by multiplying the total nitrogen by a convention factor of 6.25.

Determination of crude ash and some mineral content

2g of oil cake from dehulled and crushed seeds were used for the determination of the ash content according to the gravimetric method [5]. The incineration of the samples was carried out in an oven mitten at 550°C for 6 hours. The content of ash obtained after incineration was calculated.

After mineralization of the sample, the ash was recovered, moistened with water and concentrated hydrochloric acid, and then mineral elements were determined employing standard methods. Phosphorus was assayed by the cold colorimetric method using Murphy and Riley's reagent. Calcium, Iron and magnesium were determined by atomic absorption spectrometry (AAS).

Determination of total carbohydrate content

The carbohydrate content was estimated by the difference method [3]. According to this method, it was deduced by subtracting from 100, the sum of moisture, the fat, the proteins and the ash contained in the sample.

Determination of fiber content

The crude fiber content of the sample was determined by the method of Weende [6]. To do this, 1g of hulled, crushed and delipid seed were brought to a boil in 50 mL of sulfuric acid (0.25 N), and then in 50 mL of soda (0.31 N) for 1 h. The resulting residue is dried at 105 ° C for 8 h, and then cremated at 550 ° C for 3 h

Determination of the Energy Value

The total energy value was calculated according to the method of Manzi (1999) cited by Diallo Koffi and al [7]. The energy value is determined by using the following formula:

VE (kcal/100g) = (CHO x 4) + (CL x 9) + (CP x 4) with CHO = % of carbohydrates,

CL = % of lipid and CP = % protein.

III. Results and discussion

Moisture content

The determination of the moisture content on the fresh seeds of *Pachira glabra* gave an average value of 7.21± 0.2 %. This low content shows that these seeds can be stored for a long time without prior drying. This value is lower than those obtained of *Pachira glabra* (9.13 ± 0.02 %) and *Afzeliaafricana* (9.49 ± 0.01 %) seeds from Nigeria [3]. The 7.21%-value is similar to those obtained by various authors on groundnuts (7.48%) [8, 9] and on the Afzelia Africana seeds (7.45± 0.02%) [10]. However, the value obtained is higher than those obtained on the *PachiraaquaticaAublet* seeds (3.89 ± 0.07%) used in Brazil [12], Huitzuco 93, Rio Balsas, Ocozocuautla, Tlaxmalac, Gerardo Uribe, Ranferi Diaz, A-18 RF-214 varieties, in Mexico with values ranging from 4.12 to 4.75% [13]. It is also higher than the values ranging from 5.55 to 6.05% obtained on a groundnut variety in Sri Lanka after treatment with organic fertilizers [14], and is almost identical to the 7.18%-value obtained from a groundnut variety from Nigeria [15]. This is very low compared to the value of 37.32% for fresh almonds of *Hyphaene guineensis* [16].

Lipid content

The average lipid content obtained from *Pachira glabra* seeds is 39.35 ± 0.25%, which is lower than that of *Jatropha curcas* seeds, which is 59.32% [17]. This content is both slightly lower than 46.10% of the seeds of *Arachis hypogaea* [9] and the values ranging from 40 to 42% [18], obtained on some varieties of peanuts. It is also lower than the 46%-value of the seeds of *Arachis hypogaea L*. [19] and to values ranging from 49.20-50.76%, obtained by some authors working on five varieties of groundnuts [20], and about the same as the 39.30%-value [19] obtained on other varieties of groundnuts (*Arachis hypogaea*). This value of 39.35% is slightly lower than the 41.47%- value obtained on Moringa oleifera [21] and well above the values ranging from 19.39 to 22.56% obtained on seeds of *Parkiabiglobo*sa (Jacq.) R. Br used in northern Benin [22], much higher than those of *Pachira glabra* (15, 29 ± 0.01%) and *Afzeliaafricana* (16, 35 ± 0.02%, 22.70 ± 0.03%) seeds used in Nigeria, and soybean seeds (23.5%) [3, 10]. This content is very close to that obtained with seeds of *PachiraaquaticaAublet* (38.39 ± 0.14 %) used in Brazil [12].

Pachira glabra seeds are a good source of fat, so they could be used industrially in the production of oil.

Protein content

The average protein content obtained is 24.71±0.50%, which is lower than that of Brelra (Millettiaferruginea) seeds that have a protein content of 29.7% [23], but higher than the values obtained from

Monodoramyristica (Ehuru, 11.34%) [24], *Pachira glabra* seeds (10.38 ± 0.08%), Afzeliaafricana (16.52 ± 0.79%, 18.75 ± 0.03%) studied in Nigeria and seeds of *PachiraaquaticaAublet* (11.86 ± 0.32%) [12].

This value falls in the value-ranges obtained: (i) by some authors working on four varieties of Cowpea (*Vigna unguiculata*) from Nigeria (21.02-26.90%) [25], (ii) and from several varieties of groundnut (*Arachis hypogaea*, 24.70% [6]; 27.54-32.85% [13]; 26.40% [26]; 30.63- 38.88% [20]; 32.64% [27]; 32.93- 36.93% [28]).

Pachira glabra seeds are also affluent in protein than *Voandzou* seeds (*Vigna subterranea* (L.) grown in Côte d'Ivoire with rates ranging from 14.61 to 20.74% [7], *Cola pierlotii R. Germ* seeds (8.3%) [29], but are less rich than *Luffa aegyptica* and *Luffa cylindrica* seeds whose the contents vary from 39.74 to 40% [30]. It can thus be said that *Pachira glabra* is a protein plant.

The *Pachira glabra* seeds are therefore a good source of proteins.

Ash content and some minerals

The analysis of ash on *pachira glabra* seeds gave a mean value of 7.14 ±0.01%, which is higher than those of Pachira glabra (4.34 ± 0.01%) and *Afzeliaafricana* (4.03 ± 0.03%) seeds studied in Nigeria [3]. This value is also higher than those of Nkamba nut kernels (*Ricinodendronafricanum Bail*, 2.5%) [31], some groundnut varieties (Arachis hypogaea) from Nigeria (2.07-2.38%) [19], and of the *Mucanautilis* seeds from Nigeria (3.60%) [32].This indicates that the Pachira glabra seeds contain more minerals than the kernels of Nkamba nuts (Ricinodendronafricanum Bail.), some varieties of groundnut (*Arachis hypogaea*) from Nigeria, the seeds of the *Mucanautilis*, and of *Afzeliaafricana* from Nigeria. Therefore, they remain a significant source of minerals.

This study showed that the *Pachira glabra* seeds contain nutritionally essential minerals such as phosphorus (1.46 ± 0.02% or 1465 ± 21.21 mg/100g), calcium (1.57 ± 0.04% or 1570 ± 42.42 mg/100g), magnesium (0.095% ± 0.035% or 95 ± 35.35 mg/ 100 g), iron (0.01% or 10 mg/ 100 g) and nitrogen (5.45%). Of all these elements, nitrogen, calcium and phosphorus remain the major ones.Concerning the identified minerals, our values arehigher than those obtained on the *Mucana*seeds (phosphorus: 0.38%, iron: 0.0034% and magnesium: 0.023%)[28] and *Sterculia urens L*. seeds (phosphorus: 0.99%, iron: 0.0044% and calcium: 0.039%) [33]. They are also higher than the values obtained with the seeds of *Afzelia Africana* (iron: 2.48mg/100g, calcium: 340mg/100g, phosphorus: 8.30mg/100g and magnesium:1.60mg/100g) [10].

It is obvious that there are still some minerals to be determined in these ashes because the sum of the values of minerals found is less than 7.14%.

These identified minerals are essential for the proper functioning of the organism. Calcium and phosphorus are essential for the growth and maintenance of bones, teeth and muscles [34, 35]. It is known that a food is considered "good" if the Ca/P ratio is greater than 1 and of "poor quality" if this ratio is less than 0.05 [35]., The Ca/P ratio obtained in this study being 1.07, well above 0.05, we can therefore conclude that flour made from these seeds could be useful to supplement local infant flours poor in these minerals.

Carbohydrate content

The carbohydrate content of *Pachira glabra* seeds obtained in this study is 21.59%. This value is lower than those obtained from seeds of *Pachira glabra* (52.32 ± 0.8) and *Afzeliaafricana* (45.92 ± 0.72) studied in Nigeria [34]. This value is higher than the carbohydrate contents of some groundnut varieties: 1.81% [16]; 17.41% [8, 9]; 11.54-19.65% [11]; 17.56% [27]. Our value (21.59%) is similar to the one (21.34%) obtained in the kernels of *Ricinodendronafricanum* (Bail.) [31]. The *Pachira glabra* seeds are therefore a good source of carbohydrates that should be exploited in human and animal food.

Fiber content

The fiber rate obtained in the seeds of *Pachira glabra* is 10 %. This value is higher than those obtained from of *Pachira glabra* (8.55 ± 0.01%) and *Afzeliaafricana* (7.70 ± 0.02%) seeds studied in [3], as well as from safflower (*Dacryodes edulis*) pulp studied in Nigeria [37]. It is also high compared to the values from pumpkin (2.8%) and soybean (4.28%) seeds [34]. However, our value is lower than the ones obtained from *Borassusaetiopum*(11.2%) [36] and groundnut varieties (*Arachis hypogaea,* 17.32-22.70%) taken from Bosso and Minna markets in Nigeria [19].

Energy Value

The energy value obtained is 539.35 Kcal/100g. This value is higher than those obtained on the seeds from seven cultivars of voandzou [*Vigna subterranea (l.) Verdc. Fabaceae,* 370,02-388.8 Kcal / 100 g] grown in Côte d'Ivoire [7]. Our value falls in thevalue range 537.06-581.54 Kcal/100g obtained from a few varieties of groundnut (*Arachis hypogaea*) from Ghana [11].

This value of 539.35 Kcal/100g is not negligible and makes *Pachira glabra* a good source of energy which should be judiciously exploited in the diet of the vulnerable population.

IV. Conclusion

The *Pachira glabra*, which has been the subject of our study, is one of many plants that exist in our country whose seeds have never been the subject of a thorough scientific study.

The results obtained showed that the seeds of *Pachira glabra* are rich in lipids, carbohydrates and proteins. They are also good sources of minerals, especially calcium and phosphorus, with not negligible iron content. This leads us to say that these seeds have good nutritional and energetic values. They could be a solution to the problems of protein-calorie malnutrition experienced by vulnerable populations and should be also increasing interest as an ingredient in the food industry such as functional and healthy foods formulations as Biscuits, bread, and cakes. The oilcakes of *Pachira glabra* could be valorized in in the flour food manufacturing human and feed.

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