CHEMICAL COMPOSITION, BIOACTIVE COMPOUNDS AND FATTY ACID PROFILE OF JUÇARA (*EUTERPE EDULIS*) PULP

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Abstract

Juçara (Euterpe edulis) pulp is recognized as a potential functional food since it is rich in anthocyanins, bioactive compounds, unsaturated fatty acids and minerals. In this study, juçara pulp was characterized for proximate composition, color, bioactive, fatty acid composition and elemental analysis. Approximately 61% of all energy is given by the high lipid content. With 8.9 g 100 g^{-1}, juçara pulp has been shown to be an excellent source of protein intakes of plant origin. Juçara pulp shows intense violet color typical of the species, with Hue angle equal to 21.16°. Hue angle corroborated the high anthocyanin content (511.1 mg 100 g^{-1}) found. The carotenoid content (0.74 mg 100 g^{-1}) was low and the antioxidant activity by DPPH (26.6 µg mL^{-1}) can be attributed to the high content of phenolic compounds (8148.9 mg 100 g^{-1}). Most of the fatty acids found in juçara pulp are unsaturated (65.0%) and the polyunsaturated fatty acid content was 20.2%, predominating linoleic acid (19.6%). Among all 17 mineral elements identified in the pulp, potassium (1519.13 mg 100 g-1), calcium (347.45 mg 100 g-1), magnesium (223.70 mg 100 g-1) and sulfur (219.46 mg 100 g-1) were those found in larger quantities. This work showed the juçara pulp has the potential to be considered a functional food.

Keywords: Juçara pulp, Antioxidant capacity, Phenolic, Anthocyanins, Elemental analysis, Functional food.

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1. INTRODUCTION

Knowledge of the health benefits of a fruit-based diet has encouraged new studies especially of native and exotic fruits, which are often rich in antioxidants and minerals. The intake of these fruits is related to the reduction of cancer and cardiovascular diseases (Schulz et al., 2016; Cardoso et al., 2018; Schulz et al., 2019). One very appreciate Brazilian fruit is açai (Euterpe oleracea Mart.), which is consumed as juice or prepared as a frozen, since it has high energetic value and is rich in antioxidants (Schulz et al., 2017; Siqueira et al., 2018). With similar properties, the fruit of juçara or jussara palm (Euterpe edulis Mart.) has similar physical conformation than açaí, dark purple coloration and a thin edible epidermis (1-3 mm thick) covering the pericarp. The seed is fibrous and accounts for about 80-90% of the total fruit volume (Schulz et al., 2019). Juçara palm crops naturally in the Atlantic Forest in Brazil, from southern Bahia to Rio Grande do Sul states (Inada et al., 2015; Schulz et al., 2015).

In the 1970s, juçara palm was submitted to extractive exploitation to obtain the edible palm heart, which resulted in the depletion of the natural reserves (Castro et al., 2016). However, this situation is changing since it is known that juçara fruit and açaí have similar sensory and physicochemical properties. Then, the fruit of juçara palm became an alternative for human consumption, as juice, frozen pulp

or as raw material to produce other foodstuff. This fact increased the sustainable production of this plant (Inada et al., 2015; Garcia et al., 2019; Schulz et al., 2019).

Juçara pulp is rich in oleic and linoleic acid, protein (Felzenszwalb et al., 2013; Schulz et al., 2016) and minerals (Cardoso et al., 2018). Unsaturated fatty acids play an important role in the nutritional of human health including benefit bone structure in menopausal women, prevent cardiovascular disease and balance glycemic index (Pessoa et al., 2015; Yamaguchi et al., 2015; Souza et al., 2017; Altuna et al. 2018). In addition, minerals such as potassium, calcium, magnesium, phosphorus, iron, chromium and zinc, are important inorganic nutrients, since they act in different physiological processes in the body, sometimes as cofactors of enzymes, and have an essential role in a balanced diet (Silva et al., 2013; Damodaran and Parkin, 2017).

Besides juçara fruit presents important nutritional characteristics, the interest by it has increased mainly due to antioxidant properties attributed to its high bioactive compounds, such as flavonoids, which are responsible for protecting the organism against oxidative damages caused by free radicals (Inada et al., 2015; Schulz et al., 2015; Garcia et al., 2019). On the other hand, the high anthocyanin content makes juçara fruit an important option to produce natural food coloring (Pessoa and Teixeira, 2012). Since the composition of the fruit may be related to climate and soil characteristics as well as to anthropogenic factors (crop, harvest and fruit process), it is important to study the product crop in different regions. In this context, the aim of the present work was to evaluate the chemical composition, the bioactive compounds and the fatty acid profile of the pulp of juçara fruit available in the Brazilian south region.

2. MATERIALS AND METHODS

2.1 Samples

Juçara pulp samples were supplied by farmers from rural communities of Maquiné (Rio Grande do Sul state, Brazil, 29° 40' 30" S 50° 12' 25" O). The samples were packed in polyethylene bags and transported in a box filled with eutectic ice to the Natural Products Laboratory (Federal University of Rio Grande, Santo Antônio da Patrulha). The material was stored at -21°C for no longer than 90 days. All chemical reagents used were of analytical grade.

2.2 Centesimal composition

Moisture, lipid, protein and ash contents of juçara pulps were determined in triplicate using standard procedures (AOAC, 2005). The total carbohydrate content was determined by difference. The total energy value was estimated using the water conversion values of 9 kcal g^{-1} for lipids and 4 kcal g^{-1} for proteins and carbohydrates.

2.3 Color analysis

The color of the juçara pulp was measured by a colorimeter (Minolta, CR-400, Japan). The color was expressed as lightness L* (L* = 0 black and L* = 100 white), chromaticity a* (-a* green and +a* red) and b* (-b* blue and +b* yellow), and Hue angle (H°) values. Hue angle is represented in degrees, according to Equation 1 and corresponding to the three-dimensional diagram of colors, where 0° is the red, 90° is the yellow, 180° is the green and 270° is the blue. All measurements were performed in triplicate.

$$H° = \tan^{-1}(b^*/a^*) \qquad \text{(Equation 1)}$$

2.4 Bioactive composition

2.4.1 Total phenolic content

The total phenolic content was obtained according to the methodology described by AOAC (2005), with some adaptation. This method is based on the alkaline reduction of the Folin-Denis reagent by the phenols to molybdenum, which promote blue coloration. The calibration curve used was based on gallic acid and the absorbance was measured in a spectrophotometer UV-VIS (Halo, SB-10, UK) at 760 nm. The results were expressed as mg of gallic acid equivalent g^{-1} of dry pulp (mg GAE g^{-1}).

2.4.2 Total anthocyanin content

The total anthocyanin content of juçara pulp was determined based on the method of Fuleki and Francis (1968) with minor modifications. The juçara pulp was separated into 50 g fractions and supplemented with 90 mL extraction solution (70:30 ethanol: water). HCl was added to pH 2.0. After, the sample was allowed to stand for 24 h, filtered and transferred to a flask. The total volume was adjusted to 100 mL. The content of the flask was centrifuged at 8000 rpm for 10 min and the supernatant was filtered through a Whatman filter paper number 4. Then, the extract was washed with ethyl ether to remove chlorophyll. For the analysis of each sample, 1 mL of the concentrated extract was transferred to a 10 mL volumetric flask, and the volume was completed with 85:15 of 95% ethanol:1.5 N HCl. The absorbance reading was performed at 535 nm and the total anthocyanin content was quantified by Equation 2. Results were expressed as mg anthocyanin 100 g^{-1} juçara pulp.

$$C = 100(Abs_{535}\ M\ f) / (\varepsilon\ L) \quad \text{(Equation 2)}$$

In Equation 2, C represents the cyanidin-3-glicoside concentration (mg 100 g^{-1}), Abs_{535} is the absorbance at 535 nm, M is the molar weight of cyanidin-3-glicoside (449.2 g mol^{-1}), f is the dilution factor, ε is the molar extinction coefficient for cyanidin-3-glucoside (26900 L mol^{-1} cm^{-1}) and L is the optical path in the bucket.

2.4.3 Antioxidant activity by DPPH

The antioxidant activity of the juçara pulp was studied through the evaluation of the free radical-scavenging effect on the 2,2-diphenyl-1-picryl-hydrazyl radical (DPPH) radical. The method was described by Brand-Williams *et al.* (1995). Briefly, a solution of 0.06 mmol L^{-1} DPPH was prepared in 100 mL of methanol. Then, an aliquot of 1.2 g of sample was added to 3.9 mL of DPPH solution. The decrease in absorbance at 515 nm was monitored using the UV-VIS spectrophotometer (Halo, SB-10, UK) every 10 min until the reaction was in equilibrium. The antioxidant activity was quantified as the equivalent concentration of oxidant required to reduce the original amount of free radical by 50% (EC_{50}), expressed in µg mL^{-1}.

2.4.4 Carotenoids content

Quantification of carotenoids was performed following the methodology described by Rodrigues-Amaya and Kimura (2004). Aliquots of juçara pulp were extracted with acetone/petroleum ether in a separatory funnel. Then, the organic phase was analyzed by spectrophotometry at 450 nm. Results were expressed as mg carotenoid 100 g^{-1} juçara pulp.

2.5 Fatty acid composition

The oil for fatty acid analysis was obtained of pulp extraction with hexane in a Soxhlet type apparatus. Fatty acid methyl esters (FAMEs) were prepared by methylation, according to the methodology proposed by Joseph and Ackman (1992). In particular, 25 mg of oil was added to 1.5 mL of 0.50 M NaOH in methanol. The mixture was heated in water bath at 100 °C for 5 min. Then, 2 mL of solution BF_3 (14% BF_3 in methanol) were heated in water bath at 100°C for 30 min. After cooling, 1 mL of isooctane was added and the solution was slowly stirred for 30 s. After, 5 mL of saturated NaCl aqueous solution was added to the solution and the supernatant was transferred into a clean flask. Then, 1 mL of isooctane was added. The resulting solution was stirred and the solvent was removed under nitrogen flow until a final volume of 1 mL was reached for chromatographic analysis.

FAMEs were separated using a Shimadzu gas chromatographer (model CG-2010) equipped with flame ionization detector (FID) and Omegawax 250 capillary column (30 x 0.25 mm i.d. x 0.25 µm). The gas flow rates were 1.2 mL min^{-1} for H_2 (carrier gas), 30 mL min^{-1} for N_2 (makeup gas), and 30 and 300 mL min^{-1} for H_2 and synthetic air (flame gases), respectively. Each sample (1 µL) was automatically injected in triplicate, and the sample split rate was 1:50. The operational parameters were as follows: injection and detector temperatures were maintained at 250 °C and 260 °C, respectively; the initial column temperature of 50°C was increased to 220°C at

a rate of 4°C min^{-1}. For fatty acid (FA) identification, the retention times were compared to those of FAME standards.

2.6 Elemental analysis

The elemental analysis of juçara pulp was performed using the Particle Induced X ray Emission (PIXE) (Johansson *et al.*, 1995) technique. It is an ion beam technique used for material analysis. It is based on the emission of characteristic x ray from the sample by the incidence of a proton beam. Moreover, PIXE is known by its non-destructive and multielemental capability, as well as by the possibility to prepare samples without chemical reagents (dos Santos *et al.*, 2019). PIXE experiments were carried out at the Ion Implantation Laboratory (LII) of the Physics Institute of Federal University of Rio Grande do Sul (IF-UFRGS), using a Tandetron particle accelerator. All samples were irradiated by a 2 MeV proton beam during 400 s and 3 nA of current. The samples of juçara pulp were placed in a holder inside the PIXE reaction chamber, which was kept in a pressure of 10^{-6} mbar approximately. The emitted X rays from the samples were detected by a Si(Li) detector with an energy resolution of approximately 160 eV at 5.9 keV. The elemental concentrations were obtained by GUPIXWIN software (Campbell *et al.*, 2010). For this, apple leaves standard (NIST reference material 1515) was considered for PIXE standardization purpose.

2.7 Statistical analysis

The analysis of the studied samples was performed in triplicate. All results were calculated as the average ± standard deviations using the Statistica 7.0 software (StatSoft Inc., USA).

3. RESULTS AND DISCUSSION

3.1 Centesimal composition

Table 1 shows a centesimal composition sample of the juçara pulp, for each 100 g of sample, on dry basis or on wet basis. According to the results, on average, for each 100 g of wet pulp, approximately 16 g correspond to the dry matter. Although there is a large amount of moisture, the result shows that the pulp presents a considerable energetic value. Approximately 61% of the total energetic value of this fruit is due the high lipid content present in the juçara pulp.

As shown in Table 1, the lipid content is higher than those found by Silva *et al.* (2013) which found a lipid content of 30% for juçara pulp. Other studies showed that the lipid content in juçara pulps range between 28.3% and 42.5%, corroborating with the value obtained in our research (Schulz *et al.*, 2016). Comparing with açaí pulp, Yamaguchi *et al.* (2015) mentioned that the average lipid content is 50% and this value is higher than that found in our study. However, Pessoa and Teixeira (2012) quantified a maximum lipid content equal to 41.9%, which is close to the results obtained in our work.

Regard the total protein content, the value is slightly higher than those found by Schulz *et al.* (2015) and Silva *et al.* (2014) for juçara pulp (7.7% and 6.0%, respectively), and Rufino *et al.* (2011) (6.27% for commercial açaí pulp). On the other hand, the value was slightly lower than that found by Pessoa and Teixeira (2012) for açaí pulp (15.9%). In addition, juçara pulp showed to be an excellent source of plant protein.

Differences in the centesimal composition of pulps may be associated with edaphoclimatic conditions, place of crop, variety and ripening maturation stage of the fruit (Filho *et al.* 2017). In addition, the processing method and pulp storage conditions may modify the nutritional value, aroma and flavor of the product (Cardoso *et al.*, 2018).

Table 1. Centesimal composition and energy of the juçara pulp.

	Moisture (g 100 g^{-1}) [a]	Carbohydrate (g 100 g^{-1}) [b]	Protein (g 100 g^{-1}) [b]	Lipid (g 100 g^{-1}) [b]	Ash (g 100 g^{-1}) [b]	Energy (kcal 100 g^{-1}) [a]
Juçara pulp	83.7 ± 0.5	46.8 ± 0.9	8.9 ± 0.4	39.2 ± 0.6	5.1 ± 0.3	93.6 ± 2.1

Values are means ± standard deviation of triplicates; [a] Wet basis; [b] Dry basis.

3.2 Color parameters

Table 2 shows the values obtained for color parameters and bioactive composition in the juçara pulp.

Table 2. Analyses of physical-chemical parameters and bioactive composition of the juçara pulp.

Analysis	Result
L*	13.15 ± 0.94
a*	4.47 ± 0.28
b*	1.73 ± 0.08
Hue angle (°)	21.16 ± 0.72
Total phenolic (mg 100 g^{-1} juçara pulp) [b]	8148.9 ± 202.3
Total anthocyanin (mg 100 g^{-1} juçara pulp) [b]	511.1 ± 16.1
Carotenoids (mg 100 g^{-1} juçara pulp) [b]	0.74 ± 0.05
Antioxidant activity DPPH (µg mL^{-1}) [b]	26.6 ± 1.5

Values are means ± standard deviation of triplicates; [a] Wet basis; [b] Dry basis.

The parameters L*, a* and b* are of great interest because they can indicate the ripening stage of the fruits and the presence of anthocyanins. The higher intense color of the pulp leads to the expectation that the pulp would have higher anthocyanin levels, which could be confirmed by the luminosity and chromaticity parameters. According Schulz *et al.* (2015), chroma decreases during ripening of the fruit due to the degradation of chlorophyll and synthesis of anthocyanins, darkening the juçara pulp. As shown in Table 2, Hue angle value was similar to that found by Siqueira *et al.* (2018) of 17.22, and lower than those found by Silva *et al.* (2013) of 29.29, both for juçara pulp. Comparing with açaí pulp, Siqueira *et al.* (2018) obtained a Hue angle of 35.95. According to Schulz *et al.* (2015) over the ripening process, the fruit become bluish-black, corroborating with the value found for the Hue angle obtained in the present work. Differences in coloration of juçara pulp are expected because the fruits may have been collected at different maturation stages, affecting in color parameter results. Moreover, in the research by Siqueira *et al.* (2018) the levels of anthocyanins in the juçara pulp were higher than those found in the açaí pulp, which may explain the more intense coloration in the juçara pulp.

3.3 Bioactive composition

As shown in Table 2 the total phenolic content observed in this study is similar to those found by Bicudo *et al.* (2014) (8169 mg 100 g^{-1} dry pulp) for pulps obtained from fruits collected in Santa Catarina, state in the border of Rio Grande do Sul, in immature violet stage. Other studies found different values for total phenolics, but it is known that many factors justify this difference in the concentration of phenolic compounds in juçara, including the time of samples collection, climate factors and the extraction methods for analysis (Schulz *et al.*, 2015; Garcia *et al.*, 2019).

A high concentration of anthocyanins can also be observed, which are secondary metabolites responsible for fruit coloration. The concentration of anthocyanins found in the present work is higher than the values reported by Rufino *et al.* (2010) (192 mg 100 g^{-1} of juçara dry pulp and 111,1 mg 100 g^{-1} of açaí dry pulp). According to the European Food Safety Authority (EFSA), the FAO/WHO Expert Committee on Food Additives (JECFA) has established an acceptable daily intake of up to 2.5 mg of grape anthocyanins kg^{-1} body weight (EFSA JOURNAL, 2013). Thus, the consumption of juçara pulp contributes to an appropriate intake of anthocyanin.

Regarding the carotenoid content, juçara pulp presented low levels of this compound when compared to other fruits. This result was already expected, since juçara fruit presents anthocyanins as the main pigment (Silva *et al.*, 2015). As shown in Table 2, juçara pulp has excellent antioxidant activity. According to Siqueira *et al.* (2018), antioxidant activity can be attributed to the presence of phenolic compounds and carotenoids. In the case of the juçara pulp studied in this work, the high antioxidant activity should be related predominantly to the high content of phenolic compounds, because the carotenoid concentration was found in lower concentration. Considering the high antioxidant activity, juçara pulp presents potential to protect against oxidative damage common in various degenerative diseases.

3.4 Fatty acid composition

In Table 3 the fatty acid composition is expressed as the percentage of the total fatty acid content of juçara pulp. The most abundant fatty acid in the juçara pulp was the oleic acid (42.7%), followed by palmitic acid (24.8%) and linoleic acid (19.6%), respectively. Together, they comprised 87.1% of total identified fatty acids. As can be observed, saturated fatty acids (SFAs) represent a considerable part of the fatty acids present, with 35%. Palmitoleic acid (2.1%) and linolenic acid (0.6%) were the fatty acids found in smaller quantities.

Table 3. Fatty acid content of juçara pulp (dry basis).

Fatty acids	Content (%)
C4:0, butyric acid	10.2 ± 0.5
C16:0, palmitic acid	24.8 ± 2.8
C16:1, palmitonoleic acid	2.1 ± 0.3
C18:1 n9, oleic acid	42.7 ± 4.1
C18:2 n6, linoleic acid (ω-6)	19.6 ± 2.0
C18:3 n3, linolenic acid (ω-3)	0.6 ± 0.1
Saturated fatty acids (SFAs)	35.0
Unsaturated fatty acids (UFAs)	65.0
Monounsaturated fatty acids (MUFAs)	44,8
Polyunsaturated fatty acids (PUFAs)	20.2

Values are means ± standard deviation of triplicates

Comparing with the fatty acids found in this research, Silva *et al.* (2013) detected in samples of juçara pulp 36.0% of oleic acid, 34.4% of palmitic acid, 19.2% of linoleic acid, 2.6% of palmitoleic acid and 0.9% of linolenic acid. In another study, Schulz *et al.* (2015) quantified the fatty acid composition in seven different stages of juçara ripening and obtained values ranging from 26.6%-44.8% of oleic acid, 21.9%-41.8% of palmitic acid, 26.6%-33.8% of linoleic acid, 0.9%-3.4% of palmitoleic acid and 0.6%-1.5% of linolenic acid. Different factors can affect fatty acid composition such as environmental conditions, geographical plant origin and fruit ripening stage (Altuna *et al.*, 2018; Garcia *et al*., 2019).

Most of the fatty acids found in this research are unsaturated fatty acids (MUFAs and PUFAs), which is desirable in a diet. PUFAs work to decrease LDL cholesterol levels in the blood and are used to the prevention of cardiovascular diseases (Pessoa *et al.*, 2015), whereas a good content of MUFAs allows high stability in lipid oxidation (Altuna *et al*. 2018).

Comparing this research with the results obtained by other authors for açaí pulp, there were some differences. Santo *et al.* (2010) found levels of palmitic acid (23.91%) and linolenic acid (0.62%) very close to these found for juçara pulp. The palmitoleic acid content (3.98%) was higher, whereas the content of butyric acid (0.5%) and linoleic acid (10.89%) was much lower than those found in this study. Souza *et al.* (2017) detected similar value of SFAs (33.92%) for açaí pulp to those found in this study for juçara pulp. As for the MUFAs content (61.18%), these researchers obtained a higher value for açaí pulp, while the PUFAs content (4.9%) was much lower than those found in this research for juçara pulp. According to Yamaguchi *et al.* (2015), it is common the predominance of unsaturated fatty acids in the fruit pulp of the *Euterpe genus*, corroborating with the values found in the present study. Thus, a diet rich in essential fatty acids may incorporates juçara pulp as a potential source for these acids.

3.5 Elemental analysis

Table 4 shows the mineral composition of the juçara pulp obtained by PIXE analysis. In total, 17 elements were quantified. The number of minerals found in this work is in accordance with Schulz *et al.* (2016), which mentioned the presence of, at least, 17 elements in juçara pulp whereas Inada *et al.* (2015) quantified 14 elements in juçara pulp. According Damodaran and Parkin (2017), minerals are usually found in foods at relatively low concentrations but play an important role in living organisms.

Among the 17 minerals analyzed in this research, potassium (1519.1 mg 100 g^{-1}), calcium (347.4 mg 100 g^{-1}), magnesium (223.7 mg 100 g^{-1}), sulfur (219.5 mg 100 g^{-1}), silicon (198.8 mg 100 g^{-1}) and phosphorus (187.0 mg 100 g^{-1}) were the minerals present in highest content, followed by manganese (13.9 mg 100 g^{-1}), aluminum (13.8 mg 100 g^{-1}) and iron (3.96 mg 100 g^{-1}). The higher amount of potassium in relation to the other minerals was expected, since in general the plant tissues are rich in this element. Potassium has high mobility in plants, and low affinity for organic chelates (Blank *et al.*, 2017; Damodaran and Parkin, 2017).

Table 4. Mineral composition of juçara pulp (dry basis) obtained by PIXE analysis.

Mineral	Concentration (mg 100 g^{-1})	Mineral	Concentration (mg 100 g-1)	Mineral	Concentration (mg 100 g^{-1})
K	1519.13 ± 251.80	Mn	13.89 ± 1.50	Br	1.32 ± 0.35
Ca	347.45 ± 26.49	Al	13.77 ± 1.36	Cu	1.02 ± 0.15
Mg	223.70 ± 22.52	Fe	3.96 ± 0.57	Ti	0.59 ± 0.12
S	219.46 ± 23.27	Rb	3.55 ± 0.72	Cr	0.39 ± 0.09
Si	198.79 ± 15.38	Zn	2.99 ± 0.44	Ni	0.10 ± 0.02
P	187.05 ± 21.34	Sr	2.75 ± 0.40		

Values are means ± standard deviation of triplicates.

According to the Brazilian Table of Food Composition (TACO, 2011), in banana, which is widely known to be a source of potassium, the maximum amount found was 387 mg of potassium per 100 g of fresh banana, with a mean humidity of 70.1%, which is equivalent to approximately 12.94 mg of potassium per g of dry solid. In our study we found 15.2 mg g^{-1} of dry juçara pulp. It shows that juçara pulp can be considered an excellent source of potassium. If the Recommended Dietary Allowance (RDA) of potassium for adults should be at least 3510 mg (WHO, 2012), the consumption of 250 g of the juçara pulp suggests an intake of 18% of the RDA for potassium, approximately, considering the concentration determined in this study.

Schulz *et al.* (2016) published a thorough review of mineral levels in juçara pulp, on a dry basis, considering the ranges for the concentration of potassium (419-1291 mg 100 g^{-1}), calcium (76-596.7 mg 100 g^{-1}), magnesium (47-183 mg 100 g^{-1}), phosphorus (41-132 mg 100 g^{-1}), iron (4-7 mg 100 g^{-1}), zinc (1-3 mg 100 g^{-1}), copper and nickel (less than 1 mg 100 g^{-1}). As can be observed in Table 3, the values reported in the present work were in the range or near to the levels mentioned by Schulz *et al.* (2016).

According Blank *et al.* (2017), calcium, magnesium and zinc are required as cofactors in enzymatic processes, participating in the structure of the DNA self-repair system. The absence of iron in the organisms makes the synthesis of hemoglobin unviable, causing anemia. By including juçara pulp in the diet, iron uptake problem may be one way to minimize this problem. However, iron of vegetable origin is less bioavailable than iron of animal origin (Inada *et al.*, 2015). Depending on the ripening stage of the fruit, the bioaccessible fraction of the iron present in the juçara pulp can be up to 29.5% (Schulz *et al.*, 2017).

4. CONCLUSION

Due to the high lipid content, juçara pulp has a high energetic value and it is recommended to be consumed in moderation by people with a low-calorie diet. By other side, the high protein content makes the juçara pulp as an alternative source to the ingestion of proteins of plant origin. Moreover, juçara pulp is an important source for some minerals, such as iron and potassium. These and the other results presented in this work endorse that the fruit of *Euterpe edulis* is a rich source of different organic compounds and minerals, some of them essential to human organism. Based on this, the use of juçara pulp is a useful alternative for local farmers for consume in natura as well as a raw material to produce foodstuff rich in nutrients and with plan origin.

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Conflicts of Interest

Authors declare that there are no conflicts of interest.

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