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Research Paper

Biochemical characterization of *Pentaclethra macrophylla* seed almonds harvested in the Republic of Congo

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Abstract

***Pentaclethra macrophylla*, commonly known as the sole tree or Acacia in Congo and "Mpayi" in the study area, belongs to the Fabaceae family (*Mimosoideae Legumes*). It is a plant that grows in the savannahs, bushes and forests of the Republic of Congo in the wild. Their seeds contain almonds rich in fat (44.68%), carbohydrates (41.22%). The humidity is 4.81%. Proteins and fibres levels are 4.68% and 1.1% respectively. The ash content is 4.61%. Among the ions identified are: Phosphorus: 0.46%, Iron: 0.21%, Calcium: 2.30% and Magnesium: 0.42%, sodium: 0.045% and potassium: 1.72%. The calculated energy value is 585.72 Kcal/100g.**

Keywords: *Pentaclethra macrophylla*, Seeds, Almonds, Characterization.

Introduction

Congo, like other Central African countries, has significant agricultural potential due to their climate. Unfortunately, this capital is under-exploited and makes countries dependent on food imports to meet the needs of their populations. This dependence is observed in the areas of fats and proteins. In recent years, there has been a renewed interest in unconventional crops with potential assets for both local and industrial population development[1]. The use of local plants as sources of lipids, proteins or carbohydrates sometimes leads us to rare specimens that can be studied in depth. Indeed, *Pentaclethra macrophylla* which is the subject of our study is one of the plants that grow in the wild in Congo-Brazzaville and has never been the subject of only usual culinary applications (oil production, used as a source of proteins or carbohydrates,...). The purpose of our study is to characterize the almonds extracted from the seeds of this particular plant. *Pentaclethra macrophylla*, commonly referred to as the sole tree or Acacia in Congo and "Mpayi" in the study area. It belongs to the Family of *Fabaceae* (*Mimosoideae* Legumes). In Congo, it is present in most savannahs and bushes, mainly in the Basin region, the Western Bowl, in semi-caducifoliated forests where it is sparsely dispersed and very gregarious. Fruits are obliquely linear-oblong, woody, dark brown pods, and tapered towards the base, containing 5 to 8 seeds.

In Congo, where agriculture is not a predominant activity, the species *Pentaclethra macrophylla* has not yet appealed to the scientific community in the area, nor has it been studied in depth. Because it grows in the wild, this species can be very useful both culturally, cosmetically, but also economically in the country. Almonds in particular can be a great asset if we can determine their physical-chemical and biochemical characteristics. This work will allow to know the real nutritional potential of *Pentaclethra macrophylla* almonds in order to consider their use in the areas where this plant grows.

Materials and Methods

Plant material

The plant material in our study consists of almonds extracted from the seeds of *Pentaclethra macrophylla* pods, harvested from the forests and savannahs of Mbama, in the Department of the Western Bowl in the Republic of Congo. Figures (1,2,3) below, show respectively, the whole seeds, dried and ground almonds of *Pentaclethra macrophylla*.

Figure 1: Whole Seeds of*Pentaclethra macrophylla*

Figure 2 : Dried almonds of *Pentaclethra macrophylla*

Figure 3 : Almond broyat of *Pentaclethra macrophylla*

We described the methods used to determine humidity, lipid, ash and mineral, proteins, total carbohydrates, dietary fibres and energy values.

Determination ofmoisture (H)

Humidity was determined using the following method[2]. 2g of almond grinders extracted from the ripe fruit are placed in a capsule previously weighed and put in the oven (Memmert, Germany) at 70^{o}C until the mass becomes constant.

Determination of the rate of Fat (MG)

The lipids contained in 5g of dried and ground almonds were extracted using the Soxhlet method (NF ISO 82 62-3, 2006) by 200 mL of hexane for 6 hours. Excess solvent is evaporated to rotavapor (IKA HB 10 basic).

Determination of the rate of protein (P)

Approximately 0.1g of ground almonds are used to determine the level of raw proteins from the total nitrogen dosage using the Kjeldhal method[2]. Protein levels were obtained by multiplying the total nitrogen content by a convention factor of 6.25.

Determination of raw ash and minerals (C and M)

2g of ground almond cakes were used to determine the ash rate using the gravity m ethod[2]. The samples were incineration in a mitten oven at 550^{o}C during the Six o'clock. The ash rate obtained after incineration is calculated. Phosphorus, calcium, sodium, potassium, magnesium and iron were

measured by the cold colorimetric method, atomic absorption spectromets (SAA) and flame emission spectromets.

Determination of total carbohydrates (G)
Carbohydrate content (G) was estimated by the difference method. Under the following method[2], it was calculated by subtracting from 100, the sum of moisture (H), fat (MG), proteins (P) and ash (C) contained in the sample.

Determinationof dietary fibre (F)
The raw fibre content of the samples is determined by the Weende method[3]. For this, 1g of the grated almonds (M) is brought to a boil in 50 ml of sulphuric acid (0.25 N) and then in 50 ml of soda (0.31 N) for 1 hour. The resulting residue is dried at 105^0C for 8 hours and then incinerated at 550^oC for 3 hours.

Determination of the Energy Value (VE)
The total energy value was calculated using the Manzi method (1999) cited by Diallo Koffi et al.[4]. It is determined using the following formula:

Results and Discussion

The following table represents the biochemical composition of dried almonds of *Pentaclethra macrophylla*

Table 1: Average physicochemical composition of *Pentaclethra macrophylla* almonds

Water content	4.81%
Fat content	44.68%
Protein content	4.68%
Ash content	4.61%
Carbohydrate content	41.22%
Fibre content	1.1%
Energy value	585.72 Kcal/100g

The analysis of the ashes identified the following mineral elements: phosphorus, iron, calcium, sodium, potassium and magnesium and we obtained: Phosphorus: 0.46%, Iron: 0.21%, Calcium: 2.30% and Magnesium: 0.42%, sodium: 0.045% and potassium: 1.72%.

Water content
The various tests carried out to obtain the water content yielded an average value of 4.81% on our fresh almonds of *Pentaclethra macrophylla*. This low water content shows that these almonds can be stored for a long time without drying beforehand. This value of 4.81% is lower than that obtained by various authors on peanuts: 7.48%[5,6] on seeds (raw groundnut, sun-dried groundnut and roasted groundnut), 7.54%[7], on sinkarzie, F-mix and close to JL 24 and Manipintar. However, the value obtained is substantially close to 4.12-4.75%, values obtained on the varieties Huitzuco 93, Rio Balsas, Ocozocuautla, Tlaxmalac, Gerardo Uribe, Ranferi Diaz, A-18 and RF-214 in Mexico[8] and lower than values ranging from 5.55 to 6.05%, values obtained from a variety of peanuts in Sri Lanka after organic fertilizer treatments[9], less than 7.18%, value obtained on a Nigerian peanut variety[10] and 5.8%, value obtained on another Nigerian peanut variety[11]. On the other hand, this is very small than those of the fresh almonds of *Hyphaene guineensis* which is 37.32%[12]. This water content is normal for good seed preservation (the seed-conserving water content ranges from 10 to 14%).

Fat content
Soxhlet extraction of *Pentaclethra macrophylla* almonds gives an average lipid content of 44.68%, very low in value compared to Jatropha curcas seeds which is 59.32%[13]. This content is slightly less than 46.10%[6] and slightly above 40-42%[14], values obtained on some varieties of peanuts. On the other hand, it is slightly less than 46%[15] and above 39.30%[10], values also obtained on other varieties peanut (*Arachis hypogaea*). Some authors obtained values ranging from 49.20 to 50.76% by working on five varieties of peanuts[16]. Other authors, by studying the physical properties of eight varieties of peanuts grown in Mexico, obtained the oil content of the seeds ranging from 37.9 to 56.3%[8]. This value of 44.68% is slightly higher than 41.47%, value obtained on *Moringa oleifera*[17] and well above

values ranging from 19.39 to 22.56%, values obtained on the seeds of *Parkia biglobosa* (Jacq.) R. Br in use in northern Benin[18]. The Soxhlet extraction method obtains almost all of the fat in a seed when it is well dried. *Pentaclethra macrophylla* de-oiled almonds can be used directly in human or animal feed as a source of carbohydrates.

Protein content

The average protein content was determined from 6 trials. We obtained a value of 4.68-0.50%, low in value compared to that of Brelra seeds (*Millettia ferruginea*) which have a protein content of 29.7%[19] and *Monodora myristica* (Ehuru) studied in Ngéria, which has a protein content that varies from 11.34%[20]. This value is very low compared to the values obtained by some authors by working on four varieties of Cowpea (*Vigna unguiculata*) from Nigeria that range from 21.02 to 26.90%[21] and on several varieties of peanuts (*Arachis hypogaea*): 19.81%[10], 24,70%[5], 27,54-32,85%[8], 26,40%[22], 30,63- 38,88%[16], 23, 62-28, 88%[7], 32,64%[23], 32, 93-36, 93%[24].

Pentaclethra macrophylla almonds are less protein rich than Voandzou seeds (*Vigna subterranea*(L.) grown in Côte d'Ivoire with rates ranging from 14.61 to 20.74%[4], less protein-rich than *Cola pierlotii* R. Germ seeds, which are 8.3%[26] and also less rich than The seeds of *Luffa aegyptica* and *Luffa cylindrica*, which range in grades from 39.74 to 40%[26]. *Pentaclethra macophylla* is thus non-proteaginal. *Pentaclethra macrophylla* almonds are therefore not a good source of protein.

Ash and major minerals rate

The various tests carried out for the analysis of the ash rate yielded an average value of 4.61-0.50%, higher than that of Nkamba nut almonds (*Ricinodendron africanum* Bail.) which is 2.5%[27] and at that of some peanut varieties (*Arachis hypogaea*) from Nigeria, which range from 2.07 to 2.38%[15] and *Mucana* seeds used from Nigeria, which have an ash content of 3.60%[28]. This indicates that *Pentaclethra macrophylla* almonds contain more minerals than Nkamba nut almonds (*Ricinodendron africanum* Bail.), certain varieties of peanut (*Arachis hypogaea*) from Nigeria and *Mucana* seeds used from Nigeria but remains a significant source of mineral elements.

This value of 4.61% is higher than values ranging from 1.38 to 1.48%, values obtained on peanut seeds by some authors on certain varieties of peanut (*Arachis hypogaea*)[5,6]. It is also higher than those also obtained on peanuts by other authors and which obtained values ranging from 2.45 to 2.96%[7]. Peanuts (*Arachis hypogaea*) of "Manga" have an ash rate of 5.68%, a high value than that of the almonds studied here[23]. We looked for phosphorus, iron, calcium, sodium, potassium and magnesium in the ashes and obtained: Phosphorus: 0.46%, Iron: 0.21%, Calcium: 2.30% and Magnesium: 0.42%, sodium: 0.045% and potassium: 1.72%. Of all these elements, calcium and potassium remain the major elements. These values are better compared to *Mucana* seeds used which are: Phosphorus: 0.38%, Iron: 0.0034%, Calcium: 0.15% and Magnesium: 0.023%, sodium: 0.045% and potassium: 1.47%[28] and compared to *Culsteria urens* L. Phosphorus: 0.99% (better value than *Pentaclethra macrophylla*), Iron: 0.0044%, Calcium: 0.039% and potassium: 0.0096%[29]. This result shows that there are still some minerals to be determined in these ashes because the sum of the values found is less than 4.61%. These identified minerals are essential to the proper functioning of the body.

Carbohydrate content

Carbohydrate content of peanut varieties: 1.81%[11], 17,41%[5,6], 11,54-19,65%[7], 17.56%[23], are much lower than *Pentaclethra macrophylla*, which is 41.22%. This value of 41.22% obtained is higher than 21.34%, value obtained on almonds of *Ricinodendron africanum* nuts (Bail.)[27]. This value is on the other hand very low compared to 81.5%, value obtained on the seeds of *Cola pierlotii* R. Germ[25]. *Pentaclethra macrophylla* almonds are therefore a good source of carbohydrates that must be exploited in human and animal feed.

Dietary Fibre rate

The fibre content in *Pentaclethra macrophylla* almonds is 1.1%. This is very low compared to 11.2%, value obtained on *Borassus aetiopum*[30] and values ranging from 17.32 to 22.70%, obtained on peanut varieties (*Arachis hypogaea*) from the Market of Bosso and Minna in Nigeria[14]. This 1.1% value is also less than 9.17%, a value obtained on safou pulp (*Dacryodes edulis*) in Nigeria[31]. *Pentacletha macrophylla* almonds are therefore not a good source of dietary fibres.

Energy Value (VE)

The energy value obtained is 585.72 Kcal/100g. This value is higher than the total values of 370.02 to 388.8 Kcal/100g, values obtained on the seeds of seven cultivars of voandzou [*Vigna subterranea* (l.) Mr. Verdc. Fabaceae] grown in ivory coast[4]. This value of 585.72 Kcal/100g is slightly above values ranging from 537.06 to 581.54 Kcal/100g, values obtained from some varieties of peanut (*Arachis hypogaea*) from Ghana[7]. This value of 585.72 Kcal/100g is not in significant and makes *Pentaclethra macrophylla* a good source of energy that must be used wisely in the diet of the vulnerable population.

Conclusion

Pentaclethra macrophylla, which was the subject of our study, is one of many plants that exist in our country and whose seeds have never been the subject of extensive scientific study. Almonds extracted from seeds are rich in fat, carbohydrates and less protein-rich. They are also good sources of minerals because their ash content is not negligible. This leads us to say that these almonds have good nutritional and energy value. This work is far from over. Because the ash content is high, it is important that a study be conducted to determine the mineral elements that have not been studied to date. This work should be completed by doing an in-depth study of the fractions, carbohydrate and protein of these almonds. Thus, these almonds would be valued in the production of *Pentaclethra macrophylla* vegetable oil, which will then be determined in fatty acids and triglycerides. Fine analyses of the various biochemical constituents of these almonds will be diversified to identify the maximum number of biomolecules such as glycolipids, antioxidants, isoprenes (terpens, xanthophylles, carotenes, vitamin A, phylloquinones or vitamins K, tocopherols or vitamins E,...) that may be of interest to the food industry, pharmaceuticals.

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