Fatty acid composition and glyceride structure of the mesocarp and kernel oils of the pejibaye palm (*Bactris gasipaes* H.B.K.)*

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Abstract: A detailed qualitative, quantitative, and stereospecific chemical analysis of the mesocarp and kernel fats of pejibaye fruits (*Bactris gasipaes*) from Guápiles, Costa Rica, showed that their oils are very different, as in other palms. The qualitative composition is similar to that of the African oil palm but with a greater content of unsaturated fats which should be an advantage for food oil. In the kernel, capric acid tended to be concentrated in the sn-1,3 positions, and laurie acid in the sn-2 position, as predicted for the subfamily *Cocoideae*. The myristic acid is concentrated in the sn-1,3 positions, which has been established as varying among genera of the same subfamilies, and could be of use in clearing up the controversial taxonomic situation of *Bactris* and *Guillielma*.

The pejibaye palm (*Bactris gasipaes* H.B.K.) was a crop of great importance in several Pre-Columbian civilizations of the humid American tropics. Its geographical distribution extended from Honduras in Central America (Stone, 1951) to Bolivia in South America (Antezana, 1972). In recent years, interest in economical potential has been growing (National Academy of Sciences, 1975) because of its importance as a source of carbohydrates for human and animal consumption and for the tender part of its stem called "heart of palm". The possibility exists that, with the great genetic variability that prevails in this crop (Mora-Urpí and Clement, 1981) and the diversity in oil contents as reported in the literature, pejibaye could be developed through selection to become an oil producer. Among those reports, there is one written by Zapata (1978) on the red fruit pulp of a sample of pejibaye from the Cauca Valley of Colombia. He found 4.9% of fat in the mesocarp, equivalent to 10% of the dry matter, with a fusion point between 37 and 40 C, with a fatty acid composition of 36.8% palmitic acid, 9.3% palmitoleic acid, 0.4 stearic acid, 1.3% linoleic acid and 52.4% oleic acid. He also reported 26.7 to 31.0% of total fat content in the seed, but he did not obtain the fatty acid composition. It was, therefore, considered important to look at the chemical composition of the fats of the mesocarp or flesh of the fruit and its seed. The oil content and composition of the mesocarp is the most important of the two because it provides the bulk of the fruit.

MATERIAL AND METHODS

Red pejibaye fruits were harvested from a single tree at Los Diamantes Experiment Station, Guápiles, Costa Rica, in October 1980, sealed in cans, and carried to Iowa State University for analysis. The fruits were divided into approximately two equal parts: one for moisture determination and, the other for fat analysis. Seeds were cracked in a vise, and the kernels ground in a Wiley mill. The ground seeds were divided into two parts for moisture and fat determinations.

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used: hydrogen flame detector, the column was 2 m by 0.33 cm and packed with 15% ethyleneglycol succinate-X on Gaschrom P 100/120 mesh (Applied Science Co., State College, PA, USA); carrier gas nitrogen at 40 ml/min, hydrogen at 40 ml/min, air 200 ml/min; temperature 180 C for fruit methyl ester, programmed from 50 to 185 C for the kernel methyl esters.

For stereospecific analysis of the triglycerides, the following methods were used: mono- and diglycerides were generated by lipase hydrolysis using the thin layer plate method of Dutta *et al.* (1978). The fatty acid composition of the sn-2 position of the triglycerides was determined by conversion of the 2-monoglycerides to methyl esters as above and analysis by gas chromatography. The mixture of 1,2- and 2,3-diglycerides was phosphorylated by the method of Brockerhoff (1965), and the phospholipids thus obtained were hydrolyzed by the on-plate method of Dutta and Das (1979) using cobra venom (*Ophiophagus hannah*) phospholipase. The lysophosphatidic acid recovered from the plate was converted to methyl esters and analyzed for fatty acid composition of the sn-1 position of the triglycerides. The sn-3 position of the triglycerides was determined by difference. Melting points were determined by the capillary method of the American Oil Chemists' Society (1980).

RESULTS AND DISCUSSION

Table 1 shows that, like other members of the palm family, pejibaye fruit and kernel fats are of quite different qualitative and quantitative compositions. The analyses resemble those reported for African oil palm (Jurriens *et al.*, 1964; Salvary and Desnuelle, 1961), but the mesocarp oil is considerably more unsaturated, containing 50% of the fat as oleic acid. This should be an advantage in the use of pejibaye as a food oil.

The distribution of the fatty acids on the three positions of the glycerol is given in Table 2. The results for the fruit fat resemble the partial analyses given for African oil palm (Jurriens *et al.*, 1964; Salvary and Desnuelle, 1961). As with other vegetable oils, the long-chain saturated palmitic and stearic acids are concentrated on the sn-1,3 positions. Litchfield(1972) analyzed the kernel oils of a number of palm

TABLE I

Oil content and composition of six pejibaye fruits and seeds

	Mesocarp	Kernel
% Solids	31.1 ± 1.7 *	76.4 ± 3.7
% Fat (dry wt.)	19.0 ± 1.1	25.2 ± 2.1
Caprylic	–	0.5 ± 0.3
Capric	–	0.6 ± 0.3
Lauric	–	33.3 ± 1.5
Myristic	–	28.4 ± 1.3
Palmitic	29.6 ± 1.9	10.4 ± 1.8
Palmitoleic	5.3 ± 0.2	–
Stearic	trace	3.1 ± 1.3
Oleic	50.3 ± 0.9	18.2 ± 2.1
Linoleic	12.5 ± 1.2	5.1 ± 1.4
Linolenic	1.8 ± 0.5	–

* Average and Standard Deviation

TABLE 2

Stereospecific analysis of pejibaye mesocarp and kernel triglycerides

	Mesocarp			Kernel		
	sn-1	sn-2	sn-3	sn-1	sn-2	sn-3
Caprylic	–	–	–	0.7	–	1.4
Capric	–	–	–	0.7	–	1.5
Lauric	–	–	–	27.2	46.4	29.7
Myristic	–	–	–	34.8	19.0	38.2
Palmitic	33.2	4.6	31.7	14.4	1.8	11.4
Palmitoleic	8.2	1.6	9.0	–	–	–
Stearic	2.7	–	2.5	4.2	0.6	3.5
Oleic	35.8	68.2	37.5	14.0	24.4	13.0
Linoleic	14.4	24.0	13.3	4.0	8.0	1.4
Linolenic	5.7	1.6	6.0	–	–	–

Moisture was determined by weight loss in a vacuum oven at 105 C. The lipid was extracted by Folch's method (1957) with chloroform-methanol. The lipid was freed of chloroform and weighed. To convert the lipids to methyl esters, a portion of the lipid was dissolved in hexane to give a concentration of about 10 mg/ml. Approximately 0.2 ml of this solution was then added to 0.5 ml of 1 M sodium methoxide in methanol and left for 2 hr. The hexane layer was then recovered by the addition of 0.6 ml of water. To analyze the methyl esters, 1 μT of the hexane solution was injected onto a Beckman GC-5 gas chromatograph. The following gas chromatographic conditions were

subfamilies for the fatty acids on the sn-2 position and on the combined sn-1,3 positions and concluded that the fatty acid distribution differed among the subfamilies but was fairly consistent within a subfamily. He reported that,

for the subfamily *Cocoideae*, to which *Bactris* belongs, capric acid tended to be concentrated on the sn-1,3 positions while lauric acid tended to be concentrated on the sn-2 position. The distribution of myristic acid varied with the genera within the family. Our results support the first generalization and show that, for pejibaye, myristic acid is concentrated on the sn-1,3 positions. It would be taxonomically helpful to look into the distribution of the myristic acid in the two controversial groups of species that are included in the genus *Bactris* and that some authors claim belong to two different genera, *Bactris* and *Guillielma*.

Pejibaye mesocarp oil was primarily liquid at 20-25 C but did not melt completely until 30-31 C.

RESUMEN

Se determinó la composición química cualitativa y cuantitativa de los aceites del mesocarpo y de la semilla de una muestra de frutos de pejibaye procedentes de Guápiles, Costa Rica; también se hizo un análisis esteroespecífico. Los aceites de la pulpa y de la semilla son muy diferentes, al igual que lo encontrado generalmente en las palmeras. La composición cualitativa de estos aceites es semejante a aquella de la palma africana, pero difiere fundamentalmente en el alto contenido de ácido oleico en el mesocarpo del pejibaye, que es menos saturado y básicamente líquido a la temperatura ambiente lo que le confiere la ventaja como alimento. El análisis esteroespecífico de los triglicéridos de la semilla concuerda con lo establecido para la subfamilia *Cocoideae*, en la cual el ácido cáprico tiende a estar concentrado en las posiciones sn-1,3 mientras que el ácido láurico tiende a estar en la posición sn-2. El ácido miristico está concentrado en las posiciones sn-1,3 y se ha establecido que éste puede variar en los distintos géneros de una misma subfamilia, lo que podría tener valor taxonómico para resolver la controversia de los posibles géneros *Bactris* y *Guillielma*.

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