

# Antioxidant Capacity and Chemical Characterization of Açai (*Euterpe oleracea* Mart.) Fruit Fractions

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**Abstract** Açai (*Euterpe oleracea*) has a high nutritional value because of its antioxidant compounds, which have the appeal of health benefits. This fruit is native of the floodplain of the Brazilian state of Pará, and was fractionated in peel, pulp, peel plus pulp, and seed. The aim of this research was to evaluate the nutritional composition, total phenolic content, total anthocyanins, antioxidant capacity and the fatty acid profile of these fractions. The highest lipid content (33.5 g.100g<sup>-1</sup> DB) was present in the açai pulp fraction and gas chromatography analysis showed unsaturated fatty acids (71.8%). The peel and seed fractions had the highest dietary fiber content (86.1 and 83.4 g.100g<sup>-1</sup> DB, respectively), being insoluble dietary fiber predominant in the peel. The peel has the highest total anthocyanins (372.8 mg.100g<sup>-1</sup> DB) and the seed has the highest total phenolic content (3602 mg.100g<sup>-1</sup> DB) and the highest antioxidant capacity (88.5 µmol TE/g DB). The marketing approach in the industry of açai products is aimed at its antioxidant and energy potential, considering the high content of lipids and carbohydrates, showing that 100g of fresh fruit has approximately 130 cal. These results show promising perspectives for the use of açai fractions for new tropical products with considerable levels of nutrients and antioxidant capacity.

**Keywords** *Euterpe oleracea*, Nutritional Composition, Fractionation, GC-FID

## 1. Introduction

Açai (*Euterpe oleracea* Mart.) is an economically significant fruit originated from the Brazilian Amazon. The açai fruit is commonly found in Central and South American countries such as Peru, Ecuador, Colombia and Brazil, but the biggest producer is Brazil. The state of Pará harvested more than 200,000 tonnes in 2013; it has been the state

responsible for 55% of the Brazilian production and it exported approximately 7,000 tonnes in 2012 to USA, Japan and South Korea [1].

The fruits, which grow in bunches, are small, approximately 1 to 1.5 cm in diameter, and their color range from red to black. The exocarp is a deep purple colored peel that covers the mesocarp, and it has a thickness of only 1 to 2 mm; the seed represents approximately 85% of the volume of the fruit [2,3], however, only 15% of the fruit are used as food (peel plus pulp).

Interest in the research and development of açai has increased mainly because of its nutritional value and antioxidant capacity because of its high levels of flavonoids, especially anthocyanin, which provide its excellent potential as a functional food ingredient. This dark purple fruit has been export mainly to the USA and Europe to be used generally in fruit juices and dietary supplements, associating health-related benefits [4-6]. Previous study has demonstrated an increase in plasma antioxidant capacity induced by the consumption of the açai pulp [7]. Souza et al. [8] suggest that the consumption of açai improves the antioxidant status and has a hypocholesterolemic effect in an animal model of dietary-induced hypercholesterolemia. Moreover, açai offers a rich source of bioactive polyphenols and Del Pozo-Insfran et al. [9] confirmed its effects on the anti-proliferation and apoptosis of leukemia HL-60 cells.

The fruit is highly perishable; therefore, it is better utilized in processed products, such as fruit juices, smoothies and viscous pulp. It is noticed a slight hint of bitter aftertaste, which resembles that of chocolate, in açai products. Consumers prefer juices with a low açai content (4 to 5% of açai), but when health benefits are perceived they accept this taste dissatisfaction [10]. Probably, the taste is related to compounds present in fruit that are incorporated during the processing.

It is known that the daily consumption of these fruits can contribute to improve the antioxidant serum. On other hand,

the knowledge of the distribution of the bioactive compounds present in seed, pulp and peel of these fruits could contribute to a competitive agribusiness. Because of this, the characterization of the exocarp and mesocarp of the açai is very important for possible commercial applications [11]. However, most of the açai fruit studies are addressed to the edible part of the fruit (peel plus pulp - mesocarp), added of water and, in many cases, bought in markets without information about the origin. Thus, the aim of this work was to carry out a detailed study of açai fractions: pulp plus peel, peel, pulp and seed, and compare the chemical composition and the antioxidant capacity between the fractions. This study will allow the development of new technologies for its fractional consumption. The differences in composition between fractions may promote different applications, processing and commercialization.

## 2. Materials and Methods

### 2.1. Plant Material

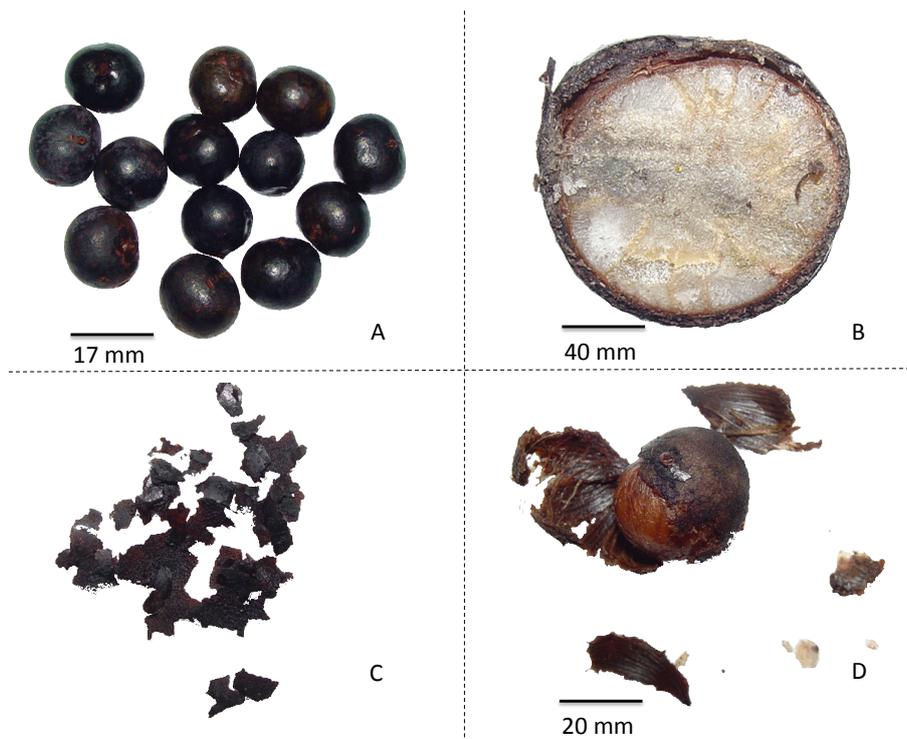
Açai fruits (*Euterpe oleracea* Mart.), 100 kg, were collected in the floodplain of the Guamá river, in the region of Castanhal (state of Pará, Brazil). They are palm trees natives to the forest management (Location 1°29'04.98" S, 47°59'27.46" W-15 m). The fruits were packed in plastic

bags of approximately 2 kg and stored in a freezer at  $-10 \pm 5^\circ\text{C}$  until testing.

### 2.2. Sample Preparation

The samples analyzed were: 1) whole fruit, 2) pulp plus peel, 3) peel, 4) pulp and 5) seed fractions. Figure 1 shows some açai fractions. The whole fruit was crushed in a grinding mill (A-20, Catel, Brazil) and this sample was called "fruit". Another sample of the whole fruit was ground using a sieve until revealing the seed, and this sample was called "pulp plus peel".

The peel, pulp and seed fractions were obtained using an abrasive system. Water was added to facilitate the separation of the "peel" and "pulp" fractions. The peels were removed and the material remaining from the peeling (pulp plus seed) was immersed in distilled water ( $40 - 50^\circ\text{C}$ ) for 1 hour to facilitate the separation of the pulp from the seed. The separation of pulp and seed was performed using a vertical cylinder containing horizontal turning rods. Residual fibers were observed in the pulp fraction after pulping, unlike the traditional methods of pulping in which these fibers are removed. The fractions were weighted in triplicate, and the mean yield of each fraction and total solids were determined. The samples were stored at  $4^\circ\text{C}$  until analysis, accomplished in one day.



**Figure 1.** Açai fractions: (A) Whole fruit, (B) Fruit in transversal section, (C) Peel and (D) Pulp with fibers in the seed.

### 2.3. Reagents

The HPLC grade Methanol and Ethanol, 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), ABTS (2,2-azino-di-(3-ethylbenzothiazoline sulphonic acid) were obtained from Sigma Chemical Co. (St. Louis, USA). The Folin-Ciocalteu reagents were obtained from Dinamica Química Contemporânea Ltda (Diadema, Brazil). All other chemical reagents and solvents used were of analytical grade (Sigma-Aldrich, St. Louis, USA).

### 2.4. Nutritional Composition

Moisture, ash and protein content were determined using the 920.151, 940.26 and 920.152 reference methods, respectively, described by the AOAC [12]. The total carbohydrate content was calculated with the formula: % of carbohydrate = 100 - % of moisture - % of lipid - % of protein - % of ash. All the analyses were performed in triplicate. Total dietary fiber (DF), soluble (SDF) and insoluble dietary fiber (IDF) were determined, in quadruplicate, using the enzymatic-gravimetric method (991.43, AOAC).

### 2.5. Fatty Acid Profile

The lipid content was determined using the Bligh Dyer [13] method. The lipids present in the pulp and seed were subjected to esterification of fatty acids according to the method described by Hartman and Lago [14]. The analyzes were performed on a gas chromatograph, model 3900 (Varian, Palo Alto, CA, USA), equipped with split injection port, CP-Sil 88 capillary column (100 m x 0.25 mm id, 0.2- $\mu$ m film thickness), oven with temperature programming ramp and flame ionization detector (FID). The injections were performed using hydrogen as carrier gas at constant pressure of 13.5 psi. The initial temperature of the oven was 140°C for 2 min, then programmed to increase from 140°C to 235°C (rate of 2.5°C/min) and posteriorly kept at 235°C for 10 minutes. The esters were identified by comparison of retention times with standards (Supelco 37 Comp. FAME Mix) and the quantification was performed by area percentage. The results were expressed as g/100 g of total fatty acids.

### 2.6. Phenolic Compounds and Anthocyanin Extraction

A solution of 95% ethanol/1.5 N HCl (85:15, v/v) was used to extract the phenolic compounds and anthocyanins from the açai fruit fractions. The samples were placed into the solution at 4°C in the absence of light for 24 hours. Posteriorly, the phenolic compounds were exhaustively extracted with the solution (ethanol/HCl) and then filtered. The fractions extract were used for the determination of total phenolic content, total anthocyanins and antioxidant capacity. The extractions were performed in triplicate.

#### 2.6.1. Total Phenolic Content

The determination of the total phenolic content (TP) was performed according to the Singleton and Rossi [15] method. The absorbance was measured at 750 nm. The control was made with water, and gallic acid was used as standard. The results were expressed as mg gallic acid equivalent (GAE)/100g of sample.

#### 2.6.2. Total Anthocyanins

The determination of total anthocyanins (TA) was performed using the procedure described by Francis [16]. The measurement of the absorbance was performed at 535 nm against extraction solution blanks. For the calculation of the anthocyanin content, the value of absorption coefficient ( $E_{1cm,535nm}^{1\%}$ ) of 98.2 was used, corresponding to cyanidin 3-glucoside in ethanol/1.5 N HCl [17, 18]. The results were expressed as mg cyanidin 3-glucoside equivalent/100g of sample.

#### 2.6.3. Antioxidant Capacity

The determination of the antioxidant capacity of the açai fraction was performed following the procedures of Re et al. [19]. The absorbance readings were recorded at 750 nm. The percentage of inhibition of ABTS<sup>•+</sup> was plotted against the concentration of the test sample and known solutions of Trolox. The radical scavenging activity of the test samples was expressed as  $\mu$ mol of Trolox (TE)/ g of sample calculated by the ratio between the gradients of test samples and the Trolox curves.

The TP, TA and antioxidant capacity were performed using a Hitachi U2000 UV-Visible spectrophotometer (HITACHI, Tokyo, Japan).

## 3. Results and Discussion

### 3.1. Açai Fruit Fractionation

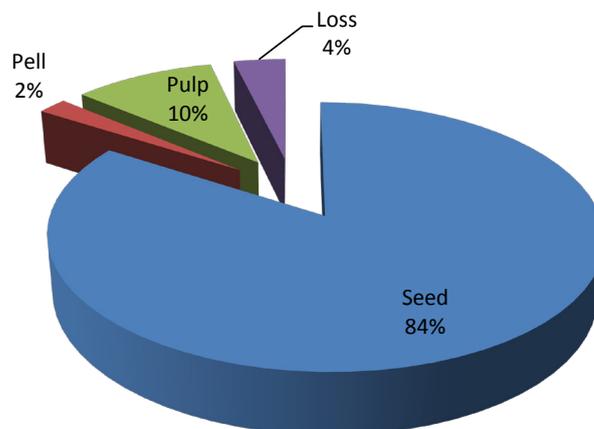


Figure 2. Mean yield of solids of açai fractions.

Figure 2 shows the mean yield of solids of açai fractions. With 100 g of fresh açai fruit, it was possible to separate the solids with mean values of  $1.22 \pm 0.04$  g of peel,  $5.62 \pm 0.54$  g of pulp and  $48.95 \pm 1.01$  g of seed.

Previous study performed by Pessoa et al. [11] obtained

approximately 18.8% of pulp, which corresponds to the epiderm and part of the internal parenchyma, 80.9% of core, which is the seed and part of the internal parenchyma, and 5.3% of fiber layer, all in a dry weight basis. Comparing with our results of the fractionation of açai fruit, we had lower pulp content (~9.6%) and similar seed content (~84%).

### 3.2. Chemical Composition

Table 1 shows the chemical composition (moisture, ash, protein, lipid, carbohydrate and fiber contents) of each fraction of açai on dry (DB) and wet (WB) weight basis. The pulp plus peel fraction presented moisture content of  $37.17 \pm 0.20 \text{ g.100g}^{-1}$ ; similar value was presented by Borges et al. [20], who found moisture content varying from  $34.95 \text{ g.100g}^{-1}$  to  $42.47 \text{ g.100g}^{-1}$  for jussara fruit (*E. edulis*) from the state of Santa Catarina. Others fractions presented high values of moisture, because water was added to help the separation, and the peel contains  $85.38 \pm 0.10 \text{ g.100g}^{-1}$ , the pulp  $94.51 \pm 0.37 \text{ g.100g}^{-1}$  and the seed  $38.57 \pm 0.07 \text{ g.100g}^{-1}$ .

The concentration of protein in the pulp and peel fraction was  $8.44 \pm 0.20 \text{ g.100g}^{-1}$  DB (Table 1); this value is consistent with previously reported content for jussara and açai fruit ( $8.21 \text{ g.100g}^{-1}$  to  $10.2 \text{ g.100g}^{-1}$  DB) [20, 21]. The same interpretation is acceptable for ash content, as the value found in this study was  $2.61 \pm 0.00 \text{ g.100g}^{-1}$  DB for pulp and peel ( $2.2 \text{ g.100g}^{-1}$  to  $3.2 \text{ g.100g}^{-1}$  DB) [21,22]. There is no difference in the protein and ash contents between the açai fractions.

Dietary Fiber (DF) seems to be predominant in the carbohydrate concentration of açai, because it represents more than 88% of the nutrients. The pulp plus peel fraction shows DF content of approximately  $67.15 \text{ g.100g}^{-1}$  DB, but only a small portion is SDF,  $0.73 \pm 0.02 \text{ g.100g}^{-1}$  DB. This DF content is two to three times higher than that reported by Neida and Elba [22] for açai from Venezuela ( $20 \text{ g.100g}^{-1}$  to

$30.9 \text{ g.100g}^{-1}$  DB). The greatest concentration of DF is in the peel fraction ( $\sim 86.05 \text{ g.100g}^{-1}$  DB), in which just  $0.65 \pm 0.05 \text{ g.100g}^{-1}$  are SDF (Table 1). High concentrations of DF were also found in the pulp and seed fractions ( $68.50$  and  $83.38 \text{ g.100g}^{-1}$  DB, respectively). This concentration present in the seed represents approximately 92% of its composition.

The açai pulp studied by Rufino et al. [23] has high content of DF ( $71.22 \pm 1.22 \text{ g.100g}^{-1}$  DB) as well. However, the authors found a higher soluble fiber content than our study and similar insoluble content ( $2.7$  and  $68.5 \text{ g.100g}^{-1}$  DB, respectively).

After the fractionation of the açai fruit, most parts of the fibers remained in the pulp fraction, presenting approximately 60% of DF of the edible part of the açai fruit. The peel fraction recovered only 16% of these fibers. This fractionation is different from the traditional process to obtain açai pulp, without the separation of IDF, because the pulp obtained does not go through the filtration process. The results of the lipid content showed that the whole fruit has the concentration of  $7.34 \pm 0.19 \text{ g.100g}^{-1}$  DB (Table 1). The pulp plus peel sample has lipid concentration of  $12.83 \pm 0.30 \text{ g.100g}^{-1}$  DB. This value is lower than those reported in the literature for similar samples:  $20.82 \pm 1.60 \text{ g.100g}^{-1}$  for Rufino et al. [23] and approximately  $46.5 \text{ g.100g}^{-1}$  for Tonon et al. [21]. This low result observed in the present study can be explained by the different origin and accessions of the açai fruit. The higher concentration of lipid is in the pulp fraction ( $33.49 \pm 0.68 \text{ g.100g}^{-1}$  DB – Table 1). The most predominant fatty acids found in the açai pulp were oleic, palmitic, follow by linoleic ( $54.3 \text{ g.100g}^{-1}$ ,  $22.7 \text{ g.100g}^{-1}$  and  $10.9 \text{ g.100g}^{-1}$  DB, respectively) (Table 2). The fatty acid profile of açai resembles those reported by Neida and Elba [22] and also for jussara reported by Borges et al. [20]. This distribution of saturated, monounsaturated and polyunsaturated fatty acids is the same in previous work with açai pulp [23].

**Table 1.** Proximate composition ( $\text{g.100g}^{-1}$ ) of açai fruit fractions

Analysis	Whole fruit <sup>1</sup>		Pulp plus Peel		Peel		Pulp		Seed	
	WB <sup>2</sup>	DB <sup>3</sup>	WB	DB	WB	DB	WB	DB	WB	DB
Moisture	$41.53 \pm 0.05$		$37.17 \pm 0.20$		$85.38 \pm 0.10$		$94.51 \pm 0.37$		$38.57 \pm 0.07$	
Ash	$0.98 \pm 0.00$	$1.68 \pm 0.00$	$1.64 \pm 0.00$	$2.61 \pm 0.00$	$0.18 \pm 0.01$	$1.26 \pm 0.03$	$0.21 \pm 0.00$	$3.78 \pm 0.06$	$0.89 \pm 0.01$	$1.44 \pm 0.01$
Protein	$3.03 \pm 0.10$	$5.18 \pm 0.17$	$5.30 \pm 0.13$	$8.44 \pm 0.20$	$1.17 \pm 0.03$	$8.01 \pm 0.24$	$0.37 \pm 0.00$	$6.75 \pm 0.06$	$3.95 \pm 0.03$	$6.42 \pm 0.04$
Lipid	$4.29 \pm 0.11$	$7.34 \pm 0.19$	$8.06 \pm 0.19$	$12.83 \pm 0.30$	$1.13 \pm 0.11$	$7.70 \pm 0.73$	$1.84 \pm 0.00$	$33.49 \pm 0.68$	$1.04 \pm 0.03$	$1.70 \pm 0.05$
Carbohydrate <sup>4</sup>	50.17	85.80	47.83	76.13	12.14	83.02	3.10	56.43	55.55	90.43
Soluble dietary fiber			$0.46 \pm 0.02$	$0.73 \pm 0.02$	$0.09 \pm 0.01$	$0.65 \pm 0.05$				
Insoluble dietary fiber			$41.73 \pm 0.00$	$66.42 \pm 0.00$	$12.49 \pm 0.01$	$85.43 \pm 0.10$				
Dietary fiber <sup>5</sup>			42.19	67.15	12.58	86.05	3.76 <sup>6</sup>	68.50 <sup>6</sup>	$51.22 \pm 0.10$	$83.38 \pm 0.16$

Values expressed as mean content [ $\text{g.100g}^{-1}$ ]  $\pm$  standard error.

<sup>1</sup>Whole fruit with seed; <sup>2</sup>WB = Wet weight basis; <sup>3</sup>DB = Dry weight basis; <sup>4</sup>Carbohydrates calculated by difference [ $100 - (\text{moisture} + \text{ash} + \text{protein} + \text{lipid})$ ]; <sup>5</sup>Calculated by addition (Soluble dietary fiber + Insoluble dietary fiber), except the seed, whose value of dietary fiber was obtained in laboratory;

<sup>6</sup>Calculated by difference between “pulp plus peel” and “peel” considering the percentage of each fraction obtained through this study.

**Table 2.** Fatty acid composition and oil of açai pulp

Fatty acids	(g.100g <sup>-1</sup> DB)	Oil (%)
Saturated	8.01	23.9
C16:0 (Palmitic acid)	7.64	22.7
C18:0 (Stearic acid)	0.36	1.1
Monounsaturated	20.02	59.8
C18:1 Omega-9 (Oleic acid)	18.20	54.3
C16:1 Omega-7 (Palmitoleic acid)	1.82	5.4
Polyunsaturated	4.00	11.9
C18:2 Omega-6 (Linoleic acid)	3.64	10.8
C18:3 Omega-3 (Alpha-linolenic acid)	0.36	1.1
Others	1.3	3.9

DB: Dry weight basis

However, the major components found in the seed oil were the oleic and myristic acids (25.9 g.100g<sup>-1</sup> and 22.9 g.100g<sup>-1</sup>, respectively) (Table 3). These results indicate that the pulp has a higher concentration of unsaturated fatty acids than the seed and this composition differs principally by the increased concentration of the myristic acid present in the seed oil.

**Table 3.** Fatty acid composition and oil of açai seed

Fatty acids	(g.100g <sup>-1</sup> DB)	Oil (%)
Saturated	0.85	50.0
C12:0 (Capric acid)	0.16	9.4
C14:0 (Myristic acid)	0.39	22.9
C16:0 (Palmitic acid)	0.28	16.5
C18:0 (Stearic acid)	0.02	1.2
Monounsaturated	0.46	27.1
C18:1 Omega-9 (Oleic acid)	0.44	25.9
C16:1 Omega-7 (Palmitoleic acid)	0.02	1.2
Polyunsaturated	0.31	18.3
C18:2 Omega-6 (Linoleic acid)	0.29	17.1
C18:3 Omega-3 (Alpha-linolenic acid)	0.02	1.2
Others	0.08	4.7

DB: Dry weight basis

Table 4 shows the total phenolic content (TP) expressed as gallic acid equivalent. Inside the phenolic group, the total anthocyanin (TA) content was determined based on cyanidin 3-glucoside, which is one of the predominant anthocyanins

in açai [24].

The higher concentration of anthocyanin is in the peel fraction (372.81 ± 7.36 mg.100g<sup>-1</sup> DB). The pulp fraction also showed significant concentration of anthocyanins (202.15 ± 51.84 mg.100g<sup>-1</sup> DB), probably because of the contribution from the TA content of the residue of the peel retained in the pulp fraction, since the anthocyanins are hydrosoluble.

Dias et al. [25] found the range of 48.8 to 58.3 mg of anthocyanins per 100g of fruit (WB), which demonstrates the great variability of the anthocyanin content in *E. oleracea* in different maturity stages. The TA content found in the present study was 47.73 ± 7.54 mg.100g<sup>-1</sup> of açai fruit (WB), and this value is close to the value reported by the authors mentioned.

The value of TA found for pulp plus peel in this study was 120.19 ± 1.07mg.100g<sup>-1</sup> WB, and this value is inside the range reported by many authors (59.8 to 289.1 mg of anthocyanin per 100g of pulp WB) [3,26].

Açai fruit has additional compounds other than anthocyanin that contribute to the scavenging activity of free radicals, which improve its potential as functional food. This study shows that the TP content is well distributed between the peel, pulp and whole fruit fractions, but the highest phenolic content is in the seed (3602 mg GAE/ 100g of seed DB).

Açai pulp was reported with high phenolic content (3268 - 3437 mg GAE/100g pulp DB) [23, 27]. Most of the research about açai is centered on the pulp, which consists of the whole edible part (pulp and peel - mesocarp) added of water and, in many cases, bought in markets without information about the origin. Against this difficult to compare the results of this work with the literature, the value of TP of 1452 ± 23 mg GAE/100g (DB) of pulp and peel fraction was lower than those report by the authors.

Comparing the values obtained on dry basis, the peel and pulp fractions have high antioxidant capacity (45.8 and 48.2 µmol TE/g, respectively - Table 4), whereas the seed fraction has the highest value (~88.5 µmol TE/g) with contribution of the high phenolic content. However, the antioxidant capacity of the peel plus pulp presented the value of 11.96 ± 0.13 µmol TE/g.

The results of the antioxidant activity demonstrated in the present study are higher than those reported by Gordon et al. [27], who found 2.78 ± 0.10 µmol TE/g (DB) for açai pulp. According to these authors, the antioxidant activity was increased with the ripening of the fruit.

**Table 4.** Total phenolic compounds, total anthocyanins and antioxidant capacity of açai fruit fractions

Analyses	Whole Fruit <sup>1</sup>		Pulp Plus Peel		Peel		Pulp		Seed	
	WB <sup>2</sup>	DB <sup>3</sup>	WB	DB	WB	DB	WB	DB	WB	DB
Phenolic compounds <sup>4</sup> (mg GAE/100g)	1386 ± 104	2370 ± 177	912 ± 14	1452 ± 23	333 ± 19	2584 ± 145	117 ± 10	2123 ± 179	2004 ± 49	3602 ± 88
Total Anthocyanins (mg.100g <sup>-1</sup> )	47.73 ± 7.54	81.62 ± 12.89	120.19 ± 1.07	191.29 ± 1.70	48.09 ± 0.95	372.81 ± 7.36	11.10 ± 2.85	202.15 ± 51.84	-	-
Antioxidant capacity (µmol TE/g) <sup>6</sup>	37.68 ± 1.95	64.44 ± 3.33	7.52 ± 0.08	11.96 ± 0.13	5.90 ± 0.24	45.81 ± 1.87	2.64 ± 1.05	48.18 ± 19.07	49.22 ± 1.44	88.46 ± 2.60

Values expressed as mean content ± standard error.

<sup>1</sup>Whole fruit with seed; <sup>2</sup>WB = Wet weight basis; <sup>3</sup>DB = Dry weight basis; <sup>4</sup>Expressed as gallic acid equivalent (GAE); <sup>5</sup>Expressed as cyanidin 3-glucoside ( $E_{1cm,535nm}^{1\%} = 98.2$ ). <sup>6</sup>Expressed as µmol Trolox Equivalent (TE) per g of sample

The comparison of the results of the antioxidant activity with the literature is difficult because different methods of analysis are used, and in addition values are often presented in wet form. Del Pozo-Insfran et al. [24] describe the açai pulp as having a relatively high antioxidant content (~48.6 µmol Trolox equivalents/mL) with respect to other anthocyanin-rich fruits such as blueberries (4.6-31.1 µmol TE/g), strawberries (18.3-22.9 µmol TE/g), raspberries (19.2-22.6 µmol TE/g), blackberries (13.7-25.1 µmol TE/g), cranberries (8.20-145 µmol TE/g), and muscadine grape juice (18.2-26.7 µmol TE/g). Pacho-Palencia et al. [28] found the value of antioxidant capacity of  $61.5 \pm 1.21$  µmol Trolox equivalent/mL of açai pulp and Rufino et al. [26] found  $64.5 \pm 19.3$  µmol Trolox/g (DB); these values are higher than that presented in this study.

It was clear that all parts of the açai are rich in nutraceuticals, particularly phenolic compounds, which benefits are already recognized, such as its excellent oxidant scavenging capacity against peroxy radicals and peroxynitrite, capability to attenuate chemically-induced colon carcinogenesis by increasing total hepatic total glutathione and attenuating DNA damage and preneoplastic lesion development, and exhibit the hypocholesterolemic effect by reducing total and non-high-density lipoprotein cholesterol, and superoxide dismutase activity [4, 8, 29].

Food Industry can use different parts of the açai for several purposes: for application in edible and biodegradable films to antioxidant and antimicrobial enrichment, such as chitosan film used in food packaging to improve oxidative stability of foodstuffs [30]. Peel provides a purple dye and can be used in functional low-fat beverage, considering that lipids are concentrated in the pulp. Since açai pulp has high concentration of lipids, consumers prefer juices having low açai content [6]. Pulp can be applied in ice cream because of its functionalities such as antioxidant, thickening and emulsifying, which are capable of improving texture.

## 4. Conclusions

Açai is a good source of anthocyanins and phenolic compounds and the distribution of these compounds in fractions obtained from the açai fruit was demonstrated for the first time. The richness of the açai fruit, original from Amazon, lies in its high antioxidant activity when compared to other anthocyanin-rich fruits. High content of anthocyanin was found in the peel fraction, whereas the majority of the phenolic content is distributed between peel and pulp. The seed normally discarded after processing showed high dietary fiber content and high phenolic content, consequently high antioxidant capacity. These results may allow the application of açai fractions in the industry as functional food, promoter of better human health, and would have as advantage, with respect to the açai traditional products, the high dietary fiber content and low caloric value, since no higher lipid content was observed in the peel fraction. This research allows the manufacture of new açai products, taking into account the properties of the fractions studied here. The chemical characterization of the parts of the fruit allows elaborations of products with enhanced antioxidant properties.

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