

Antioxidant properties of açai (*Euterpe oleracea*) in human plasma

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Abstract. Açai is a very popular polyphenol-rich fruit juice in the Amazonian region. In order to evaluate its effects on blood oxidative level, 350 ml açai juice were added to the daily diet of 30 male volunteers (aged 41±8.9 years) during 28 days. Fasting blood samples were obtained by vein puncture on day 0, 10, 20 and 28 and LDLs were isolated on day 0 and 28. Plasmatic and LDL thiobarbituric acid-reactive substances (TBARS), copper-induced LDL oxidation (CILO) and plasmatic TRAP (Total radical-trapping antioxidant parameter) and ORAC (Oxygen radical absorbance capacity) values were determined to evaluate the antioxidative status of the subjects. Cluster Analysis was used to build up two groups of subjects (more versus less protected), according to these antioxidant parameters on day 0. At that time, the LDL TBARS were three times higher in cluster 1 than in cluster 2 (4.2±2.1 and 1.2±0.5, respectively). On day 28, these values had gone down (1.6±0.9 and 1.1±0.6, respectively) and the change was significant for cluster 1. More generally, all parameters tended to show an improvement of the antioxidative status with açai: decrease of plasma TBARS, increase of lag time in the CILO test, stability or small increase of ORAC and TRAP values. These changes were however not statistically significant ($p>0.05$). Serum biochemical markers and lipid levels were measured enzymatically, but any significant effect was observed. These results suggest that the consumption of açai juice has anti-atherosclerotic effects through the substantial inhibition of LDL peroxidation in susceptible subjects.

Introduction. *Euterpe oleracea* Mart. is a palm tree widely distributed in Northern South-America. It is one of the most naturally abundant species in the Amazonian estuary floodplains (States of Amapá and Pará, Brazil). The juice of *E. oleracea* fruits, known as açai, is viscous (Dry matter ~ 8-15%) and typically prepared by macerating the edible pulp and adding water^[1]. It is characterized by a high content in polyphenols and notably in anthocyanins (mean of 870 mg/l), responsible for its dark purple color. Cyanidin 3-o-glucoside and cyanidin 3-o-rutinoside are the major anthocyanins present^[2]. These compounds are known to protect the LDLs against oxidative damage in vitro and in vivo^[3].

Materials and Methods. Thirty male volunteers (aged 41±8.9 years and BMI 24.59±3.5) were recruited from Belém-Pará (Brazil). All volunteers drank 350 ml of thick (14.4% DM) açai juice (350 ml) on a daily basis, during 28 days. Total anthocyanins¹, phenolic content^[4] and ORAC values⁴ were determined in the açai juice. Blood samples from fasting subjects were obtained by vein puncture at day 0, 10, 20 and 28, and were collected in 10 mL Li-heparin tubes, as well as in 5 mL tubes without anticoagulant. The blood was immediately centrifuged at 5.000 rpm for 10 min at 4°C and the plasma was frozen at -80°C. Plasmatic and LDL malondialdehyde (MDA) was determined as thiobarbituric acid-reactive substances (TBARS). Copper-induced LDL oxidation (CILO) was determined by spectroscopic measurement of conjugated dienes. The antioxidant capacity of plasma was analyzed by the TRAP (Total radical-trapping antioxidant parameter) and ORAC (Oxygen radical absorbance capacity) methods. Serum biochemical markers and lipid levels (total cholesterol (TC), HDL-C, LDL-C, triacylglycerols (TG)) were measured enzymatically with commercial kits (Biosystems, Barcelona, Spain). LDLs were isolated by sequential ultracentrifugation of the samples taken on day 0 and 28. Cluster Analysis (Statistica Program - StartSoft, Tulsa, OK) was used to build up two groups (more versus less protected subjects), according to the antioxidant parameters (TRAP, ORAC, CILO, plasma and LDL TBARS) on day 0. Comparisons of values between the groups (on day 0) and within the groups (across time) were carried out using the Student's paired t-test for independent samples.

Results and Discussion. The açai juice used for this study presented values of 1,890 mg, 5,152 mg and 192.68 mmol TE per litre, respectively for total anthocyanins, total phenolics and ORAC. LDL TBARS was the only parameter presenting a significant difference between the two clusters on day 0 (4.2 ± 2.1 and 1.2 ± 0.5 , $p < 0.05$). Concerning the changes induced by the consumption of the açai juice, Table 1 shows a significant reduction ($p < 0.05$) in the formation of LDL TBARS in the cluster with the high LDL oxidability at time zero. More generally, all parameters tended to show an improvement of the antioxidative status: decrease of plasma TBARS, increase of lag time in the CILO test, stability or small increase of ORAC and TRAP values. These changes were however not statistically significant ($p > 0.05$). The serum biochemical markers and lipid levels (total cholesterol and fractions and triacylglycerols) were not modified significantly (Table 2). These results suggest that the consumption of açai juice has anti-atherosclerotic effects through the substantial inhibition of LDL peroxidation in susceptible subjects.

Table 1: Evaluation of the antioxidative status of the volunteers through the determination of plasmatic and LDL thiobarbituric acid-reactive substances (TBARS), copper-induced LDL oxidation (CILO) and plasmatic TRAP (Total radical-trapping antioxidant parameter) and ORAC (Oxygen radical absorbance capacity) values^a

	Time (days)	LDL TBARS (nmol MDA/mg LDL)	Plasma TBARS (nmol MDA/ml)	CILO Lag Time (min)	Plasma ORAC (mmol TE/l)	Plasma TRAP (μ mol TE/l)
Cluster 1 (n=13)	0	4.2±2.1	217.5±72.4	61.7±33.1	19.8±2.3	15.4±6.1
	10		183.7±86.2		19.5±2.0	18.2±8.9
	20		170.0±66.8		18.9±2.9	18.1±7.3
	28	1.6±0.9	166.1±82.3	66.4±32.7	19.1±2.5	17.4±7.1
Cluster 2 (n=17)	0	1.2±0.5	158.8±91.0	50.4±12.2	14.7±2.5	19.6±8.0
	10		152.3±98.6		15.6±2.4	21.8±11.1
	20		143.3±88.6		17.1±4.7	20.9±8.2
	28	1.1±0.6	126.9±64.0	53.9±17.1	17.5±5.1	20.6±9.8

^a Results are means \pm SD. Cluster Analysis was used to build up two groups (more versus less protected subjects), according to the antioxidant parameters (TRAP, ORAC, CILO, plasma and LDL TBARS) on day 0.

Table 2: Triacylglycerols (TG), Total, LDL and HDL cholesterol (LDL-C, HDL-C and TC) for each cluster during the time of juice consumption^a

	Time (days)	TG (mg/dl)	TC (mg/dl)	LDL- C (mg/dl)	HDL- C (mg/dl)
Cluster 1 (n=13)	0	178.5±115.7	189.5±28.3	121.8±23.9	47.2±9.5
	10	169.3±85.0	188.5±31.2	120.6±29.1	48.5±9.1
	20	162.7±78.7	179.6±23.8	114.5±21.0	47.6±8.2
	28	199.3±89.6	182.6±31.9	116.5±25.0	47.9±8.9
Cluster 2 (n=17)	0	113.5±56.4	159.0±35.1	105.4±28.8	41.9±7.3
	10	141.3±84.0	159.8±26.2	102.4±21.5	43.9±7.0
	20	129.0±67.6	161.3±31.4	104.1±27.0	44.3±6.4
	28	148.3±74.7	165.0±31.6	107.3±25.5	43.4±6.8

^a Results are means \pm SD.

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