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RESEARCH ARTICLE

BIOCHEMICAL AND NUTRITIONAL ANALYZES OF ALMONDS FROM *ANACARDIUM OCCIDENTALE* NUTS (ANACARDIACEAE) FROM CÔTE D'IVOIRE

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Abstract

The present work was devoted to the chemical and biochemical analysis of *Anacardium occidentale* almonds from Côte d'Ivoire. Dried almonds contain a dry matter content of $96.46 \pm 0.53\%$ and $3.53 \pm 0.13\%$ water content; They give an average oil yield of $22.01 \pm 0.85\%$, in 3 hours of Soxhlet extraction. The seed is a modest source of protein ($9.11 \pm 0.26\%$) and contains $62.61 \pm 0.46\%$ of carbohydrates. The carbohydrate content gives it an appreciable energy value (573.15 ± 0.77 kcal/100g) which is comparable to that of certain conventional oilseeds whose average is between 550 - 650 kcal/100g of dry matter. Also, this study revealed a total sugar content of 2.01 ± 0.69 g/L, in reducing sugars of 0.05 ± 0.02 g/L, and of 0.09 ± 0.01 g/100g in oxalates and 1.61 ± 0.58 mg/100g in phytates. The results obtained clearly show the interesting dispositions of the almonds of *Anacardium occidentale* from Côte d'Ivoire; Which gives them potentially nutritional properties.

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Introduction:-

Currently, the solution of rational use and conservation of biodiversity presents a problem linked to the food security of the population and sustainable development. Therefore, the identification, in-depth study and application of promising species, as well as new crops with unique characteristics will fully resolve this problem (Katou, 2018). In this context, the search for new types of oilseed plants, rich in diverse properties, will present a relevant contribution to improving biodiversity. Among these plants we have *Anacardium occidentale* (Anacardiaceae).

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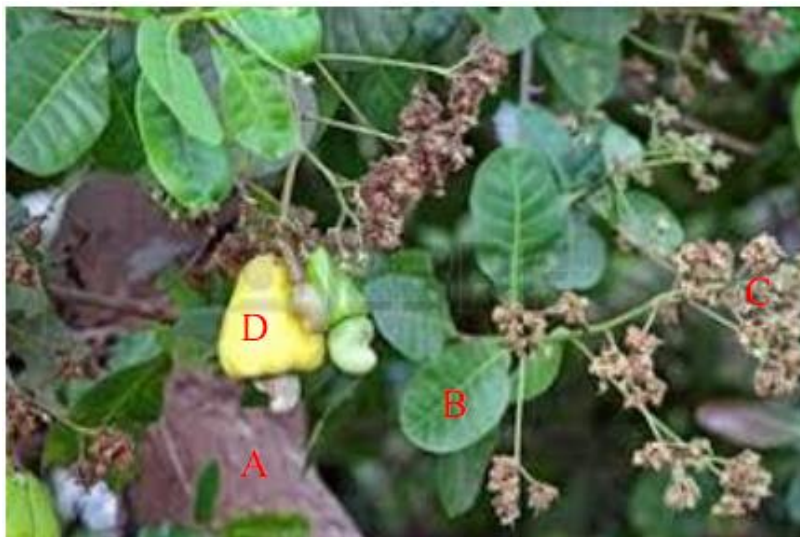


Fig I:- Organs of *Anacardium occidentale*

(A) Stem; (B) Leaf; (C) Flowers; (D) Fruits; (E) Nuts. (Photos taken by Katou in 2023)

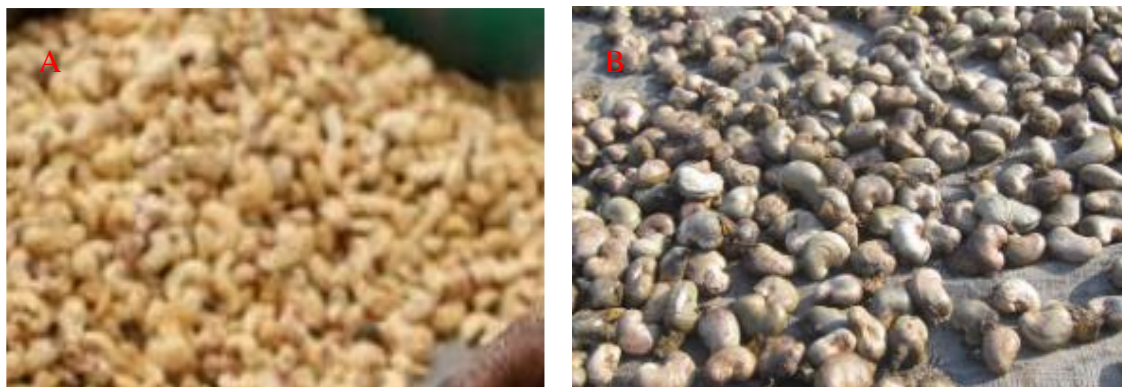
Indeed, the first plantations were created to fight against environmental degradation in certain regions (Koffi et al., 2012) and since the beginning of the 2000, *Anacardium occidentale* of the Anacardiaceae family, has become one of Côte d'Ivoire's main export crops, due to growing global demand and Africa-Asia trade. This plant is cultivated in almost all of the central and northern regions of the country (Ruf et al., 2019). Also, the *Anacardium occidentale* culture allows the peasants of the center and the north to not only constitute a source of social emancipation (Koné, 2002); but also to acquire a satisfactory income (Ricaud & Konan, 2010).

However, scientific work on *Anacardium occidentale* almonds from Côte d'Ivoire remains insufficient; This is why, this study initiated, will contribute to the valorization of *Anacardium occidentale* from Côte d'Ivoire through the determination of some biochemical and nutritional parameters of almonds from cashew nuts harvested from Côte d'Ivoire.

Material and Methods:-

1. Plant material:

The fruits of *Anacardium occidentale* were harvested in Sessenouan, a village located 3km from the town of Bouaké (Gbeke region) in the center of Côte d'Ivoire. After harvest in June 2023, the seeds are collected. Then, they were roasted, shelled and the almonds obtained were dried in an air-conditioned room at 18°C for two (2) weeks, then stored in an oven at 50°C for 7 days. After which, they were pulverized using an agate mortar and the samples obtained were preserved for the various analyses.



FigII:- Almonds (A) and seeds (B) of *Anacardium occidentale*.

(Photos taken by Katou in 2023)

2- Analysis Methods:-

Determination of humidity and dry matter levels:

Humidity level: Seeds (5 g) were left to heat in an oven at 105°C until a constant mass was obtained. The humidity level (Hd) was determined according to the following formula (AFNOR, 1981-1982):

$$Hd = \frac{(m - m')}{m} \times 100$$

m: mass of seeds before drying (g)

m': mass of seeds after drying (g)

Hd: humidity level (%)

Dry matter rate:

The dry matter (DM) rate was calculated as follows:

$$MS(\%) = 100 - Hd$$

MS (%): dry matter rate

Determination of the ash content: Seeds (of mass m = 0.4 g) were incinerated for 8 hours in an oven at 600°C until a constant mass (m') of white ashes was obtained. (AFNOR, 1981-1982). The ash content is calculated according to the equation:

$$Ash(\%) = \frac{m'}{m} \times 100$$

Extraction of fat:

The fat is obtained by continuous extraction (3 hours) with Soxhlet (Bamba et al., 2015). The fat content calculated according to the formula:

$$MG(\%) = \frac{m_0}{m_1} \times 100$$

m₀: mass of the extracted MG (g)

m₁: mass of the initial powder (g)

Determination of protein content:

Proteins were quantified using the Kjeldahl method (Kouamé et al., 2015). The total nitrogen content (TN) was determined according to the equation:

$$TN = \frac{[VHCl(b) - VHCl(e)] \times NHCl \times 14,01}{10 \times V_{sample}}$$

VHCl(e): volume of HCl required for sample titration (mL); VHCl (b): volume of HCl necessary for titration of the blank (mL); NHCl: titer of the HCl solution; Ve: volume of the test portion (mL); 14.01: atomic mass of nitrogen

Protein content (TP) was obtained using 6.25 as the usual conversion factor:

$$TP(\%) = TN \times 6,25$$

Determination of total carbohydrate content and energy value:

The total carbohydrate contents (TGT) and energy values (EV) of almonds were determined according to Koko et al., 2016 (Koko et al., 2016):

$$TGT = 100 - (TC + TP + MG + TH)$$

$$VE(kcal/100g) = [(TGT \times 4) + (TP \times 4) + (MG \times 9)]$$

TC: ash content; TP: protein content; Fat content: fat content; TH: humidity level

Determination of sugar content:

• **Preparation of the carbohydrate extract:** Two (2) g of *Anacardium occidentale* powder were macerated in 10 mL of 80% ethanol with stirring for 15 min at room temperature. The whole was centrifuged at 3000 rpm three times for 5 min. The collected supernatant was reduced until a viscous solution was obtained, which was made up to 25 mL with distilled water (Kouamé et al., 2015).

• **Determination of the total sugar content (ST):** The total sugar contents were determined from the glucose calibration line (from 0.067 to 1 mg/mL), under the same conditions as the carbohydrate extract (Alaoui, 1994).

• **Determination of the reducing sugar (SR) content:** 300 µl of 3,5-dinitrosalicylic acid (DNS) were added to 150 µl of carbohydrate extract. The mixture was incubated for 5 min in a boiling water bath, then 2 mL of distilled water

was added to the cooled mixture. The reducing sugar content was determined from the glucose calibration line (0.067 to 1 mg/mL) (Yao et al., 2015), after reading at 540 nm.

Determination of the phytate content:

The phytate content from a calibration curve carried out with phytic acid (0 to 10 mg/mL) in mg phytic acid equivalent (EAP)/100g of dry matter (MS) according to the method described by Kwanyuen (Kwanyuen and Burton, 2005).

Determination of the oxalate content:

The method described by Day (Day & Underwood, 1986) and taken up by Agbaire (Agbaire, 2011) made it possible to determine the oxalate content (TO), expressed in mg/100g of DM, and calculated according to the equation:

$$TO(\text{mg}/100\text{g}) = \frac{2,2 \times \text{Veq} \times 100}{\text{me}}$$

Veq: volume of KMnO₄ used for the titration (mL); me: mass of the sample (g).

Results and Discussion:-

Table 1 presents the different contents of dry matter, moisture, ash, fat, proteins, carbohydrates and the energy value of *Anacardium occidentale* almonds.

Table 1:- Biochemical parameters of *Anacardium occidentale*.

Parameters	Mean Value ± ET
Humidity (%)	3,53 ± 0,13
Dry matter(%)	96,46 ± 0,53
Ash (%)	2,72 ± 0,19
Fat (%)	22,01 ± 0,85
Protein (%)	9,11 ± 0,26
Carbohydrates	62,61 ± 0,46
Energy Value (kcal/100g)	573,15 ± 0,77

1. Dry matter content, ash and humidity level:

The ash content is 2.72 ± 0.19%. Also, it seems useful to note that the dry matter levels of *Anacardium occidentale* almonds are slightly higher than those of oilseeds (90-95%) (Saki et al, 2005). The water content of dried *Anacardium occidentale* almonds used for oil extraction in the laboratory is 3.53 ± 0.13%. This relatively low value ensures good storage of the almonds for the various subsequent analyzes and a better oil yield (Saxhold, 2009).

2. Fat content:

The extraction of the fat with a Soxhlet made it possible to obtain an average oil content of 22.01 ± 0.85. Furthermore, we note that this value is comparable to that of soybeans (19.2%) (Saxhold, 2009) but lower than those of certain edible oilseeds such as sunflower seeds (55.5%), peanuts (45-50%), sesame (49.7%), cashew (49.5%), palm kernel (48%) (Saxhold, 2009), corn (18%-50%) (Kapseu, 1997).

3. Protein content, total carbohydrates and energy values of *Anacardium occidentale* almonds:

The protein content of *Anacardium occidentale* almonds from Ivory Coast (9.11 ± 0.26%) is lower than those of protein crops known as peanut seeds (24.9%), sunflower (21.3%), flax (20.2%) (Saxhold, 2009), hemp (22.2%), cotton (21.3%), coconut (23.7%) (Foidl, 2001); Which indicates that the organ studied is not a protein crop. The total carbohydrate content (62.61 ± 0.46%) allows the strengthening of its energy value. Indeed, the determined energy value (573.15 ± 0.77 kcal/100g) coming from lipid, protein and carbohydrate intake, is within the margin of that of oilseeds, most often between 550 and 650 kcal/100 g of DM (Dahouenon, 2012). From this point of view, the plant studied would find use in the prevention of cases of malnutrition because it constitutes a significant energy source.

4. Content of reducing sugars and total sugars:

Present in cereals from 1 to 4% (Subramanien et al., 1981), total and reducing sugars, most often, are responsible for the sweetness of a food. The plant material studied contains 2.01 ± 0.69 g/L of total sugars and 0.05 ± 0.02 g/L of reducing sugars (Table 2); When the sugar content is low, the food can be recommended for diabetics (Kouamé, 2015).

5. Analysis of the antinutrient composition of *Anacardium occidentale* almonds:

The results recorded in Table 2 showed that *Anacardium occidentale* almonds contained phytate contents of 1.61 ± 0.58 mg/100g and oxalates of 0.09 ± 0.02 g/100g. The oxalate value is relatively low and lower than that of Nigerian Tigernut (*Cyperus esculentus L.*), with an oxalate content of 0.25 ± 0.65 (Ekeanyanwu, 2010); It should also be noted that the phytate content is lower than that of certain seeds or tubers: wheat (0.3-1.4 g/100g), corn (0.8-2.2 g/100g), rice (0.8-1.0 g /100g) (Reddy, 2002) and also, the phytate content of Nigerian Tigernut (*Cyperus esculentus L.*) which is 1.97 ± 0.69 mg/100g (Ekeanyanwu, 2010) . It should be remembered that the high presence of phytates in biological systems allows the chelation of divalent metals such as calcium, magnesium or blocks the absorption of essential minerals in the intestinal tract (Dan, 2005), thus reducing their bioavailability. (Oberleas, 1973).

Table 2:- Some antinutrients present in *Anacardium occidentale*.

Parameters	Mean Value \pm SD
Reducingsugars (g/L)	$0,05 \pm 0,02$
Total sugars(g/L)	$2,01 \pm 0,69$
Phytates (g/100g)	$1,61 \pm 0,58$
Oxalates (g/100g)	$0,09 \pm 0,01$

Conclusion:-

This study showed that *Anacardium occidentale* almonds from Côte d'Ivoire are an excellent source of nutrients, rich in carbohydrates, modest in lipids and proteins. They have a very appreciable energy potential (573.15 ± 0.77 kcal/100g) and a low level of antinutrients (oxalates and phytates). The low water content of the dried materials ensures good storage and preservation of the almonds. Furthermore, the results obtained from the various analyzes revealed the nutritional properties of *Anacardium occidentale* almonds which will have to be confirmed in the continuation of our work on this plant.

References:-

1. AFNOR.(1981-1982). Recueil des normes française. Corps gras, graines oléagineuses, produits dérivés. NF 03-720, NF V03 903, NF T60-204, NT T 60-223, NF T 60-205 et NF T60-203. Ed. la Défense, Paris, 327 p.
2. Agbaire, P.O.(2011). Nutritional and anti-nutritional levels of some local vegetables (*Vernoniaamygdalina*, *Manihotesculenta*, *Teferiaoccidentalis*, *Taliumtriangulaire*, *Amaranthusspinosus*) from Delta State, Nigeria. J. Appl. Scien. And Envntal. Mgt., 15 (4): 625-628.
3. Alaoui-SOSSE, B., Parmentier, C., Dizengremel, P., Barnola, P. (1994). Rhythmic growth and carbon allocation in *Quercusrobur.*, 1. Starch and sucrose. *Plant Physiol. Biochem.*, 32 (3): 331-339.
4. Bamba, S., Mamyrbekova-Békro, J.A., Virieux, D., Kabran, G.R.M. ,Pirat, J.-L., and Bekro Y.-A. (2015). Analysis of a Rutaceae fat matter from Côte d'Ivoire. *Der ChemicaSinica*, 6(4): 47-50.
5. Dahouenon, A.E., Djenontin, T.S., Codjia, D.R.M., Alitonou, A.G., Dangou, J., Avlessi, F., Sohounhloue, D.C.K. (2012).Morphologie des fruits et quelques caractéristiques physique et chimique de l'huile et des tourteaux de *Irvingiagabonensis*(Irvingiaceae). *The International Journal of Biological and Chemical Sciences*, 6(5): 2265-2271.
6. Dan I. (2005). Une controverse récente sur la sécurité des graines de soja. *Le journal Punch*, 26-46.
7. Day, R. and Underwood, A. (1986). *Quantitative analysis 5th*. Ed. In Prentice-Hall Publication, Upper Saddle River, 701 p.
8. Ekeanyanwu, R.C., Njoku, O., and Ononogbu, I.C.(2010). La composition phytochimique et certains effets biochimiques de Tigernut nigérian (*Cyperrus esculentus L.*) Tubercule. *Pakistan Journal of Nutrition*, 9(7): 709-715.
9. Foidl, N., Makkar, H.P.S., Becker, K. (2001). Potentiel de *Moringa oleéfera* en agriculture et dans l'industrie. *Dar es Salaam*, 1-20.
10. Kapseu, C., and Parmentier, M. (1997). Composition en acides gras de quelques huiles végétales du Cameroun. *Science des aliments*, 17 (3) : 325- 331.
11. Koffi, Y.J.J. (2012). La dynamique de la transformation de la noix de cajou dans les zones rurales Centre et Nord de la Côte d'Ivoire. *Revue de géographie du laboratoire Léidi*, 2515 (10) : 179-199.

12. Koko, C.A., Diomandé, M., Kouamé, B.K., Yapo, E-S.S., Kouassi, J.N. (2016). Caractérisation chimique des graines de quatorze variétés de Niébé (*Vigna unguiculata* L. Walp) de Côte d'Ivoire. *International Journal of Innovation and Applied Studies*, 17 (2): 496-505.
13. Koné, G. (2002). La place de l'anacardier dans la gestion foncière et recomposition des relations sociales : exemple du village Kouakro (Bouaké). Mémoire de maîtrise sociologie, Université de Bouaké, Côte d'Ivoire, 62p.
14. Kouamé, N.M.T., Soro, K., Mangara, A., Diarrassouba, N., Koulibaly, A.V. (2015). Etude physico-chimique de sept (07) plantes spontanées alimentaires du centre-ouest de la Côte d'Ivoire. *Journal of Applied Bioscience*, 90: 8450-8463.
15. Kwanyuen, P., and Joe, W.B. (2005). A simple and rapid procedure for phytate determination in soybeans and soy product. *Journal of the American Oil Chemists' Society*, 82 (2): 81-85.
16. Oberleas, D.C.(1973). Teneur en phytates des céréales et légumineuses et méthodes de détermination des céréales. *J. Food Chem.*, 28 : 352-357.
17. Reddy, N.B., Cook, J.D. (2002). Occurrence, diminution, content, and dietary intake of phytate. Dans *Food Phytates*, (édité par Reddy NR, Sathe SK) pp. 25-(&. Boca Raton : CRC Pres.
18. Ricau, P.,and Konan, C. (2010). La filière anacarde en Côte d'Ivoire Acteurs et Organismes. INADES formateurs, Abidjan (Côte d'Ivoire), 36p.
19. Ruf, F., Koné, S., and Bebo, B. (2019). Le boom de l'anacarde en Côte d'Ivoire : transition écologique et sociale des systèmes à base de coton et cacao. *Agricultures EDP Sciences*, 28 (21) : 1-12.
20. Saki, S.J., Mosso, K., Sea, T.B.,and Diopoh, K.J.(2005). Détermination de quelques composants essentiels d'amandes de akpi (*Ricinus communis*). *Agronomie Africaine* 17 (1): 137-142.
21. Saxhold, E., Christensen, A.T., Moller, A., Hartkopp, H.B., Hess, Y.K., Hels, O.H.(2009). *Danish Food Composition Databank*, Natural Food Institute, Technical University of Denmark, version 7.1.
22. Severin, Y.K., Marcel, K.K., Janat, A.M-B., Philippe, K.N., Yves-Alain, B. (2018). Variabilité chimique et nutritive des graines de *Myrianthus arboreus* P. Beauv. (Cecropiaceae) de quatre régions de Côte d'Ivoire. *J. Soc. Ouest-Afr. Chim*, 045: 25-30.
23. Subramanian, V., Suryaprakash, S. (1981). Sugars of pearl millet (*Pennisetum americanum* (L.) Leeke). *Journal of Food Science*, 46, 1614-1615.
24. Yao, K.A., Koffi, M.D., Blei, S.H., Irié, B.Z., and Niamké, S.L. (2015). Propriétés biochimiques et organoleptiques de trois mets traditionnels ivoiriens (attiéké, placali, attoukpou) à base de granulés de manioc natifs. *Int. J. Biol. Chem. Sci.*, 9 (3): 1341-1353.