WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES

SJIF Impact Factor 5.210

Volume 4, Issue 11, 1912-1920 Research Article ISSN 2278 – 4357

PHYSICO-CHEMICAL CHARACTERIZATION OF OIL AND DEFATTED MEAL FROM *ANACARDIUM OCCIDENTALE* ACCLIMATED TO TEVAL IN NORTHEN BENIN

Wotto D.V. [1*], N'dayishimiye V.[1], Yété P.[1], Sessou P[2]., Agbangnan P. [2], Sohounhloué D[2]

[1]Laboratoire de Chimie Physique, Faculté des Sciences et Techniques (FAST/UAC) 01 BP 526 Cotonou République du Bénin

[2]Laboratoire d'Etude et de Recherche en Chimie Appliquée (LERCA), Unité de Recherche sur les Interactions Moléculaires (URIM), EPAC/UAC, 01 BP 2009 Cotonou; République du Bénin.

Article Received on
16 Sep 2015,

Revised on 07 Oct 2015,
Accepted on 28 Oct 2015

***Correspondence for Author**
Wotto D.V.
Laboratoire de Chimie Physique, Faculté des Sciences et Techniques (FAST/UAC) 01 BP 526 Cotonou République du Bénin.

ABSTRACT

This work focuses on the physico-chemical characterization of oil and defatted meal obtained from the kernels of *Anacardium occidentale* acclimated in Benin. The lipidic potential of the roasted cashew nutkernelsis 51.80±0.38%. The extracted oil, liquid at room temperature, is dark yellow with a pleasant aroma of toasted kernels. Chemical properties (acid, saponification, peroxide, and iodine index) and the fatty acids profile have been determined for the oil. The fatty acids profile showed a predominance of the unsaturated fatty acids specially oleic acid (44%), palmitoleic acid (13%) and linoleicacid (12.5%). The acid index (1.14 mg KOH/g) and peroxide index (8.08 meq O_2/kg) are in agreement with the Codex Alimentarius (1999). The high iodine value (108.84 g I_2/100g) explains the unsaturated nature of the oil. The saponification index (205.29 mg KOH/g) is almost the same with saponification index of the common edible oils; this high value could direct the oil to be used in soap factory. The protein content is 38.64% and the main minerals present are phosphorus (1.233%), potassium (1.287%), magnesium (0.480%) and calcium (0.133%). Sodium, iron, zinc, copper and manganese are at low concentrations (0.002 to 0.037%). Given this composition, the defatted meal rich in minerals and especially protein could be used inhuman and animal nutrition.

KEYWORDS: *Anacardium occidentale*, lipidic potential, fatty acid profile, delipidated cake.

INTRODUCTION

The African flora in general and that of Benin in particular is full of a variety of plants with little or unexploited potential. Plants, mostly are used in traditional medicine to treat certain diseases, construction, food, etc. Given the proven importance of plants in the life of every day, the need for their valorization is well established. *Anacardium occidentale*, a native of Brazil, has been introduced in Africa in the fifteenth century to fight against erosion.[1,2 3] From the family of Anacardiaceae, *Anacardium occidentale*is a tree in the flared tops measuring from 6 to 12 meters high, sometimes more (up to 15 m). It is a very short trunk tree whose branches spread and are very low, sometimes almost to the ground. The main root is swiveling and sinks to great depth; lateral roots, highly developed, often extend far around the shaft. The leaves are simple, alternate, entire, thick, elliptical. They are smooth, tough, and have a thick cuticle with projecting ribs on the upper side. They measure 7 to 18 cm long and 5 to 12 cm wide and are carried by a petiole of 1 to 2 cm, thickened at the base. The upper leaf surface is dark green while the bottom is clear. The leaves are labeled from 10 to 15 pairs of lateral ribs.[4] The white flowers tinged with pink appear during the dry season in February; they are small, fragrant and united in terminal inflorescences. We meet male flowers and hermaphrodites.[5] The fruits, cashew nuts, are formed at the end of the dry season, under a stalk swollen, fleshy and juicy (cashew apple) in April. They have a pungent and toxic hull giving balm, phenolic resin popular in the manufacture of friction components (brakes, clutches), rubber, insulation, plastics and special coatings.[6,7] The edible white almond is used in food (chocolates, pastries, cookies, etc.). It has a lipidic potential higher than 45%.[4,8,9] The fatty acid profile shows a predominance of unsaturated fatty acids especially oleic (47.79%) and linoleic acid (29.67%). [10] Defatted meals contain proteins and minerals.[11, 12, 13] The composition of the meal could towards their use in food and feed. It is therefore necessary to valorize the Anacardium occidentale nuts from Benin through the study of the oil and cake of their almonds.

MATERIAL AND METHODS

Seeds harvest

The seeds were harvested at Teval in northern Benin in the town of Copargo. Nuts were dried for 7 days in the laboratory at room temperature (25 ° C) and were mechanically crushed using a hammer. The manually separated almonds were dried in air at 25 ° C for 10 days before the determination of the water content and volatile matter according to NF T 60-

201norm. They were mechanically ground in a Moulinex and fats were extracted with Soxhlet using hexane at 69 °C following the method of standard NF V03-924.

Determination of some characteristics of the oil

Acid values (IA), peroxide (IP), iodine (II) and saponification (IS) were determined respectively by the standards NF T60-204, NFT60-220, NF ISO 3961, NF T 60 -206. The ester value (IE) has been calculated on the basis of the analytical data using the formula

IE = IS - IA (1)

The calorific value was calculated using the formula

PC = 47645 - 4.187II - 38.31IS (KJ / Kg) (2)

Determination of fatty acid composition by GC

The methylesters were prepared according to the protocol of the standard NF T60-233. To determine the fatty acid composition 1µL of a hexane solution of methyl esters was injected into an Agilent HP 6890 series (Agilent, USA) equipped with a INNOWax type column (Agilent, USA), length 30m, 0.32 mm inner diameter and a thickness of 0.25µm film. The injector was split mode, ratio 1/80 to 250 ° C. The carrier gas was helium flow rate 1.5 mL / min. The flame ionization detector was 270 ° C. Programming of the oven temperature was 150 ° C for 3 minutes followed by an increase of 3 ° C / min up to 220 ° C (26.3mm) which was kept constant until the end of acquisition (35.3mn). The peak identification was made by comparison of retention time of methyl esters of fatty acids of vegetable oils such as olive oil, sunflower oil and palm oil, injected into the same operating conditions. To verify the reproducibility of the results, each injection was resumed three times in the same operating conditions.

Characterization of meals

Mineral nutrients (N, P, Ca, Mg, Na) were measured by ICP (Inductively Coupled Plasma) after sample mineralization. The samples were dissolved by the dry ashing process. The spectrometer, Varian Vista brand, is equiped with CCD sensor (Charge Coupled Device). The apparatus (Jobin Yvon JY) was on the following wavelengths: λ = 214.914 nm for phosphorus and λ = 589.592 nm for sodium. The assays were carried out by performing a calibration that meets the conditions of the analyzed medium (matrix, acidity). The calculations were made by interpolation relative to the calibration range. Validation of

analytical results is based on the analysis of internal reference samples (control) which mineral contentsare known.

RESULTS AND DISCUSSION

Oil content of *Anacardium occidentale* almonds

The lipid content of Anacardium occidentale toasted almonds of Benin is 51.80 ± 0.38. This content is higher than that of raw samples from Nigeria (11.14) (Table 3). Almond's toasting has significantly decreased water content (1.70 ± 0.01) and significantly improved the extractive yield. The high value of lipid potential may foster lipid extraction by press.

Chemical characteristics of the *Anacardium occidentale*oil

• Acid value

The acid value *Anacardium occidentale*oil from Benin was 1.14 ± 0.09 mg KOH / g of oil. It is less than the standard (4 mg KOH / g of oil), set by the Codex Alimentarius and lower than that reported by[14] (12.66 mg KOH / g of oil) for *Anacardium occidentale*oils but higher than that of *Anacardium occidentale* oils from Nigeria (0.0495 ± 0.00 to 0.1118 ± 0.00 mg KOH / g of oil).[15] The low content of free fatty acids of this oil demonstrates the good quality of the almonds used.

• Saponification value

The sample of saponification is higher than that found in[14] but is smaller than those reported by[16] (Table 5) for *Anacardium occidentale*'s oils from Nigeria. However, it is in the same order of magnitude as those of edible oils of palm (190-209 mg KOH / g of oil), cotton (189-198 mg KOH / g of oil), peanut (187 - 196 mg KOH / g oil) and soy (189-195 mg KOH / g oil) required by the Codex Alimentarius.

• Peroxide value

The peroxide value of the oil in *Anacardium occidentale* of Benin is lower than that of Nigeria oils (19.75 ± 0.05 - 20.84 ± 0.04 meq O2 / kg oil) analyzed by[15] but higher than that reported by[14] (table 5). However, it is less than the upper limit set at 15 meq O_2/ kg of oil by Codex Alimentarius for raw edible oils.

• Iodine value

The determination of the iodine value is used to find the degree of unsaturation of fatty acids in the oil. The oil iodine value of *Anacardium occidentale* almonds of Benin has a value

greater than those of Nigeria oils studied by[15] but is smaller than the value reported by[14] (Table 1). This value is higher than that of the palm oil (50.0 to 55.0). It is in the same order of magnitude as those of corn oil (103-135) and cotton (100-123).[16] The high value of the iodine value is related to the unsaturated nature of the extracted oil.

Table 1: Chemical characteristics of *Anacardium occidentale* oil

Characteristics	*A. occidentale* oil from Benin	*A. occidentale* oil from Nigeriaa	*A. occidentale* oil from Nigeria	Peanut oil	Palm oil
Acid value (mg KOH/g of oil)	1.14±0.09	12.66	0.09 ±0.00	< 4	< 4
Peroxyde value (meq O_2/Kg of oil)	8.08±0.12	2.94	20.18 ± 0.04	< 15	< 15
Saponification value (mg KOH/g Of oil)	205.29±0.32	17.60	235.66 ± 0.03	187-196	190-209
Iodine value (g of I_2/100 g of oil)	108.84±0.74	136.89	85.12 ± 0.03	86-107	50.0-55.0

• Fatty acid profile of the oil

The results obtained regarding the fatty acid composition of *Anacardium occidentale* kernels are presented in Table 2. It appears that the fatty acid composition is marked by the predominance of oleic acid (C18: 1) following by palmitoleic acid (C16: 1) and linoleic acid (C18: 2). Linolenic acid (C18: 3), stearic (C18: 0), palmitic (C16: 0) and arachidic (C20: 0) are poorly represented. This composition shows a predominance of unsaturated fatty acids, which justifies its physical state at room temperature. The sample of Benin is rich in oleic acid than the Nigerian sample, but it is less rich than its palmitic acid and linolenic acid. The sample of Benin is also richer in unsaturated fatty acid than that of the sample of Brazil (Table 2).

Table 2: Fatty acid composition of some *Anacardium occidentale* oils

Fatty acid	*A. occidentale*	*A. occidentale* from Nigeria	*A. occidentale* from Brazil
Palmitic acid (C16 : 0)	4.53±0.31	0.06	3.33±0.39
Palmitoléic acid (16 :1n-7)	12.65±0.02	25.00	0.10±0.03
stearic acid (18 : 0)	6.35±0.09	03.70	3.13±0.52
Oleic acid (18 : 1n-9)	43.86±0.21	30.70	24.10±1.33
Linoleic acid (18 : 2n-6)	12.50±0.18	02.50	7.28±0.29
α-linolenic acid (18 : 3n-3)	7.01±0.06	23.00	0.10±0.01
arachidic acid (20 :0)	0.30±0.01	ND	0.20±0.02

• Composition of the sterol fraction

This family of compounds especially the β-sitosterol helps fight against heart disease by reducing the intestinal absorption of cholesterol.[1718] The β-sitosterol is the major sterol (64.80%) followed by campesterol (13.50%) and stigmasterol (11.30%) of total sterols. This total sterols content (169mg / 100g oil) was compared to that of olive oil (119- 268 mg / 100g)[19 20], groundnut and palm (66-93 and 147-171 mg / 100g respectively) (Table 3).[11] It appears that *Anacardium occidentale* oil seems to have a total and individual sterol content similar to that of olive oil and peanut marked by the predominance of β-sitosterol (58 - 79.7%).

Table 3: Sterol composition of *Anacardium occidentale* oil

Stérols	*A. occidentale*	Peanut	Palm	Olive oil
Campesterol (%)	13.50	12 - 15	19 -21	2.9
Stigmasterol (%)	11.30	8 - 11	11 -23	0.7
β-sitosterol (%)	64.80	58 - 66	56 -59	79.7
Δ^5-avenastérol (%)	10.2	9 - 14	2 - 3	13.5
Total sterols (mg/100g)	169	147-171	66-93	119-268

• Composition of the fraction in tocopherols

There are not data in the literature, to our knwoledge on the tocopherol content of *Anacardium occidentale* oil. Tocopherols constituting the class of vitamin E have antioxidant properties due to their ability to inhibit lipid peroxidation.[21.22] The oil from seeds of *Anacardium occidentale* has a total tocopherols content of 209.15 mg / kg. This value is low compared to other vegetable oils such as soybean (980mg / kg), corn (816mg / kg) and palm oil (718-818 mg/Kg). It is however higher than that of the olive (110-183mg / kg).[23.24] *Anacardium occidentale* oil contains only α, β, δ and γ- tocopherols (Table 4). Given this composition, *Anacardium occidentale* oil would possess an average antioxidant activity.

Table 4: Tocopherol composition of *Anacardium occidentale* oil

Tocopherols	*A. occidentale*	Peanut	Palm	Olive oil
α-tocopherol (%p)	57.80	42 - 59	23.9 ± 0.3	52 - 87
β-tocopherol (%p)	3.40	2 - 5	32.5 ± 0.2	10 - 25
γ-tocopherol (%p)	35.10	32 - 52	40.2 ± 0.4	7 - 23
δ-tocopherol (%p)	3.70	2 - 4	3.3 ± 0.1	-
Total Tocopherols (mg/Kg)	209.15	-	718 – 818	110-183

Characterization of *Anacardium occidentale* meal

Defatting cake significantly improves the content of the measured elements. Table 5 shows high content of N, P, K, Ca and Mg for *Anacardium occidentale* meal of Benin while the elements (Na, Fe, Mn, Zn, Cu) are present in low concentrations. Except for the phosphor, the contents of all the elements analyzed are superior to those of the sample from Brazil.[12] The contents of the defatted cake of Benin are also higher than those of all elements analyzed by[25] for the Brazilian sample. However, the contents of Ca, Na, Fe and Zn of non-defatted ted cake of Benin are lower than those of Nigeria cake.[14] The high protein and mineral elements of the defatted cake of Benin could direct their use in food and feed. Also, their high content of N, P and K would favor their use in oil amendment.

Table 5: Mineral elements of *Anacardium occidentale*

Parameters (mg/100g)	Defatted meals *Anacardium occidentale*	Defatted meals of *Anacardium occidentale* from Nigeria
N	6182±0.038	-
P	1233±0.049	37.59±0.001
K	1287±0.096	250.49
Ca	133±0.019	220.67
Mg	480±0.012	180.58
Na	30.23±0.001	257.71
Fe	37.59±0.001	17.00
Mn	2.64±0.000	0.76±0.16
Zn	9.76±0.000	2.89±1.20
Cu	3.34±0.000	0.95±0.19
Proteins(%)	38.64±0.237	-

CONCLUSION

This work is a contribution to the characterization of *Anacardium occidentale* kernels from northern Benin. The fat content and chemical characteristics are reported. The data obtained are also compliant with standards and show their quality and their possible use in margarine industry. The predominance of unsaturated fatty acids such as oleic acid and linoleic acid is compatible with the values obtained for iodine and saponification and justifies the liquid aspect of the oil at ordinairy temperature. This study has allowed to update the data in the literature and should support the food and socio-economic interest of the specie *Anacardium occidentale*. The valuation of forest resources for industrial purposes can contribute to protecting our endangered forests. Indeed, the preservation of species established through diversification and a greater emphasis on their by-products can promote their development.

REFERENCES

1. Akinhanmi T.F. et Atasie V.N.Chemical composition and physicochemical properties of cashew nut (Anacardium occidentale) oil and cashew nut shell liquid. Journal of agricultural. Food and Environment Sciences. 2008; 2(1).
2. N'Guessan A. et Bamba Y. Plan de compétitivité de la filière anacarde au Mali. PCDA (Programme de Compétitivité et de Diversification Agricole). Mali. 2008.
3. Lautié E. Dornier M. De Souza F. et Reynes M. Les produits de l'anacardier : caractéristiques. voies de valorisation et marchés. Fruits. 2001; 56(4): 235-248.
4. Lacroix. E. 2003. Les anacardiers. les noix de cajou et la filière anacarde à Bassira et au Bénin. projet Restauration des ressources forestières de Bassira.
5. FAO. Espèces fruitières forestières. Rome 1982.
6. Teblekou K.Tandjiekpon A. et Dah-Dovonon J.Z. Premier cours de formation en techniques de création et de gestion des plantations d'anacardiers. Unité de recherches forestières. Cotonou; 2001.
7. Lubi M.C. et Thachil E.T.Cashew nut liquid (CNSL) – a versatile monomer and polymer synthesis. Designed Monomers and Polymers, 2012; 3(2): 123-153.
8. Pobeda. M. Huile de noix de cajou vierge; 2011.
9. Toschi T.G. Cabori T.G. Pennazzi G. Lerker G. et Capella P. A study on cashew nut oil composition. Journal of the American Oil Chemists' Society, 1993; 70(10): 1017-1020.
10. Abitogu A.S.et Borokini F.B.Physicochemical parameters and fatty acid composition of cashew nut (Anacardium occidentale) oil. Journal of Research in National Development, 2009; 7(2).
11. Aremu M.O. Olonisakin A. Bako D.A. and MaduP.C. Composition studies and physicochemical characteristics of cashew nut (Anacardium occidentale) flour. Pakistan Journal of Nutrition, 2006; 5(4): 328-333.
12. De Oliveira Sousa A.G. Fernandes D.C. Alves A.M. De Freitas J.B. et Naves M.M.V. Nutritional quality and protein value of exotic almonds and nut fromthe Brazilian savanna compared to peanut. Food Research International, 2011; 44(7): 2319- 2325.
13. Omosuli S.V. Ibrahim T.A. Oloye D. Agbaje R. et Jude-Ojei B. Proximate and mineral composition of roasted and defatted cashew nut (Anacardium occidentale) flour. Pakistan Journal of Nutrition, 2009; 8(10): 1649-1651.
14. Aletor O. Agdebe J.O. Adeyeye S. A. et Aletor V. A. Chemical and physiochemical characterization of the flour and oils from whole and rejected cashew nuts cultivated in southwest Nigeria. Pakistan Journal of Nutrition, 2007; 6(1): 89-93.

15. Olugunde O.M. OmosebiM.O. Ariyo O. Olunlade B.A. et AbolajiR.A. Preliminary nutritional evaluation of cashew nuts from different locations in Nigeria.Continental J. Food Science and Technology, 2011; 5(2): 32–36.
16. Codex Stan 210. 1999. Norme pour les huiles portant un nom spécifique.
17. Djenontin S. T. Dangou J. Wotto D. V. Sohounhloue K.C. D. Lozano P. Pioch D. composition en acides gras. stérols et tocophérols de l'huile végétale non conventionnelle extraite des graines de jatropha curcas (euphorbiaceae) du bénin. j. soc. ouest-afr. Chim ; 2006; 022 : 59 – 67.
18. Djenontin S. T. Etudes de graines oléagineuses du Bénin: Caractérisation chimique. Fractionnement et activité biocide ; 2006.Thèse de doctorat.
19. Edmonds S.E. Winyard P.G.Guo.R. Kidd B. Merry P. Langrishsmith A. Hansen C. Ramm S. Blake D.R. Putative analgesic activity of repeated oral doses of vitamin E in the treatment of rheumatoid arthritis - Results of a prospective placebo controlled double blind trial - Annals of the rheumatic diseases; 1997; 56: 649-655.
20. Essien E.U., Esenowo G.J., Akpanabiatu M.I. Lipid composition of lesser known tropical seeds. Plants Foods for Human Nutrition; 1995; 48: 135-140.
21. Jones P. JH. Ntanios F.Y. RaeinI-Sarjaz M. Vanstone C.A. Cholesterol-lowering efficacy of a sitostanol-containing mixture with a prudent diet inhyperlipidemic men – Am. J. Clin. Nutr. 1999; 69: 1144-1150.
22. Kilic T. Dirmenci T.Satil.F. Bilsel G. Kocagoz T. Altun M. Goren. A.C.Fatty acid compositions of seed oils of three Turkish Salvia species and biological activities. Chem. Nat. Compds, 2005; 41(3): 276-279.
23. Leger C.L. La vitamine E : état actuel des connaissances. Rôle dans la prévention cardiovasculaire. biodisponibilité–OCL, 2000; 7(3): 258-265.
24. Ndéye A. K. Etude de la composition chimique et de la qualité d'huiles végétales artisanales consommées au sénégal. Thèse de Doctorat; 2001.
25. Soares D.J., De Sousa Sabino L.B. De Sousa M.S.M.L. De Carvalho Magalhåes C.E. Almeida M.M.B., De Sousa. P.H.M. et De Figueiredo. R.W. Mineralcontent.based in the recommended Daily intake. in cashew nut obtained fromconventional and organic cultivation in different stages of processing. Semina: Ciências. Londrina, 2012; 33(5): 1869-1876.