Bioactive Compounds and Antioxidant Activity on Fruits from Different Açaí (*Euterpe oleracea* Mart) Progenies

M.C. de Souza, R.W. Figueiredo and G.A. Maia
Food Technology Department
UFC
Fortaleza – CE
Brazil

R.E. Alves, E.S. Brito, C.F.H. Moura and M.S.M. Rufino
Postharvest Technology and Physiology Lab.
Embrapa Tropical Agroindustry
Fortaleza – CE
Brazil

Keywords: ascorbic acid, yellow flavonoids, anthocyanins, polyphenols, carotenoids

Abstract

Nowadays, there is great interest in açaí fruits due to their functional and energetic properties. Based on some of these characteristics (bioactive compounds and antioxidant activity), açaí fruits from different progenies were evaluated in order to select superior genetic materials. The fruits were harvested from eight progenies of the Tropical Fruits Collection at the Curu Experimental Station of the Embrapa Tropical Agroindustry, Paraipaba, CE, Brazil. Each sample was evaluated for ascorbic acid, carotenoids, yellow flavonoids, anthocyanins, total extractable polyphenols tannins and AA by the β-carotene/linoleic acid bleaching method. Regarding the majority of parameters evaluated, açaí fruits presented a high variation among progenies. It was observed that the average ascorbic acid mean of the açaí fruit was 58.7 mg/100 g. The anthocyanin average was 108.9 mg/100 g, with variations from 73.52 to 143.52 mg/100g, and progenies P131-3 (143.62 mg/100 g) and P034-3 (134.71 mg/100 g) showed the highest contents. In general, a high content of biological active compounds was observed when compared to others tropical fruits in the literature. Açaí extracts presented an excellent oxidation inhibition, with progenies presenting different antioxidant capacities. AA varied from 47.7 to 75.0% of oxidation inhibition (% OI), with higher values for progenies P049-6 (75.0% OI), P048-8 (72.0% OI), P032-5 (70.0% OI) and P308-2 (67.0% OI).

INTRODUCTION

At the present time, fruits are known by their bioactive compounds, which have functional properties and can contribute to human health. Many compounds naturally present in fruits, such as pigments, vitamins, phenolic compounds and minerals, have physiological functionality (Moraes and Colla, 2006). A balanced diet rich in vegetable and fruit, with different amounts of such substances, can contribute to antioxidant defense system avoiding oxidative damage to macromolecules (Silva and Naves, 2001).

In such a way açaí has been studied because of it bioactive compounds, mainly due to the presence of anthocyanins, which are responsible to its purple color. Açaí is an Amazonian native fruit with a huge genetic diversity in the Amazon River delta area and it is an exotic fruit even in some parts of Brazil. Genetic material characterization could lead to an identification of açaí plants with better quality, including secondary metabolites with possible health effects. This study has the aim to evaluate the antioxidant activity and quantify some bioactive compounds from different açaí progenies.

MATERIAL AND METHODS

Fruits from eight açaí progenies were harvested at their commercial maturity (deep purple epicarp color covered by a gray layer). The fruits were from Experimental Station of Curu of the Embrapa Tropical Agroindustry, at Paraipaba, CE, Brazil. The selected progenies were: P032-5, P034-3, P048-8, P049-6, P072-1, P064-8, P131-3 and P308-2. The experiment was performed at the Postharvest Technology and Physiology Laboratory of the Embrapa Tropical Agroindustry, Fortaleza, CE, Brazil, where the fruits were manually de-pulped with the addition of water and part of the material was freeze dried.

Chemical determinations were vitamin C (Pearson, 1976), total carotenoids (Higby, 1962), yellow flavonoids and total anthocyanins (Francis, 1982), and total extractable polyphenols (TEP) (Larrauri et al., 1997). The results were expressed by mg/100 g of pulp or edible portion (epicarp + mesocarp). TEP antioxidant activity, corresponding to a 10 g/L dilution, was measured by the β-carotene/linoleic acid co-oxidation method (Marco, 1968; Miller, 1971) and was expressed as a percentage of oxidation inhibition (% OI).

The experiment was conducted with a completely randomized design, using eight treatments (progenies) and three replications. The variables were analyzed by ANOVA and the F Test, and the means were compared by the Tukey's test at 5% (Banzatto and Kronka, 1992).

RESULTS AND DISCUSSION

In all analyses, there was a significant statistical difference ($p<0.05$) showing progenies variation (Table 1). Ascorbic acid mean value was 58.72 mg/100g with P048-8 progenies presenting the highest value (80.81 mg/100 g), but without the statistical difference of the P064-8 and P131-3 progenies (71.48 and 66.98 mg/100 g), respectively.

Ascorbic acid values found in this study were six times higher than the values reported by Franco (2003), which were 9.0 mg/100 g for açaí pulp. This huge difference could be explained by the way samples were processed. Our samples were manually removed from fruits without the moisturizing step, which consists of leaving fruits in water to soften the mesocarp. This procedure is widely used for açaí pulp removal. Another possible explanation for low value ascorbic acid is the pasteurization process.

Carotenoids value ranged from 3.88 mg/100 g to 6.23 mg/100 g, with a mean value of 5.07 mg/100 g. The higher value for carotenoids was from P034-3 and P064-8 progenies, both with a value of 6.23 mg/100 g. However, there was no statistical difference from P072-1 (5.41 mg/100 g) and P032-5 (5.21 mg/100 g) progenies. These results showed that açaí has a high carotenoid content when compared to other carotenoid rich fruits, such as mango (1.91 and 2.63 mg/100 g), red guava (6.21 mg/100 g), pitanga (1.64 mg/100 g) and papaya (0.85 mg/100 g), that are similar or even higher. An exception is buriti (48.88 mg/100 g), which has the highest carotenoid content from known Brazilian fruits (Godoy and Rodriguez-Amaya, 1998).

Generally speaking, flavonoid content was equivalent in all progenies, ranging from 111.01 mg/100 g to 135.15 mg/100g, with a mean of 121.40 mg/100g. The P308-2 progenie had the highest mean for yellow flavonoids differing from progenie P064-8, which presented the lowest value. There was no statistical difference to all other progenies. Yellow flavonoids have been reported as having antioxidant activity (Pietta, 2000). Our results indicated that, besides anthocyanins, açaí is an important source of other flavonoids that can contribute to its nutritional and functional value.

For anthocyanins, the overall mean was 108.9 mg/100 g, ranging from 73.52 to 143.52 mg/100 g. The progenies P131-3 (143.62 mg/100 g) and P034-3 (134.71 mg/100 g) showed the highest values. Similar values were reported by Constant (2003) with anthocyanin values from fresh açaí fruit of 100 mg/100 g of fruits (wet weight). However, different values (44.00 mg/100 g of fruits) were reported by Rogez (2000). Anthocyanin values reported by Bobbio et al. (2000) were 50.00±5 mg/100.00 g of fruits. Compared to other fruits, açaí proved to be an excellent source of anthocyanins (Tjin Akwie, 2000).

The total extractable polyphenols mean was 604.69 mg/100g, ranging from 528.03 mg/100 g for P049-6 to 691.21 mg/100 g for P131-3. These results are higher than that reported by Hassimotto et al. (2005). These authors studied the antioxidant activity of frozen pulps and reported an açaí total polyphenol content of 328 mg/100 g. We should emphasize that in our study we corrected the results for the water added in the pulp extraction step, which probably contributed to this difference.

AAs were observed on all phenolic extracts, ranging from 47.67 to 75.00% OI. The best results were obtained by P049-6 (75.00% OI), P048-8 (72.00% OI), P032-5 (70.00% OI) and P308-2 (67.00% OI) progenies, which were statistically different

($p<0.05$) from other progenies. However, some progenies with a high % OI presented lower anthocyanin and phenolic contents. An example is P131-3, which had the higher anthocyanin and phenolic content compared to the other progenies, presented one of the lowest % OI. This led to the assumption that açaí AA was not only related to anthocyanins and phenolics, but also to other bioactive compounds.

Hassimotto et al. (2005) studied AA by the β-carotene/linoleic acid method in various fruit pulps, including açaí, and observed a 73.3% OI for this fruit. They did not find a significant correlation between antioxidant activity and phenolics. Duarte-Almeida et al. (2006), also using the β-carotene/linoleic acid system, reported a 70% OI for a methanolic açaí extract (20 g/L). It should be noticed that this concentration was two times the one used in our study.

CONCLUSION

When compared to others tropical fruits in the literature**,** açaí was characterized as having a high content of bioactive compounds and antioxidant activity which means that it is a potential source of natural antioxidants to human diet. There is a different antioxidant activity amongst açaí progenies, being P032-5, P048-8, P049-6 and P308-2 the highest ones.

ACKNOWLEDGMENTS

To CNPq, EMBRAPA, FUNCAP and European Union (FP6 - Contract n. 0015279) for the financial support.

Literature Cited

Banzatto, D.A. and Kronka, S.N. 1992. Experimentação agrícola. FUNEP/UNESP, Jaboticabal.

Bobbio, F.O., Druzian, J.I., Abrao, P.A., Bobbio, P.A. and Fadelli, S. 2000. Identification and quantification of the anthocyanins from the fruit of açai (*Euterpe oleracea* Mart.). Ciênc. Tecnol. Aliment. 20:388-390.

Constant, P.B.L. 2003. Extração, caracterização e aplicação de antocianinas de açaí (*Euterpe oleracea* M.) - Thesis. Universidade Federal de Viçosa, Viçosa.

Duarte-Almeida, J.M., Santos, R.J., Genovese, M.I. and Lajolo, F.M. 2006. Avaliação da atividade antioxidante utilizando sistema β-caroteno/ácido linoléico e método de seqüestro de radicais DPPH. Ciênc. Tecnol. Aliment. 26:446-452.

Francis, F.J. 1982. Analysis of anthocyanins. In: P. Markakis (ed.), Anthocyanins as food colors. Academic Press, New York.

Franco, G. 2003. Tabela de composição química dos alimentos. Atheneu, São Paulo.

Godoy, H.T. and Rodriguez-Amaya, D.B. 1998. Occurence of cis-isomers of provitamin A in Brazilian vegetables. J. Agric. Food Chem. 46:3081-3086.

Hassimotto, N.M.A., Genovese, M.I. and Lajolo, F.M. 2005. Antioxidant activity of dietary fruits, vegetables, and comercial frozen pulps. J. Agric. Food Chem. 53:2928-2935.

Higby, W.K. 1962. A simplified method for determination of some the carotenoid distribution in natural and carotene-fortified orange juice. J. Food Sci. 27:42-49.

Larrauri, J.A., Pupérez, P. and Saura-Calixto, F. 1997. Effect of drying temperature on the stabilitity of polyphenols and antioxidant activity of red grape pomace peels. J. Agri. Food Chem. 45:1390-1393.

Marco, G.J. 1968. A rapid method for evaluation of antioxidants. J. Am. Oil Chem. Soc. 45:594-598.

Miller, H.E. 1971. A simplified method for the evaluation of antioxidant. J. Am. Oil Chem. Soc. 48:91.

Moraes, F.P. and Colla, L.M. 2006. Alimentos funcionais e nutracêuticos: definições, legislação e benefícios à saúde. Rev. Eletr. Farm. 3:109-122.

Pearson, D. 1976. Técnicas de laboratório para el análises de alimentos. Acribia, Zaragoza.

Pietta, P.G. 2000. Flavonoids as antioxidants. Journal of Natural Products. 63:1035-1042.
Rogez, H. 2000. Açaí: Preparo, composição e melhoramento da conservação. EDUFPA, Belém.
Silva, C.R.M. and Naves, M.M.V. 2001. Suplementação de vitaminas na prevenção de câncer. Rev. Nutr. 14:135-143.
Tjin Akwie, S.N.L. 2000. Cinéticas de amadurecimento, de oxidação e de extração das antocianinas de *Euterpe oleracea* – Thesis. UFP, Belém.

Table

Table 1. Bioactive compounds – mg/100 g (vitamin C – VC, total carotenoids – TC, yellow flavonoids - YF, total anthocyanins – TA and total extractable polyphenols - TEP) and antioxidant activity (AA) - % OI, from pulp of different açaí progenies.

Progenies	VC	TC	YF	TA	TEP	AA
P032-5	45.60d	5.21ab	115.34ab	128.68b	598.61bcd	70.00a
P034-3	45.56d	6.23a	130.43ab	134.71ab	614.33abc	50.33b
P048-8	80.81a	3.88c	114.58ab	101.64c	604.12bcd	72.00a
P049-6	49.51cd	4.50bc	114.02ab	78.59d	528.03d	75.00a
P064-8	71.48ab	6.23a	111.01b	73.52d	601.50bcd	53.66b
P072-1	58.16bcd	5.41ab	122.56ab	103.69c	558.95cd	47.66b
P131-3	66.98abc	4.41bc	128.08ab	143.62a	691.21a	51.33b
P308-2	51.65bcd	4.66bc	135.15a	106.79c	640.78ab	67.00a
General Mean	58.72	5.07	121.40	108.90	604.69	60.87

* Means followed by different letters are statistically different by Tukey ($p<0.05$).