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Catolé palm (*Syagrus oleracea* Mart) fruits: fatty and amino acids composition

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RESUMEN

Frutos de la palmera de catolé (*Syagrus oleracea* Mart). Composición en ácidos grasos y aminoácidos.

Los frutos de la Palmera catolé *(Syagrus oleracea* Mart) fueron analizados para determinar su composición química. Las fracciones de la pulpa y almendra contenían 0,7 y 40.0% de lípidos. El aceite de almendra fresca mostró una pequeña concentración de peróxidos pero no presentó ácidos grasos libres. El índice de iodo y de saponificación fueron 27,4 y 226, respectivamente. Fue observada una gran diferencia cualitativa como también cuantitativa en la composición de ácidos grasos entre el aceite de la pulpa y de la almendra. 15 y 19 ácidos grasos fueron identificados en el aceite de la pulpa y de la almendra, respectivamente. Esos aceites contenían 48,9 y 73,2% de ácidos grasos saturados. El principal ácido graso saturado del aceite de la pulpa fue el ácido palmítico (C_{16}), mientras que en el aceite de almendra fue encontrado ácido laúrico (C_{12}). El ácido oleico fue el principal ácido graso monoinsaturado en ambos aceites. En el aceite de la pulpa, ácido linoleico ($C_{18:2}$) y linolénico ($C_{18:3}$) estaban presentes en concentraciones de 23.5 y 11.3% respectivamente, mientras que solo el aceite de la almendra contenía 3,59% de ácido linoleico. En relación a la composición de aminoácidos, las proteínas de la pulpa presentaron mejor perfil de aminoácidos que de la almendra. En las proteínas de la pulpa, los aminoácidos esenciales estaban presentes en concentraciones mayores que las recomendadas por la FAO, excepto metionina y lisina, mientras que la proteína de la almendra estaban deficiente en todos los aminoácidos esenciales, excepto fenilalanina, isoleucina y treonina.

PALABRAS-CLAVE: .Aceites y proteína - Composición de ácidos grasos y aminoácidos - Palmera Catolé (Syagrus oleracea Mart) - Propiedades físicoquímicas

SUMMARY

Catolé palm (*Syagrus oleracea* Mart) fruits: fatty and amino acids composition.

Catolé Palm *(Syagrus oleracea* Mart) fruits were analysed for their chemical composition. The pulp and kernel portions contained 0.7 and 40.0% lipids. Freshly extracted kernel oil showed a small concentration (0.4 meq/kg) of peroxides but did not contain free fatty acids. The iodine and saponification values were 27.4 and 226, respectively. A large qualitative as well as quantitative difference in the fatty acid composition between the catolé pulp and kernel oil was observed. Fifteen and 19 fatty acids were identified in the pulp and kernel oil, respectively. These oils contained 48.9 and 73.2% saturated fatty acids. The principal saturated fatty acids of the pulp oil was palmitic (C_{16}) acid, while that of kernel oil was lauric (C_{12}) acid. Oleic acid was the main monounsaturated fatty acid in both oils. In pulp oil, linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) were present at 23.5 and 11,3% concentrations, while kernel oil contained only linoleic acid (3.59%). In relation to amino acid composition of proteins, pulp proteins presented better amino acid profile than kernel proteins. In pulp proteins, the essential amino acids were present at concentrations higher than recommended by FAO except for methionine and lysine, while kernel proteins were deficient in all essential amino acids except phenylalanine, isoleucine and threonine.

KEY-WORDS: Catolé Palm (Syagrus oleracea Mart.) - Fatty acids and amino acids composition - Oil and protein - Physicochemical properties.

1. INTRODUCTION

The palm tree belong to *Palmae* or *Palmaceae,* family which include about 3.000 to 3.700 species distributed among 240 to 387 genres, out of which about 200 native and 200 exotic species of palms grow in Brazil (Lorenzi, 1992). The catolé (*Syagrus oleracea* Mart) is one of the native species, which has its origin and habitat in the northeast and southeast regions of Brazil. The specie is also known as guariroba, goriroba, gueroba, coquero amargoso, coquero guariroba, pati amargosa etc (Lorenzi, 1992). Catolé palm tree possesses a straight trunk reaching to a height of about 20 meters. The leaves are about 3 meters in length. Each bunch contains 10 to 40 fruits (Correia, 1975). Although palmetto (palm heart) is its principal product, almost everything of this palm is utilised by human and animals. The nuts are an important complement for animal nutrition, and kernels are used in the manufacture of sweets. Besides, kernel oil is used for edible purpose and in soap manufacture. Due to its multiple utilities, and to the fact that this palm is easy to cultivate, its plantation becomes lucrative.

Scientific literature on this palm specie is scanty. Glassman (1972, 1974) quantified its gene and anatomy. With regard to its utilisation, Correia (1975) and Ramalho et al. (1991) recommended production of palmetto and honey, respectively. In spite of the fact that kernel of this palm contains about 60% lipids (Correia, 1975), no report is so far published on the characterisation and composition of this oil except for one on fatty acid composition of mesocarp oil (Lubrano,1994). However, detailed information on

the properties and fatty acid composition of oils of mesocarp and kernel portions of the fruit as well as amino acid composition of their proteins is so far lacking. Therefore the present work was undertaken to furnish data on these aspects of the catolé (*Syagrus oleracea* Mart) palm fruits.

2. MATERIALS AND METHODS

2.1. Palm fruits

Catolé palm (*Syagrus oleracea* Mart) fruits were obtained from a farm situated in the city of João Pessoa, northeast region of Brazil. The fruits were divided into 5 lots and the pulp and seeds were separated manually using a stainless steel knife. The seeds were broken and kernels were separated. The pulp and kernels were dried at 40°C overnight, triturated in a mill and screened through 40 mesh sizes. The powdered pulp and kernels from each lot were packed separately in polyethylene bags and stored at 4°C in a refrigerator.

2.2. Proximate analysis of catolé pulp and kernels

Moisture, protein, lipid, ash and crude fibre contents were determined following the standard methods of the Association of Official Analytical Chemists (AOAC, 1990). Total carbohydrate content was calculated from difference. Samples from 5 lots were analysed in duplicate.

2.3. Extraction of oil

The oil was extracted from the dried and triturated pulp and kernels with hexane in a Soxhlet extraction apparatus. After completion of extraction, solvent was recovered. Residual solvent from the oil was removed in a boiling water bath. For physical, physicochemical and fatty acids analysis, pulp and kernel oils from three of the original five lots were analysed in duplicate.

Defatted pulp and kernel meals were stored in a refrigerator at 4°C for amino acids analysis.

2.4. Physical and physicochemical properties of kernel oil

Determination of physical and physicochemical properties was carried out only with kernel oil. Refractive index and specific gravity of kernel oil were determined at 40°C as the oil was partially solid at room temperature. For determination of acid, peroxide, iodine and saponification values, standard AOAC (1990) methods were used.

2.5. Fatty acid composition of pulp and kernel oils

Fatty acids were transformed to their methyl esters (FAME) following the method of Hartman and Lago (1973) and were determined by using a gas chromatograph HP 5890 Series II (Hewlett Packard) equipped with a flame ionisation detector. 1.5%l of the FAME sample were injected and GC separation was carried out on HP-INNOwax capillary column (Hewlett Packard; 30m length, 0.25 mm id. and 0.25m film thickness). The carrier gas (helium) head pressure and column flow rate were maintained at 11.5 psi and 1ml/min, respectively. The oven temperature was initially held at 120°C for 1 min, increased to 210°C at a rate of 8°C/min and maintained at 210°C for 45 min. The temperatures of injection port and detector were 250°C and 280°C, respectively. FAME were positively identified by matching their retention time data and mass spectra with those of the authentic standards obtained from various firms (Sigma; Nu-Chek-Prep, USA) which were also run under identical analytical conditions using high resolution GC-MS system (GCQ of Finnigan Mat).

2.6. Amino acid composition

The solvent extracted meals were used for determination of amino acids in an amino acid analyser (Biochrome 20, Pharmacia). Twenty milligrams of finely powdered sample were taken in an ampoule and hydrolysis was carried out using 1 ml of 6N HCl containing 0.1% phenol at 110°C for 20 hours. The hydrolysate was dried in a vacuum desiccator, redissolved in 1 ml of sodium citrate buffer 0.2 M (pH 2.2) and filtered using Millipore micro-filters of 0.45 μM porosity. Fifteen micro-litres of the solution were injected directly in amino acid analyser containing high performance ion exchange column (Bio 20 Peek) using sodium citrate buffer of increasing pH (3.20, 4.25 and 6.45) programmed to inject automatically in the column. On column exit, amino acids mix with ninhydrin reagent resulting in a violet-blue colour. The colour intensity is read at 570 nm except for proline and hydroxyproline (yellow-orange) at 440 nm. The peak area of each amino acid present in the sample protein was quantified taking in to consideration the peak area of amino acid in standard amino acids mixture.

Three samples each of defatted pulp and kernel meal obtained after oil extraction were analysed for their amino acids composition.

3. RESULTS AND DISCUSSION

3.1. The proximate composition

The proximate analysis of dried catolé (*Syagrus oleracea* Mart) pulp and kernels is shown in Table I.

Table I
Proximate composition (%w/w; Mean ± Standard Deviation) of catolé pulp and kernel

Constituents (%)	Pulp	Kernels
Moisture	22.3±1.4	8.5±0.5
Lipids	0.6±0.1	40.0±1.3
Protein	5.0±0.8	5.8±0.4
Ash	5.9±0.6	3.2±0.2
Fibre	6.2±1.2	23.9±1.7
Carbohydrates (by diff.)	60.0	18.7

The catolé pulp and kernel samples were dried in an oven overnight at 40° C before analysis.
The results represent the mean of the analysis of five lots of pulp and kernel fractions of catolé fruit.

Table II
Physical and physico-chemical properties (Mean ± SD) of catolé seed kernel oil

Refractive Index	Specific Gravity	Acid value	Peroxide Value	Saponification Value	Iodine Value
1.4446±0.0012	0.92±0.00	0,00	0.40±0.04	226.0±2.8	27.4± 1.3

The results represent the mean of the analysis of the oils of three lots of pulp and kernel fractions of catolé fruit.
SD – Standard Deviation

The lipid was the principal constituent of the dried kernels present at a concentration of 40.0% but a very low concentration (0.7%) was observed in pulp. Both fractions contained almost similar concentrations of proteins. Besides these constituents, compared to the pulp (6.2%) crude fibre was also present in high concentrations (23.9%) in dried kernels. However, total carbohydrate content of the pulp was much higher (60 %) than that of kernel. Low concentrations of proteins has also been reported for other dried palm fruit pulp and kernels such as *Astrocaryum vulgare* Mart (6.7 and 8.4%, Picanço, 1996 and 8.4 and 12.0% Bora et al, 2001) and *Elaeis guineensis* (3.4 and 4.9%, respectively; Moreira 2000). Contrary to catolé palm fruits in our study, these authors reported high lipid content in the pulp of *Astrocaryum vulgare* Mart and *Elaeis guineensis* palm fruits.

3.2. Physical and physicochemical properties of kernel oil

Table II shows data on some physical and physicochemical properties of kernel oil. Freshly extracted oil from kernels showed low peroxide value and no free fatty acids. Low iodine value (27.4) and reasonably high saponification value 226) reflect the possibility that the oil contained small chain saturated fatty acids. For another palm specie *Astrocaryum vulgare* Mart kernel oil, low iodine value (12.5) and a saponification value of 231 has been reported by Bora et al (2001). Moreira (2000) also reported iodine and saponification values of 18.9 and 221 for *Elaeis guineensis* kernel oil, respectively. Similarly for the kernel oil of *Acrocomia intumescens* palm fruits, Correia (1975) reported iodine and saponification values in the range of 16.2-30 and 214-254, respectively.

3.3. Fatty acid composition of pulp and kerne oils

The fatty acid composition of *Syagrus oleracea* Mart fruit pulp and kernel oils is shown in Table III. A wide difference between fatty acid composition of the pulp and kernel oils was observed. Fifteen fatty acids were detected in pulp oil and 19 fatty acids including

Table III
Fatty acid composition (Mean ± SD) of catolé pulp and kernel oils

Fatty Acid		% of the total fatty acids	
		Pulp oil	Kernel oil
Saturated fatty acids:		48.90	72.35
Hexanoic acid	($C_{6:0}$)	0.50±0.02	Tr
Heptanoic acid	($C_{7:0}$)	Nd	Tr
Octanoic acid	($C_{8:0}$)	0.36±0.02	5.32±0.02
Nonanoic acid	($C_{9:0}$)	Nd	Tr
Decanoic acid	($C_{10:0}$)	0.58±0.05	4.54±0.11
Undecanoic acid	($C_{11:0}$)	Nd	Tr
Dodecanoic acid	($C_{12:0}$)	3.91±0.44	41.58±0.90
Tridecanoic acid	($C_{13:0}$)	Nd	Tr
Tetradecanoic acid	($C_{14:0}$)	2.14±0.03	9.68±0.06
Pentadecanoic acid	($C_{15:0}$)	0.35±0.01	Tr
Hexadecanoic acid	($C_{16:0}$)	36.36±1.25	7.19±0.12
Heptadecanoic acid	($C_{17:0}$)	0.92±0.11	Tr
Octadecanoic acid	($C_{18:0}$)	3.36±0.42	3.54±0.11
Eicosanoic acid	($C_{20:0}$)	Nd	0.21±0.002
Docosanoic acid	($C_{22:0}$)	Nd	0.22±0.01
Tetracosanoic acid	($C_{24:0}$)	Nd	0.07±0.002
-Monounsaturated fatty acids:		16.94	23.90
9-tetradecenoic acid	($C_{14:1}$)	0.76±0.10	Nd
9-hexadecenoic acid	($C_{16:1}$)	1.36±0.09	Nd
10-heptadecanoic acid	($C_{17:1}$)	0.44±0.11	Nd
9-octadecenoic acid	($C_{18:1}$)	14.38±0.17	23.81±0.72
11-eicosenoic acid	($C_{20:1}$)	Nd	0.09±0.01
Polyunsaturated fatty acids:		34.57	3.59
9,12-octadecadienoic acid	($C_{18:2}$)	23.50±0.62	3.59±0.10
9,12,15-octadecatrienoic acid	($C_{18:3}$)	11.07±1.08	Nd

Tr - Traces (concentration less than 0.06 % of the total fatty acids)
Nd - Not detected
The results represent the mean of the analysis of the oils of three lots of pulp and kernel fractions of catolé fruits

7 in trace concentrations, in kernel oil. The distribution of fatty acids was as follows: saturated 48.9%, mono-unsaturated 16.9% and polyunsaturated 34.6% in pulp oil, while kernel oil contained 72.3% saturated, 23.9% monounsaturated and 3.6% polyunsaturated fatty acids. Normally, odd carbon numbered fatty acids are not reported in oils, but kernel oil showed the presence of C_7, C_9, C_{11}, C_{13} and C_{15} fatty acids, though at trace concentrations. However $C_{15:0}$, $C_{17:0}$ and $C_{17:1}$ fatty acids were found in pulp oil at concentrations of 0.35, 0.92 and 0.44% of total fatty acids.

Table IV
Amino acid composition (g/100 g of protein, Mean ± SD) of catolé pulp and kernel proteins)

Amino acid	Pulp Protein	Kernel Protein	% of FAO (1981) reference protein	
			Pulp Protein	Kernel Protein
Essential:				
Isoleucine	5.10±0.10	3.05±0.04	170.0	101.7
Leucine	8.10±0.20	5.66±0.14	124.6	87.1
Lysine	3.26±0.40	4.92±0.06	92.7	89.4
Methionine	0.90±0.03	0.92±0.03	40.9	41.8
Phenylalanine	5.59±0.17	4.46±0.07	199.6	159.3
Threonine	4.68±0.90	4.00±0.20	117.0	100.0
Valine	6.21±0.21	4.18±0.20	122.4	83.6
Non-Essential:				
Alanine	8.14±0.28	5.96±0.21	-	-
Arginine	4.15±0.51	17.80±1.46	-	-
Aspartic acid	7.64±0.04	15.04±0.34	-	-
Cystine	0.37±0.04	0.50±0.03	-	-
Glutamic acid	13.97±0.83	22.68±0.94	-	-
Glycine	7.65±0.20	5.98±0.40	-	-
Histidine	1.48±0.03	2.41±0.05	-	-
Proline	7.04±0.04	3.25±0.27	-	-
Serine	5.07±0.02	3.77±0.06	-	-
Tyrosine	3.35±0.24	2.81±0.14	-	-

The results represent the mean of the analysis of tree lots of defatted pulp and kernel

Among saturated fatty acids in pulp oil, C_{16} was the principal acid with 36.36% of the total fatty acids concentration followed by C_{12}, C_{18} and C_{14} with 3.91, 3.36 and 2.14% concentrations respectively. The kernel oil, similar to other palm oils presented C_{12} (lauric acid) as its principal acid (41.58%), while C_{14} (9.68%), C_{16} (7.19%), C_8 (5.32%), C_{10} (4.54%) and C_{18} (3.54%) were also present in appreciable concentrations.

Oleic acid ($C_{18:1}$) was the dominant monounsaturated fatty acid in both oils constituting about 99.6 and 84,9% of mono-unsaturated fatty acids with concentration of 23.9 and 16.9% of total fatty acids in pulp and kernel oils, respectively. In comparison to kernel oil, the pulp oil contained high concentrations (34.57%) of polyunsaturated fatty acids. The oil was rich in linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) acids which were present at 23.5 and 11.0% concentrations. These acids represent the family of ω-6 and ω-3 fatty acids, respectively and are precursor of arachidonic acid, which is transformed into long chain polyunsaturated fatty acids such as eicosapentaenoic ($C_{20:5}$), and decosahexanoic ($C_{22:6}$) acid. These fatty acids, besides other functions are important in the formation of eicosanoides. The eicosanoides include prostaglandins (PG), tromboxans (TX), prostacyclines (PGI) and leucotriens (LT). These compounds play an important role in the mediation of imunological allergic and inflammatory reactions and in the control of hermostacy (Calder, 1993; Voss, 1994).

3.4. Amino acid composition of pulp and kernel proteins

The data on amino acid composition of the catolé fruit pulp and kernel proteins are presented in Table IV. Similar to oil seed proteins, catolé pulp and kernel proteins are rich in aspartic (7.64 and 15.04 g/100g of protein, respectively) and glutamic (13.97 and 22.68 g/100g of protein, respectively) acids. Besides these amino acids, arginine was also present in fairly

good concentrations (4.15 and 17.8 g/100g of protein, respectively). Similar qualitative observation were also made by Amaya-Farfan *et al*. (1986) and Bora et al. (2001) for *Astocaryum acaule* Mart and *Astocaryum vulgare* Mart palm fruits, respectively. Other non-essential amino acids such as alanine, glycine, proline and serine were also present in good concentrations.

In relation to the essential amino acids, the pulp proteins possessed a better profile. Except for methionine and lysine, which were the first and second limiting amino acids (40.9 and 92.7% of reference protein), other essential amino acids in pulp proteins were present in concentrations higher than recommended by FAO (1981). Similar observation for other palm fruits: *Astocaryum tucuma* Mart (Hall et al, 1981) and *Astocaryum vulgare* Mart (Bora et al, 2001) that the fruit pulp contained large quantities of all essential amino acids, except sulphur amino acids also appeared in the scientific literature. The kernel proteins with exception to phenylalanine, isoleucine and threonine contained other essential amino acids in concentrations ranging from 41.8 to 89.4% to that of FAO reference protein. Thus catolé fruit pulp proteins can be considered for use in the formulation of high quality protein foods with other protein sources which are rich in methionine and lysine but deficient in other essential amino acids.

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