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Nutritional Approach of Some Members of Ricinodendron Family by Physicochemical Analysis

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Abstract: The nuts of Ricinodendron family have good nutritive value. The moisture rounded 6% with ashes varying from 2.6-13.3%. The lipids content are ranging from 39.7-65.97% and the carbohydrates up to 6.6%. The comparison of 3 lots harvested in R. Congo (Goka), Cameroon (Njansan) and D.R. Congo (Kingoma-Ngoma) gave great differences. The oil of Njansan has a α eleostearic acid to 40.98% while the oil of Goka contains 54.3% of linoleic acid as major component. The oil of Kingoma-Ngoma contains 39.42% of linoleic acid and 31.63% of linolenic acid. The thermal behavior gave a little contrast with one melting point at -30.5°C (Goka) or -27.1°C (Kingoma-Ngoma). The 3 nuts harvested in 3 countries of the central Africa are very different.

Key words: Ricinodendron, najansan, goka, Kingoma-Ngoma, nut, oil

INTRODUCTION

The current family of Ricinodendron presents two or three species well identified as *Rautanenii*, *Africanum* and *Heudelotii*. They belong all to the family of the Euphorbiaceae. The area of repartition of *R. rautanenii* is well known in the Eastern part of the continent while *R. heulodotii* and Africanum are well located in the Guinea Gulf (Tchoundjeu and Atangana, 2006). Generally, it's possible that certain species disappear to be ranged as earlier species.

The fruit of *Ricinodendron heudelotii* in the South West of Cameroon is commonly named Njansan (Tshibangu and Ndigba, 1999). In the North of Congo-Brazzaville (locality of Ouesso) at the frontier with The Republic of Cameroon the Njansan is named Goka. But in the cataracts regions in the South of both Congo, it is named Kingoma-Ngoma. Morphologically, Njansan and Goka are same. Kingoma-Ngoma kernel and nut are twice or three times larger.

In a big program of the CEMAC (Economic and Monetary Community of the Central Africa) a great study coordinated by T. Silou was meant to located and to identify all the potential lipids sources in order to stimulate the local intake. Also, many papers are available (Nzikou *et al*., 2006; 2009a, b; Dhellot *et al*., 2006; Bouanga-Kalou *et al*., 2011) in the region.

In this study, researchers will try to compare 3 members of *Ricinondendron heudelotii*, harvested in South of Cameroon, the North of Congo Brazzaville and the South of Democratic Republic of Congo. It seems that the resemblance is only on morphologic aspects.

MATERIALS AND METHODS

Raw material: The nuts of Goka were from Ouesso (1.61°N; 16.05E) in the North of Congo Brazzaville. The Nkamba nuts were from South West Democratic Republic of Congo (19E5S). The results of Njansan were reported from Kapseu and Tchiegang (1995).

Proximate composition: To determine the composition of Nkamba nut as oil content, crude proteins (micro-Kjeldahl), moisture, crude fiber and researchers use the current methods of Pearson (1976). The level of ashes was determined also by current methods (Pomeranz and Meloan, 1994). The total carbohydrates were gotten by difference. Each determination was in triplicate.

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The minerals were determined by atomic absorption spectrophotometry (Perkin-Elmer, Model 2380, USA). The 1 g of matter dried and crushed into ashes in a muffle furnace at 550°C for 8 h until a white residue of constant weight was obtained. The minerals were extracted from ash by adding 20 mL of 2.5% HCl heated in a steam bath to reduce the volume to about 7.0 mL and this was transferred quantitatively to 50 mL volumetric flask. It was diluted with deionised water stored in clean polyethylene bottles and mineral content. The instrument was calibrated with standards solutions.

Seeds and oil extraction: Seeds harvested from Ouesso (R. Congo) and Nkamba (South West of D.R. Congo) were crushed in a coffee grinder (Moulinex Model SeB PREP'LINE 850). The 30 g of ground seed were placed into a cellulose paper cone and extracted using n-Hexane (60°C) in a 2 L Soxlhet extractor for 5 h. The solvent was removed using rotary evaporator model N-1 (Eyela, Tokyo Rikakikal Co., Ltd. Japan). Residual solvent was removed by drying in an oven at 60°C for 1 h, flushing with 99.9% nitrogen.

Determination of fatty acid composition: Fatty Acid Methyl Esters (FAME) were obtained by transmethylation of total lipid aliquots (50 mg) with 1 mL of borontrifluoride in methanol (8% w/v) for 10 min in a shaking water bath heated at 90°C as described by Ackman (1998) earlierly to submit the samples to gas chromatography analysis.

The analysis of FAME was carried out by Gas Chromatography in a PerichromTM 2000 System (Saulx-les-Chartreux, France), equipped with a Flame Ionization Detector (FID) and a fused silica capillary (25 m×0.25 mm×0.5 μm, BPX70 SGE Australia Pty., Ltd.). Column temperature was kept at 145°C for 20 min, then warmed up from 145-210°C flowing out at 5°C min^{-1} and held at 210°C for 15 min. The ended injection port was maintained at 230°C and the detector at 260°C. The fatty acids were identified by comparison of their retention times with appropriate standards PUFA-1 Marine source (Supelco, No. 4-7033, Bellefonte, PA-USA), PUFA-2 Animal source (Supelco, No. 4-7015-U, Bellefonte, PA-USA). Each measure was in a triplicate.

The indices of oils: The usual indices determinate in oils were acid value (AOAC, Standard Method 969.1), iodine value (AOAC, Standard Method 993.20), saponification value (AOAC, Standard Method 965.33) and peroxide value (AOAC, Standard Method 920.160).

Thermal properties of oils: Thermal analyses were performed with a Perkin-Elmer Differential Scanning Calorimeter, DSC-7, equipped with a thermal analysis data station (Perkin-Elmer Corp., Norwalk, CT, USA). Nitrogen was the purge gas and flowed at 20 mL min^{-1}. The calorimeter was calibrated according to standard procedures established in the manufacturer user book using indium and distilled water. Samples of 15 mg were weighed into aluminum pans and cooled and/or heated at 2.5°C min^{-1} from -60 to +60°C. The heat of fusion enthalpies ΔH (J/g) were calculated for each peak by the Pyris Software (Perkin-Elmer Corp., Norwalk, CT, USA). DSC measurements were carried out in triplicate.

Student's t-test was used for statistical validity of results and the coefficient of variation between each measurement do not exceeded 2%.

RESULTS AND DISCUSSION

Chemical composition of nuts: Generally, the nuts present a moisture of 6% occurring that they are not totally dried. Nuts are poorly provided in carbohydrates (5.6-6.6%). Ashes vary from 2.58-13.36%. The high value was from njansan of Cameroon meaning that this nut is rich in minerals. Main differences appeared when researchers compare lipids and proteins levels (Table 1). Nuts from Cameroon and those of DR Congo were highly provided in fats matter (62-65%). While Goka contains 39.7% of oil. Protein content (45%) in the nuts of Cameroon may help to human or animal feeding. With a fat level ranging from 40-66% the almonds of the Ricinodendron family members could be used as alternative source of lipids of current consumption. The chemical content confirmed that these nuts had good nutritive value.

The resemblance is possible but the content was not the same. These results have yet to be obtained by many researchers (Bezard *et al*., 1991; Silou *et al*., 2000, 2002; Dzondo-Gadet *et al*., 2005) who research on safou and on gumbo seed oil (Nzikou *et al*., 2006). There always exist main differences when the same fruit was harvested in many localities or countries. The difference obtained might lead to new classification of species.

Fatty acids composition: The profile of fatty acid shows a great difference between the members of the same family. The presence of α elaeosteric acid (cis, trans, transoctadecatrienoic) (41%) recognized as a C18:3 conjugated fatty acid is the principal characteristic of the oil extracted from Njansan of Cameroon. Never in Goka (R. Congo) nor in Kingoma-Ngoma (D.R. Congo) was the α elaeosteric acid found. The oil from Goka contains the linoleic acid as major component (54.3%). The oil from Kingoma-Ngoma contains 39.44% of linoleic acid and

Table 1: Chemical composition of nuts

Composition	Goka	Kingoma-Ngoma	Njansan (reported values)
Moisture	6.59±0.09	6.61±0.93	5.75±0.07
Lipids	39.70±0.72	65.97±3.00	62.53±0.71
Ashes	5.81±0.28	2.58±0.80	13.26±0.49
Proteins (N×6.25)	16.59±0.07	21.34±2.75	45.15±0.33
Total carbohydrates	6.59±0.07	6.20±0.70	5.60±0.09

31.63% of linolenic acid as major components. This oil cannot be cooked at high temperature, the suitable application is for dressing and dessert. It seems that saturated fatty acids level (9-29%) is always less than polyunsaturated fatty acid fraction (70-82%) in the three nuts. The ratio SFA/PUFA ranging from 0.1-0.4 will help to health benefits.

When researchers compare only the fatty acid composition, it is difficult to affirm that researchers were dealing with the same species of *Ricinodendron harvested* in three different countries of the same Central Africa region. The presence or the absence of α elaeosteric acid in the oil could lead to affirm the differences of species (Table 2).

Indices values: The indices were in two parts. In the first one, it was admitted that it depends on experiments as Av and Pv. In the over hand intrinsic indices are Sv and Iv. The acid values are uniform Av 0.13-4.2 (Table 3). The peroxide value of Congolese oils 1.4-7.9 meqO_2/kg are less than the Pv of oil extracted from Njansan 16.9 meqO_2/kg. The oil from Cameroon was in this case more oxidized. The intrinsic indices are uniform from 105-175 mg/100 g for iodine value and from 179-226 mol/KOH for saponification value. In the Iv and Sv the numbers of R. Congo are near of those of Cameroon. Indeed Ouesso is at the frontier of the two countries.

The iodine value over 100 indicate the richness in bonds; confirming the fatty acid profile. The saponification value neighboring 200 carries out the cosmetic applications of the oils. According to the indices, there is no significant difference between oils extracted from the three nuts. It seems that the oil behavior or content is independent of the harvesting site or country.

Certain researchers like Silou *et al.* (2000, 2002) who had compared safou pulp oil from fruit of Congo, Gabon and Cameroon had conclude that the inter individual variations are pronounced while the intra individual differences in the same tree of the district of Boko seems to be absent.

Thermal behavior of oils: The oils present only one melting point (Table 4). But the difference between oils from Goka (R. Congo) and Kingoma-ngoma (D.R. Congo) is not significant. The difference seen could be a lecture translation on the apparatus. In the experiments, the peak appeared at -30.5°C or at -27.1°C, confirming the high unsaturation of oils and seem to carry out a little resemblance.

At this point of view, it's really difficult to put distinction on the oils according to their origins while researchers have not the values of the Cameroonian oils.

Table 2: Fatty acid composition of Ricinodendron family lipids

Fatty acids	Goka	Kingoma-Ngoma	Njansan (Reported values)
Palmitic acid (C 16:0)	12.27±0.29	6.11±0.91	5.42
Stearic acid (C 18:0)	17.39±1.17	3.03±0.21	7.12
ΣSFA	29.66	9.14	12.54
Oleic (C 18:1)	16.03±1.30	19.48±1.27	26.68
ΣMUFA	16.03	19.48	26.68
Linoleic acid (C 18:2)	54.30±2.01	39.44±1.90	15.09
α elaeosteric acid (C 18:3)			40.98
α linolenic acid (C 18:3)		31.63±1.64	
ΣPUFA	70.33	71.07	82.75
R(SFA/PUFA)	0.42	0.13	0.15

Table 3: Chemical properties of nut oil from three countries

Indices	Goka	Kingoma-Ngoma	Njansan (reported values)
Acide value (oleic)	0.13±0.63	2.47±0.22	4.30
Iodine value	113.40±4.47	175.39±2.71	105.25
Peroxide value	7.94±0.98	1.36±0.49	16.85
Saponification value	179.50±6.49	226.10±2.78	181.40

Pv: meqO_2/kg. Sv; mol/KOH; Iv: mg/100 g [Goka R. Congo, Njansan Cameroon, Kingoma-Ngoma DR Congo]

Table 4: Thermogram of oils of Ricinodendron familly

Thermogram	Goka (R. Congo)	Kingoma-Ngoma (D.R. Congo)	Njansan (reported value) (Cameroon)
Pic 1 (°C)	-30.500	-27.100	ND
ΔH (J g^{-1})	+0.417	+1.094	ND

CONCLUSION

The nuts of the Ricinodendron family have good nutritional value. They are rich in oil content principally the good unsaturated fraction of fatty acids and in protein level. When researchers take the same fruit in many countries, researchers think first that they have the same tight composition. Unfortunately, the same fruit harvested in three different countries in the same region of central Africa, seems to be hardly different. The resemblance was on the thermal behavior of oils. The absence of α elaeosteric acid in two nuts harvested in R. Congo and D.R. Congo brings out a great difference. The composition of oil or the fatty acid profile could be necessary for phylogenic aspect to classify species. More research will be done in genetics to bring out the authentic difference between the three nuts.

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