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Physico-chemical characteristics of the Barinas nut (*Caryodendron orinocense* Karst. Euphorbiaceae) crude oil.

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SUMMARY. A proximate analysis of the seed of the *C. orinocense* K. (Euphorbiaceae) has demonstrated that these are a good source of edible oil. The crude oil was analized to determine its physical and chemical characteristics and the lipid composition, using the AOAC methods and gas liquid chromatography. The results showed that the oil meets Venezuelan standards for edible vegetable oils, with the exception of moisture content and the acid index. It is rich in polyunsaturated fatty acids (75.13% linoleic acid), having a polyunsaturated to saturated fatty acid ratio of 6.50, and therefore could be used for human consumption.

RESUMEN. Características físico-químicas del aceite crudo de la nuez de Barinas (*Caryodendron orinocense* Karst. Euforbiaceae). El análisis proximal del *Caryodendron orinocense* K. (Euforbiaceae) demuestra que las semillas de esta planta son una buena fuente de aceite. El aceite crudo se analizó para determinar sus características físicas y químicas, así como el perfil de ácidos grasos, usando los métodos del AOAC y la cromatografía de gases. Los resultados mostraron, que el aceite cumple con las normas venezolanas para aceites comestibles con excepción del contenido de humedad y el índice de acidez. Es rico en ácidos grasos poliinsaturados (75.13% de ácido linoléico), presentando una relación de ácidos grasos poliinsaturados-saturados de 6.50; lo que va en favor para el uso humano.

INTRODUCTION

The *Caryodendron orinocense* Karst, Euphorbiaceae (CO), is a plant of South American origen, known as «Nuez de Barinas» and «Nogal de Barquisimeto» (Barinas nut and Barquisimeto walnut), named by Reckin (1) as «Orinoconut». It grows at the base of the Andes mountains in the Apure, Barinas and Lara States, where its nuts or seeds are consumed in diverse ways by the farmers of the region. (2)

Seelkofp (3) determined the proximate composition and found between 33.7 and 41.1% oil, which contained between 31.9 and 36.8% of linoleic acid. These results depended on the place of harvest. In 1982 Reckin (1) found 37% oil, 21% protein and 35% carbohydrates.

The purpose of this study was to determine the proximate composition of the seeds harvested at Calderas, (Barinas, Venezuela) and analyze the extracted oil in order to know its physical and chemical characteristics as well as its lipid composition, and compare the results with the Venezuelan standards for vegetable oils for human consumption (4).

MATERIAL AND METHODS

The seeds were obtained at Calderas (Barinas), dehulled, dried in a vacuum oven at 60°C for 18 hr; whole seeds had an average weight of 10.15g, dehulled seeds 4.86g. After extraction with hexane in a Soxhlet extractor, the solvent was removed using a rotary evaporator, and the lipid was kept under nitrogen until analyses were performed.

Proximate composition and physico-chemical analyses.

The analyses of the seeds and crude oil were performed according to the AOAC (5) methods. Carbohydrates were determined by subtracting the total percent composition from 100.

Fatty acid analysis

The fatty acid compositon was determined by gas liquid

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chromatography (GLC) on a 1.83m - 4mm glass column, packed with 4% PEG adipate on 80/100 mesh Chromosorb AW, held at 200°C. Nitrogen was the carrier gas, used at a flow rate of 60 ml/min. with the flame ionization detector held at 250°C. Fatty acid methyl esters were prepared with Meth-Prep II (Applied Science) at ambient temperature for 30 min., following McCreary's method (6). The integration of peak areas permitted the quantification of individual fatty acids, using a Hewlett-Packard 5880A gas chromatograph.

All analyses were conducted in triplicate and results are expressed on a dry weight basis.

RESULTS AND DISCUSSION

Proximate composition

Table 1 represents the proximate composition of the *C. orinocense* seeds. The seeds contained 33.85% oil and 17.16% crude protein, which suggests that they are a good source of these nutrients. These results are comparable to those reported by Seelkopf (3) and Reckin (1).

TABLE 1
PROXIMATE COMPOSITION OF THE *C. ORINOCENSE* SEEDS

g/100 g (dwb)	Mean (a)	St. Dev.
Moisture (105 °C)	8.3	0.117
Crude fat	33.85	0.121
Protein (N x 6.25)	17.16	0.195
Crude fiber	10.76	1.5
Ash (550 °C)	2.77	0.042
Carbohydrates	27.16	

(a) Mean of triplicate

Physical and chemical values

Table 2 and 4 present those values and in Tables 3 and 5 the comparison with Venezuelan standars (4) is made.

TABLE 2
PHYSICAL VALUES OF THE *C. ORINOCENSE* CRUDE OIL

Index	Mean (a)	St. Dev.
Melting point (°C)	-14.33	0.471
Refractive index (20°C)	1.4734	
Apparent viscosity (cps)	27.5	2.5
Relative density (20°C / 20°C)	0.9065	
Color (Lovibond) Yellow-Red	7-2.5	

(a) Mean of triplicate

TABLE 3
CHEMICAL VALUES OF THE *C. ORINOCENSE* CRUDE OIL

Index	Mean (a)	St. Dev.
g/100g oleic acid	3	0.02
Saponification # (mg KOH/g)	176.93	4.247
Unsaponifiable matter (g/100g)	1.07	0.033
Moisture & volatile matter (%)	3.33	0.117
Iodine value (Wijs)	136.53	0.147
Peroxide value (meq. 02/kg)	7.16	0.105
Iron (mg/kg)	5.29	0.4

(a) Mean of triplicate

TABLE 4
COMPARISON OF PHYSICAL VALUES WITH VENEZUELAN REGULATION

Index	*C. orinocense* crude oil	Covenin (a)
Refractive index (25°)	1.473	1.463 - 1.476
Apparent viscosity (cps)	27.5	
Melting point (°C)	-14.33	
Relative density (20 °C/ 20 °C)	0.9065	0.910 - 0.926
Color (Lovibond) Yellow-red	7.0 - 2.5	60 - 6 max

(a) Comision Venezolana de Normas Industriales

TABLE 5
COMPARISON OF CHEMICAL VALUES WITH VENEZUELAN REGULATION

Index	*C. orinocense* crude oil	Covenin (a)
g/100g oleic acid	3	2.0 max.
Saponification # (mg KOH/g)	176.53	185-205
Iodine value (Wijs)	136.53	85-145
Unsaponifiable matter (g/100g)	1.07	3.0 max.
Moisture & volatile matter (g/100g)	3.33	0.2 max.
Peroxide value (meq. O_2/kg)	7.16	10.0 max.
Iron (mg/kg)	5.29	5.0 max.

(a) Comision Venezolana de Normas Industriales

Venezuelan regulations for edible oils do not take into account some of those values, e.g. melting point and apparent viscosity, because they are of importance only for fats. The results show that the acid index is higher than the maximum allowed, although this could be due to hydrolysis of the triglycerides; nevertheless the peroxide value is within range. Therefore this index can be a characteristic of the oil.

The oil presented a saponification number of 176.93 mg KOH/g, according to Mehlenbacher (7), the normal values for oils are in the range of 190-200 mg KOH/g, and lower values could be related to a high percent of unsaponifiable matter, which is not the case. Seelkopf (3) reported values of 155.5 - 168.1.

The moisture content found (3.33%) is higher than the limit, but one has to consider that this limit was set for refined vegetable oils. Seelkopf (3) and Reckin (1) reported values of 17.58% and 3.2% respectively; according to Reckin (1) these nuts are very sensitive to moisture, which promotes their deterioration very rapidly. It is very important to control the moisture content, because it can reduce the shelf life and induce oxidation, which could be enhanced by the presence of metals such as iron, found in the amount of 5.29 mg Fe/kg.

Fatty acid analysis

Fig. 1 represents a choromatogram of the methylated fatty acids of the oil, Table 6 presents the fatty acid composition percent, and in Table 7 this compositon is compared to that of other vegetable oils. As shown, the CO oil is rich in linoleic acid ($C_{18:2}$) 75.13%, which is of great biological importance for the biosynthesis of arachidonic acid. The absence of these two fatty acids in the diet can result in certain pathological symptoms (8). The comparison shows that the CO oil is similar in fatty acid composition to the sunflower seed oil.

TABLE 6
FATTY ACID COMPOSITION OF THE *C. ORINOCENSE* CRUDE OIL

Fatty Acid	Percent
Palmitic C16:0	9.52
Palmitoleic C16:1	0.469
Stearic C18:0	2.168
Oleic C18:1	11.8
Linoleic C18:2	75.127
Linolenic C18:3	0.916

FIGURE 1
Fatty acid methyl esters chromatogram. Conditions: PEG adipate 4% on Chromosorb AW, 80/100 mesh, 1.83 m x 4mm. Col. Temp. 200 °C. flow rate: 60 ml/min, N_2, Det. FID 250°C., sample: 1μl, (10% sol.).

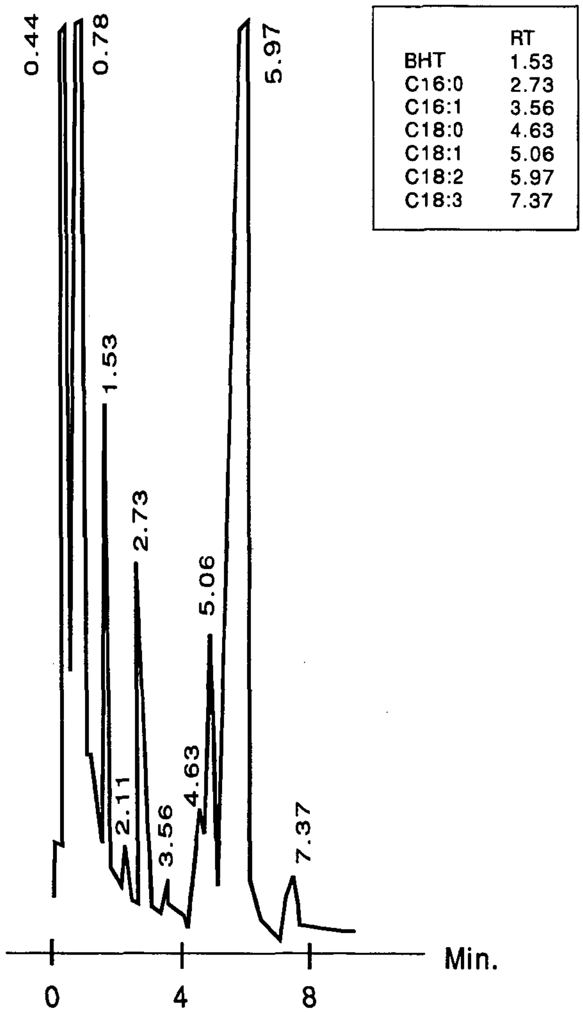

TABLE 7
FATTY ACID COMPOSITION OF DIFFERENT VEGETABLES OILS

Vegetable oil	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3
Palm	2-5	—	0-1	40-53	02-11	—
Peanut	-	6-12	2-4	42-72	13-28	—
Sesame	-	7-09	4-5	37-50	37-47	—
Soy	-	7-14	2-6	23-34	52-60	—
Sunflower	-	6-09	1-8	5-13	60-72	—
C. orinocense	-	9.52	2.17	11.80	75.13	0.92

From the nutritional point of view the ratio of polyunsaturated to saturated (P/S) fatty acids, is very important, and according to the World Health Organization (WHO), this ratio should be ≥ than 2.0. The value of 6.5 found (Table 8) is also similar to that of sunflower seed oil.

TABLE 8
POLYUNSATURATED/SATURATED FATTY ACID RATIOS (P/S)

Vegetable oil	P/S ratio
Palm	0.14
Peanut	1.69
Sesame	3.36
Soy	4.3
Sunflower	6.4
C. orinocense	6.5

CONCLUSIONS

From these results it can be concluded that the CO oil complies with Venezuelan regulation, it is rich in unsaturated fatty acids, presents a very good P/S ratio and therefore is a potencial edible vegetable oil.

Stability and refining process studies should be conducted.

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