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## ASSESSMENT OF THE NUTRITIONAL POTENTIAL OF THE KERNELS OF THE SEEDS OF *TETRACARPIDIUM CONOPHORUM* COLLECTED IN LÉKANA IN THE DEPARTMENT OF PLATEAUX IN THE REPUBLIC OF CONGO

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### ABSTRACT

*Tetracarpidium conophorum*, commonly known by the names, African nut, kaso or "Nkah" in Congo, belongs to the Euphorbiaceae family. It is a rainforest plant that can also be found in shrubs in the Republic of Congo, in the wild. Its seeds contain almonds rich in fat (47.15%), protein (33.95%), with a moisture content of 4%. The carbohydrate content is relatively low (7.77%). The fibers and the ashes represent respectively: 0.15% and 9.14%. Among the minerals identified are: Phosphorus: 1.46%, Iron: 0.01%, Calcium: 1.57%, Magnesium: 0.19% and Nitrogen: 5.45%. The calculated energy value is 591.23 Kcal / 100g.

Keywords: *Tetracarpidium conophorum*, Seeds, Almonds, Characterization.

## I. INTRODUCTION

Congo is one of the countries that constitute the green lung of the world. It is rich in very diverse flora and fauna. The Congolese vegetation has several types of species recorded to date. Unfortunately, this capital is insufficiently exploited and makes the country dependent on food imports to meet the needs of its population. This dependence is particularly observed in the areas of fats and proteins. In recent years, there has been a resurgence of interest in unconventional crops with potential assets for both the development of populations at the local level and that of industry [1].

The promotion of local plants as sources of lipids, proteins or carbohydrates sometimes leads us to rare specimens that can be the subject of in-depth study. *Tetracarpidium conophorum* 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 usual culinary applications (industrial production of oil for example), but very often used for aphrodisiac purposes.

*Tetracarpidium conophorum*, commonly called "Nkah" in the Téké language of Congo (in the study area), belongs to the *Euphorbiaceae* family. It is present in rainforests, in most shrubs, mainly in the region of the plateaux, the West Cuvette and the Cuvette. The fruit it produces is a capsule 7 to 9 cm wide, 3 to 3.5 cm high; provided with tough radial wings, having four star compartments (sometimes three per abortion); inside each lobe is a large

sub-globose seed with a black, thin, sclerified, very hard seed coat, whitish endosperm with thin leafy cotyledons.

In the Congo, *Tetracarpidium conophorum* has not yet been thoroughly studied because it grows in the wild and has never been the subject of attempted domestication. However, it is likely that the plant is useful from a nutritional and cosmetic point of view, but also economically in the country. Almonds in particular can be a great asset if we can determine their physicochemical and biochemical characteristics.

This present work will therefore constitute a contribution to the knowledge of the real nutritional potential of the almonds of *Tetracarpidium conophorum* in order to consider their valuation in the areas where this plant grows.

## II. MATERIAL AND METHODS

### II.1. Plant material

The plant material of our study consists of almonds extracted from the seeds of the pods of *Tetracarpidium conophorum*, collected in Lekana, in the Plateaux Department in the Republic of Congo.

Figures (II.1; II.2; II.3) below show, respectively, whole seeds, fresh almonds, dried and then ground almonds of *Tetracarpidium conophorum*



**Figure II.1:** Whole seeds of *T. conophorum*    **Figure II.2:** Fresh almonds of *T. conophorum*



**Figure II.3:** Ground dried almonds of *Tetracarpidium conophorum*

## II.2. Methods

The methods used in this study are described below:

### Determination of humidity level (H) [2]

The moisture content was determined as follows: 2 g of ground almonds extracted from the ripe fruit are placed in a capsule weighed beforehand and placed in an oven (Memmert, Germany) at 70 ° C until the mass becomes constant.

### Determination of lipid level (MG)

The lipids contained in 5 g of dried and crushed almonds were extracted according to the Soxhlet method (NF ISO 82 62-3, 2006) in 200mL of hexane for 6 hours. The excess solvent is evaporated off in a rotary evaporator (IKA HB 10 basic).

### Determination of protein level (P) [2]

About 0.1 g of ground almonds are used to determine the level of crude protein from the determination of total nitrogen by the Kjeldhal method. The protein content was obtained by multiplying the total nitrogen content by a convention factor of 6.25.

### Determination of crude ash and mineral content (C and M) [2]

2g of deoiled ground almond cake were used to determine the ash content using the gravimetric method. The samples were incinerated in a muffle furnace at 550 ° C for 6 hours. The ash content obtained after incineration is then calculated.

Phosphorus, calcium, sodium, potassium, magnesium and iron were measured by cold colorimetric method, atomic absorption spectrometry (AAS) and flame emission spectrometry.

### Determination of the total carbohydrate content (G) [2]

The carbohydrate content (G) was estimated by the difference method. According to the method, it was calculated by subtracting from 100 the sum of moisture (H), fat (MG), protein (P) and ash (C) contained in the sample.

### Determination of the fiber content (F) [3]

The raw fiber contents of the samples were determined by the Weende method: 1g of grated almonds (M) was brought to the boil in 50 ml of sulfuric acid

(0.25 N) and then in 50 ml of soda (0.31 N) for 1 hour. The obtained residue was dried at 105 ° C for 8 hours and then incinerated at 550 ° C for 3 hours.

### Determination of the Energy Value (EV)

The total energy value was calculated according to the method of Manzi (1999) cited by Diallo Koffi *et al.* [4].

It is determined using the following formula:

$$VE \text{ (kcal / 100g)} = (\text{CHO} \times 4) + (\text{CL} \times 9) + (\text{CP} \times 4)$$

with CHO =% of carbohydrates, CL =% of fat and CP =% of protein.

## III. Results and discussion

### III.1 Results

The table below represents the biochemical composition of the dry almonds of *Tetracarpidium conophorum*

**Table 1:** Average physicochemical composition of *Tetracarpidium conophorum* almonds

<b>Water content</b>	<b>4%</b>
<b>Lipid content</b>	47.15%
<b>Protein content</b>	33.95%
<b>Ash content</b>	9.14%
<b>Carbohydrate content</b>	7.77%
<b>Dietary fiber content</b>	0.15%
<b>Energetic value</b>	591.23 Kcal/100g.

Analysis of the ash identified the following mineral elements: phosphorus, iron, calcium, magnesium and nitrogen. We thus obtained: Phosphorus: 1.46%, Iron: 0.01%, Calcium: 1.57%, Magnesium: 0.19%, and Nitrogen: 5.45%.

### III.2 Discussion

#### Water content

The various tests carried out to obtain the water content gave an average value of 4% on the kernels of *Tetracarpidium conophorum* studied. This value is low compared to those obtained by certain authors (Nwaguikpe *et al.*, in 2012) [5] who obtained a value of 39.27%; Onawuni *et al.*, in 2013 [6]) obtained a value of 29%; Sura *et al.*, in 2016 [7]) obtained a value of 6.86% and Chikezie

and Uchechukwu in 2017 [8] obtained a value of 5.46%, working on the same product.

The relatively low value for water content could be justified by the fact that the seeds were stored for about three months at room temperature before being analyzed. The value obtained is also very low compared to the average values obtained by Liu *et al.*, in 2008 [9], Malacrida and Jorge in 2012 [10], all working on the seeds of *Passiflora edulis f. flavicarpa* Degener, the values of which are respectively 10.8% and 7.38%. This difference would probably be due to the condition of the fruits or to the growing area of the latter. This rate (4%) is also found to be very low compared to that of

*Cocos nucifera* 94.45%, obtained by Jean *et al.*, in 2009 [11]; it is also less than 56.33%, a value obtained by Kabiru *et al.* in 2015 [12] on fresh almonds from *Borassus aethiopum*; which allows us to conclude that the fresh seeds of the studied fruit are less hydrated than the fresh almonds of *Borassus aethiopum* and therefore keep better than the latter.

This rate of 4% is also low compared to those obtained by various authors on other products such as peanuts with: 7.48%, value obtained by Ayoola and Adeyeye in 2010 [13]; Ayoola *et al.* in 2012 [14] on peanut seeds (raw groundnut, sun-dried groundnut and roasted groundnut); 5.55-6.05% (Brintha *et al.*, in 2014 [15], on a peanut variety in Sri Lanka after treatments with organic fertilizers; 7.18% obtained by Adegoke Bosede *et al.* in 2014 [16], on a variety of peanuts from Nigeria.

It can be noted that this water content of 4% is normal for good preservation of the seeds. The moisture content of the seeds varies between 10 and 14%. So for better conservation, the seeds must be lightly dried beforehand after their harvest.

### Lipid content

Soxhlet extraction of *Tetracarpidium conophorum* almonds gives an average lipid content of around 47.15%. This value is very high compared to certain values found by other authors on the same product: 5.19%, value obtained by Nwaguikpe *et al.* in 2012 [5]; 5.63%, value obtained by Onawuni and Ayoola in 2013 [6], on boiled almonds and 21.61%, value found by Suara *et al.*, In 2016 [7]. Chikezie in 2017 [8] obtained a higher value of 53.74% compared to 47.15% (value obtained in this study) on the same product. This value obtained in our study is very high compared to that obtained

by Liu *et al.* in 2008 [9] which is 23.4% on *Passiflora edulis f. flavicarpa* Degener. This indicates that these seeds studied constitute a good source of lipids.

Compared to other fruits, the seeds of *Tetracarpidium conophorum* are richer in oil than the fruit kernels of *Spondias mombin* L., studied by Ngakégni in 2012 [17] who obtained a value of 3% and the kernels of the fruit of the Cayor's apple tree (*Neocarya macrophylla* Sabine), studied by Balla and Baragé in 2008 [18] and which obtained a value of 0.4%. This content is very high compared to 0.01%, value obtained by Kabiru *et al.*, [12] in 2015 on *Borassus aethiopum*

However, the value obtained in this study is slightly lower than those obtained by Chowdhury *et al.*, [19] 2015 whose values oscillate between 49.20 and 50.76%, working on five varieties of peanuts. They are also poor in oil compared to the nuts of *Juglans regia* (58.3- 65.2%) studied by Tapia *et al.*, in 2013 [20], but incorporates the values obtained by other authors (Mora-Escobedo *et al.*, 2015 [21], by studying the physicochemical properties of eight varieties of peanuts cultivated in Mexico whose seed oil contents ranged from 37.9 to 56.3%.

The seeds of the fruit of *Tetracarpidium conophorum* can be used in oil mills as a raw material in the production of vegetable oil for either food or cosmetic use.

### Protein content

The seeds of the fruit of *Tetracarpidium conophorum* have an average protein content of 33.95%. Some authors have obtained variable values for the same product, depending on the treatments applied: 11.78 value obtained by Suara *et al.*, in 2016 [7]; 16.62% value obtained by Onawuni and Ayoola in 2013 [6];

17.90% value obtained by Chikezie in 2017 [8]; 20.74% value obtained by Nwaguikpe *et al.*, in 2012 [5]. All these values are low compared to that obtained in this study. This value of 33.95% is greater than 10.53%, a value obtained by Liu *et al.* in 2008 [9], working on the seeds of *Passiflora edulis f. flavicarpa* Degener and also greater than 12.23%, value obtained by Malacrida and Jorge in 2012 [10], working on the seeds of *Passiflora edulis f. flavicarpa* Degener. The seeds of *Tetracarpidium conophorum* are richer in protein than the seeds of Voandzou (*Vigna subterranea* L.) cultivated in Côte d'Ivoire, whose rates vary from 14.61 to 20.74% (Diallo Koffi *et al.*, 2015) [4] and seeds of *Parkia biglobosa* (Jacq.), The rates of which vary from 24.33 to 33.70% (Koura *et al.*, 2014) [22].

We can thus affirm that the seeds of *Tetracarpidium conophorum* are therefore proteinaceous.

#### **Ash content and major minerals**

The ash content of the seeds of *Tetracarpidium conophorum* studied is higher compared to the values found by Chikezie in 2017 (2.62%) [8]; Nwaguikpe *et al.*, in 2012 (3.18%) [5] on the same product because it was around 9.14%. This value of 9.14% is on the other hand close to the value found by other authors on the same product: 8.57% (Suara *et al.*, in 2016) [7] and lower compared to 12.62%, value found by Onawuni and Ayoola in 2013 [6]. This value obtained in this study is very high compared to those obtained by Malacrida, and Jorge (2012) [10] and by Liu *et al.* in 2008) [9]), on the seeds of *Passiflora edulis f. flavicarpa* Degener, the values of which are respectively 1.27%; 1.46% and 2.26%. Ash is a good indicator of the concentration

of mineral elements in a sample. Since the ash content is high, the seeds of the fruit of *Tetracarpidium conophorum* studied are therefore very rich in mineral elements.

Compared to other fruits, this value (9.14%) is higher than 1.17%, obtained on *Borassus aethiopum* by Kabiru *et al.* in 2015 [12] and those ranging from 1.38 to 1.48%, obtained on peanut seeds by Ayoola and Adeyeye in 2010 [13] and Ayoola *et al.* in 2012 [14].

It is also higher than 4.08%, a value obtained by certain authors (Bouazzaoui *et al.*, 2016) [23], when working on melon seeds (*Cucumis melo* L. Inodorus) and those of other seeds of peanuts studied by Eshun *et al.* in 2013 [24], values ranging from 2.45 to 2.96%. The "Manga" peanut has an ash content of 5.68% (Ossoko, 2017) [25], which is also low compared to that of the seeds studied here.

The result obtained in this study shows that there are still a lot of minerals to be determined in these ashes because the sum of the values found is less than 9.14%. The high ash content justifies that the seeds of *Tetracarpidium conophorum* studied are very rich in mineral elements.

#### **Carbohydrate content**

This study shows a low carbohydrate content (7.77%) of the seeds studied compared to the values found by other authors on the same product regardless of the treatments applied: 19.28% (Chikezie in 2017) [8]; 20.94% (Onawuni and Ayoola in 2013) [6]; 23.22% (Nwaguikpe *et al.*, in 2012) [5] and 51.18% (Suara *et al.*, in 2016) [7] and also very low compared to the seeds of the fruit of *Passiflora edulis f. flavicarpa* Degener which is 48.94% (Ossoko *et al.*, 2020) [26]. The seeds studied are also less rich in carbohydrates compared to the seeds of

*Passiflora edulis f. flavicarpa* Degener studied by Liu et al., in 2008 [9] which obtained a value of 1.53%. The value obtained in this study (7.77%) is very low when compared to that obtained on the almonds of *Borassus aethiopum* (81%) studied by Kabiru et al., in 2015 [12]. The carbohydrate content of certain varieties of peanuts: 17.41% (Ayoola and Adeyeye 2010 [13]; Ayoola et al., 2012 [14]); 11.54-19.65% (Eshun et al., 2013) [24] and 17.56% (Ossoko, 2017) [25] are high compared to the seeds of the fruit of *Tetracarpidium conophorum*, which is 7.77 %. The seeds studied here are therefore a poor source of carbohydrates.

#### **Dietary fiber rate**

The seeds of the fruit of *Tetracarpidium conophorum* which were the subject of our study are a very poor source of dietary fiber with a content of 0.15%. This value is negligible compared to the values found by other authors on the same product regardless of the treatments applied: 1.24% (Chikezie, 2017) [8]; 1.56% (Suara et al., 2016) [7]; 8.40% (Nwaguikpe et al., 2012) [5]; 14.92% (Onawuni and Ayoola, 2013) [6]. This value is on the other hand very negligible compared to 17.48%, value obtained by Liu et al., in 2008 [9] while working all on the seeds of *Passiflora edulis f. flavicarpa* Degener.

The seeds of the fruit of *Tetracarpidium conophorum* are therefore a very poor source of dietary fiber.

#### **Energy Value (VE)**

The energy value obtained on the seeds studied here is 591.23 Kcal / 100g. This value is higher than that obtained on the seeds of *Passiflora edulis f. flavicarpa* Degener by Ossoko et al., in 2020 [26] which is 450.73 Kcal / 100g. This value is

also above those obtained by other authors on the same product, 398.04 Kcal / 100g, value obtained by Liu et al. in 2008 [9] also on *Passiflora edulis f. flavicarpa* Degener. This energy value is also higher than that obtained on the seeds of seven cultivars of voandzou [*Vigna subterranea* (L.) Verdc. Fabaceae] cultivated in Ivory Coast and studied by Diallo Koffi et al., 2015 [4] and which obtained values ranging from 370.02 to 388.8 Kcal / 100g.

The seeds of the fruit of *Tetracarpidium conophorum* are therefore a very good source of energy.

#### **Conclusion and perspectives**

*Tetracarpidium conophorum* which has been 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 the seeds are high in fat, protein and low in carbohydrates. They are also good sources of minerals because their ash content is not negligible. These almonds are therefore a good source of nutrients and have a good energy value.

This work is far from over. As the ash content is high, it is important that a study be carried out to determine the rest of the mineral elements which so far are not known

This work should be completed by making an in-depth study of the lipid, carbohydrate and protein fractions of these almonds. Thus, these almonds would be valued in the production of the vegetable oil of *Tetracarpidium conophorum*.

Detailed analyzes on the various biochemical constituents of these almonds will be carried out in order to identify the maximum number of

biomolecules such as glycolipids, antioxidants, isoprenoids (terpenes, xanthophylls, carotenes, vitamin A, phyloquinones or vitamins K, tocopherols or vitamins E, ...) Likely to be of interest to the food and pharmaceutical industries.

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