

# Bioactive Compounds of Acai (*Euterpe oleracea*) and the Effect of their Consumption on Oxidative Stress Markers

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**Abstract:** Açaí fruit (*Euterpe oleracea* Martius) is highly perishable, so it sought to apply conservation techniques that make its commercialization more bearable such as dehydration by the tray. This thermal technique that significantly inactivates harmful enzymes and microorganisms prolongs their shelf life but has the disadvantage that it decreases the proportion of bioactive components and its antioxidant power. The present work aims to estimate the content and antioxidant activity of the bioactive compounds of açaí powder supplied in hydroxypropyl methylcellulose (HPMC) vegetable capsules. For this purpose, total polyphenols were determined by the Folin-Ciocalteu test, total anthocyanin's by the differential pH test, and the antioxidant capacity *in vitro* DPPH method (using Trolox and Vitamin C equivalent). Also, the effect of consumption of four daily capsules on a healthy population (10 people) between the ages of 33-65 years old evaluated through a 10-day intervention study in which the following biomarkers in blood assessed: glycemia, triglycerides, total cholesterol, HDL, LDL, and 8-isoprostane. The açaí powder showed a total polyphenol content of 962.7±22.2 mg EAG/100g, total anthocyanin's up to 938.5±19.1 mg C3GE/100g, the antioxidant capacity of 643±24.32 µmol TE/100g and 14.07±0.45 g VCE/100g. In the intervention study, no significant differences were observed between before and after the different biochemical markers except for 8-isoprostane, suggesting that the consumption of dehydrated açaí caused effects benéfices in the population tested.

**Keywords:** Açaí, bioactive compounds, antioxidant capacity, oxidative stress, intervention study.

## INTRODUCTION

*Euterpe oleracea* Martius, commonly known as açaí, is a palm tree indigenous from the Amazonian region found in dense concentrations. This palm grows in Brazil, Colombia, Paraguay, Argentina, the Guianas, Venezuela, and Bolivia [1-3]. In the 90s was discovered that açaí berry had very high antioxidant properties *in vitro*, this fact causes the development of a vast industry over the years to supply açaí fruit for export in Brazil. By the year 2009, açaí had gained so much popularity that it became the top "superfood" among the rest of the fruits due to its extraordinary oxygen radical absorbance capacity (ORAC) assay value. In part, this antioxidant capacity is owed to polyphenols content in açaí fruit. Polyphenols are secondary metabolites widely distributed in the plant kingdom. Structural characteristics give these compounds the ability to reduce the risk of certain diseases by consuming foods and beverages containing them [4]. Among the diseases in which polyphenols exert positive health changes are: cardiovascular and neurodegenerative diseases, hormonal disorders, obesity, diabetes, and cancer. For this reason, polyphenols have been increasingly studied, so their

health-promoting properties can be extensively applied in humans prolonging the life cycle [5].

Metabolic syndrome is a collection of risk factors associated with diabetes and cardiovascular diseases associated with a pro-inflammatory state. This syndrome avoids the body antioxidant's incapacity to neutralize oxidative stress by excessive free radical's production [6]. Polyphenols protect against cardiovascular diseases through several mechanisms, mainly their capacity to scavenge oxygen-derived free radicals, acting as reducing and chelating agents, chain-breaking antioxidants, quenchers of singlet oxygen formation, and protecting ascorbic acid, and so forth [7]. Clinical studies support the beneficial effect of dietary intervention with various polyphenol-rich foods on blood lipids and glycemic measures changes. They also play a role in lipid metabolic disorders, which are the pathologic antecedents of atherosclerosis. Regarding açaí, a series of studies have also made about diet supplementation with açaí showing improvement of oxidative stress biomarkers in animals [8,9] and humans [10,11].

Açaí fruit degrades rapidly, mainly its phytochemicals content because of polyphenol – oxidase and peroxidase activity. Therefore, açaí berries have to be processed quickly and under low temperatures. Açaí pulp that is frozen continues to

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degrade as opposed to the pulp that is dehydrated to inhibit the rate of enzymatic degradation [12]. The best process to dehydrate is freeze-drying that maintains its full bioactivity. Also, spray-drying and conventional drying are used, but these techniques preserving a little bit less bioactivity. Conventional drying has disadvantages, prolonged times, heat, and oxygen exposure, but this process allows the producers of less developed regions to preserve higher production amounts at cheaper costs. This study aims to assess if açai fruit processed by tray-drying preserve enough polyphenols amount, antioxidant capacity *in vitro* and *in vivo* so it would be economically and technically reasonable to process açai this way.

## MATERIALS AND METHODS

### Açai Pulp, Powder, and Capsules

Açai berries harvested in Amazonas and Bolivar state; Venezuela then transported, cleaned, and frozen into a manufacturing facility in Amazonas state, Venezuela. The next day fruits were processed to pulp and stored at  $-10^{\circ}\text{C}$ . Next, it was transported to the laboratory where part of it was dehydrated on a tray dehydrator (Mitchel dryers 6451/59) until constant weight at  $45\pm 5^{\circ}\text{C}$  temperatures and converted to powder using a standard grain grinder (ZXMOTO 700 g Electric grain grinder). The powder was finally packed in hermetic bags and kept at  $-10^{\circ}\text{C}$  until analyzed. The powder was encapsulated in commercial HPMC capsules, size "0" using a manual 100 holes capsules filling machine (chengzhijingmi) under aseptic conditions, and packed on hermetic Mylar bags then stored at  $-10^{\circ}\text{C}$  Until intervention study was done.

The chemical composition was determined according to [13] moisture method 925.10, lipid method 920.39, ash method 923.03, nitrogen method 920.87, and carbohydrates by difference. Bulk and tapped density of açai powder measured according to [14] following method I for both densities using 250mL graduated cylinder next Hausner index was calculated with previously obtained values.

### Microbiological Analysis

The following tests realized in açai capsules: total aerobic microbial count, total combined yeast and molds count, bile tolerant Gram-negative bacteria, and absence of *Salmonella* spp and *E. coli*, as recommended on Nutritional and Dietary Supplements [15] for dried or powdered botanicals. Proceedings

described in chapters 2021 and 2022 of the same norm.

### Extraction of Polyphenolics Fractions

Açai aqueous extract was prepared by diluting açai pulp and previously prepared açai powder in pure methanol for total polyphenols and antioxidant capacity tests. For the anthocyanin's test, two extracts prepared using acidified methanol at 0.1% (buffer pH=1) and sodium acetate buffer (pH=4.5). These solutions placed in a shaker for 60-minute intervals (for total polyphenols and antioxidant capacity) and 45 minutes (total anthocyanin's), centrifuged at 3000rpm during 10m, the upper lipid phase of centrifuge tubes discarded, and the rest of the supernatant filtered through a #2 Whatman paper. Upon filtration, the extracts were immediately analyzed.

### Total Polyphenols Content

Phenolic extract previously prepared was used for total polyphenols determination using Folin-Ciocalteu assay [16] and quantified against a Gallic acid standard curve. A 0,1mL aliquot of extract or standard was mixed with 7mL of distilled water followed by 0,5mL of Folin-Ciocalteu reagent. After the solution mixed and incubated (1 to 8 minutes), were added 1,5mL of a 20% sodium carbonate solution and 0,9mL of distilled water. Remixed and left to stand for 2 hours at approximately  $20^{\circ}\text{C}$ . Finally, absorbance was determined at a wavelength of 765nm. The results were expressed as mg Gallic acid equivalents per 100g sample in fresh and dry weight (mg GAE/100g).

### Total Anthocyanin's Content

Anthocyanin content was determined in the previously prepared extracts using the pH differential method, as described by [17] with some modifications. Absorbance was determined at 510 and 700nm. Results expressed as mg cyanidin-3-glucoside/100g sample in fresh and dry weight.

### Antioxidant Activity

Antioxidant activity was assessed by the DPPH assay [18,19] with modifications based on the reduction of the free radical 2,2'-diphenyl-1-picrylhydrazyl (DPPH). Trolox and ascorbic acid are used as reference antioxidants. A standard solution of 35mg/L DPPH in absolute methanol was prepared daily and stored in a bottle protected from light. A 0.1mL aliquot of extract or standard added to test tubes (protected

from light) containing 3.9mL of DPPH solution and gently mixed. Absolute methanol is used as a negative control. At 515 nm was determined (immediately), the absorbance in control for the rest of the tubes was determined every 10 minutes. The relative DPPH scavenging capacities were expressed as micromoles of Trolox Equivalents (TE) per 100g sample ( $\mu\text{mol TE}/100\text{g}$ ) and milligrams of vitamin C equivalents (VCE) per 100g sample ( $\text{mg VCE}/100\text{g}$ ) [20] and as a percentage of residual DPPH at a constant state. Residual DPPH percentage was assessed according to the following equation:

$$\%R = \text{DPPHf} / \text{DPPHi} * 100$$

Where, DPPHf means absorbance of DPPH radical at a constant state, and DPPHi means absorbance of DPPH at 0m.

### Stability Analysis

Açaí capsules were stored in airtight high-density polyethylene (Mylar) bags under stress and accelerated conditions ( $40 \pm 1^\circ\text{C}$ ) for three months, next, samples were analyzed for: total polyphenols, total anthocyanin's, and antioxidant capacity. Results expressed as increasing/decreasing percentages based on the initial and final values of the previously mentioned assays.

### Anthropometric and Biochemical Markers

A dietary intervention study was carried out with the participation of ten healthy volunteers without distinction between sexes and ages between 33 and 65 years old. Volunteers with pathologies of chronic diseases, diabetes, infections, immunological diseases, obesity treated with surgery, pregnant women were excluded from the study. Those who are have been prescribed antihypertensive drugs were excluded too. All volunteers did sign an informed consent form. This study was approved by the Ethics Committee of the Military Hospital "Dr. Carlos Arvelo" and conducted at the same location (Caracas, Venezuela). The study complied with the guidelines provided by the Declaration of [21]. Also, a survey was conducted among the participants to assess their food frequency consumption. Participants were instructed to consume four (4) açaí capsules per day for ten days, preferably with their regular daily meals, and avoid consuming polyphenols-rich foods like wine and chocolate. It was extracted 30mL of peripheral blood in fasting conditions right at the beginning and the end of the ten-day açaí

consumption period. The blood samples were analyzed for plasma glucose, cholesterol, triglycerides, HDL, LDL, and 8-isoprostane using standard commercial enzymatic colorimetric methods except for isoprostane, which was performed by Elisa using a Cayman-Chemical commercial kit. The following anthropometric measurements were also taken at the beginning and the end of the study: weight, height, body mass index, and waist to hip ratio using the methodology of the International Biology Program [22] and bio-impedance scale.

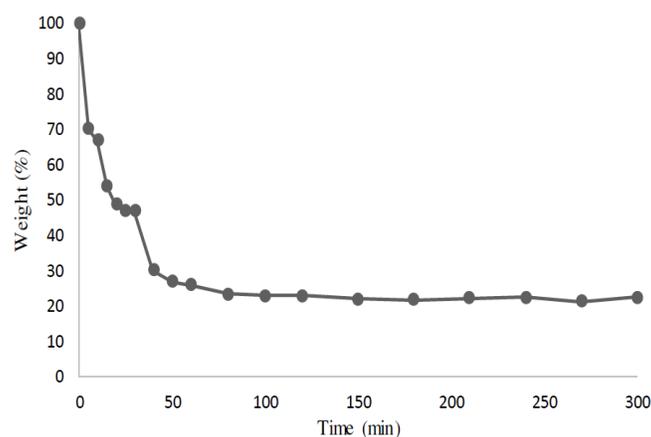
### Statistical analysis

Every experiment was realized per triplicate (except *in vivo* analyses) and expressed as mean values with the respective standard deviation. Statistical analyses were using paired Student's t-test on the intervention study. All statistics were based on a confidence level of 95%, and  $p < 0.05$  was considered statistically significant [23].

## RESULTS

### Proximate Composition

The water content of the açaí pulp of  $78.98\% \pm 0.11$  was obtained, which indicates that its solids are approximately 21%, a concentration that is higher than the commercial açaí pulp products marketed today. Some of which were analyzed in this study and yielded full contents of 14% solids. The drying curve showed that at 300 minutes, the pulp reached stability (Figure 1). The powder obtained from the size reduction of the açaí solids yielded a water content of  $8.46\% \pm 0.11$ . Acai powder (Table 1) is mainly composed of carbohydrates, similar to that reported in the literature [24-27].



**Figure 1:** Drying curve of açaí pulp at a temperature of  $45 \pm 1^\circ\text{C}$  during 300 minutes.

**Table 1: Proximate Composition of Dehydrated Açai on a Dry Basis**

Components	Contents per 100g
Ashes	2.23 ± 0.05
Protein*	9.23 ± 0.13
Fat	36.40 ± 0.48
Carbohydrates	52.13 ± 0.01
Energy	59.12 ± 0.01

Analyses were performed in triplicate, and the results are expressed on a dry weight basis as means ± standard deviations.

\*Conversion factor used to calculate protein content: N = 6.25.

Energy is expressed as KJ/ 100g.

### Microbiological Analysis

Analysis microbiological was carried out to know the quality and guarantee its safety to consumers. Table 2 shows the results of microbial counts of açai capsules. Obtained very low counts for fungi (yeast and molds), and for gram-negative bacteria tolerant to bile, the açai capsules had an absence of *Salmonella* and *E. coli*. These results indicate no failures during processing or lack of adherence to good manufacturing practices. There is no specific legislation for this type of product; however, it can compare with the United States Pharmacopeia and National Formulary. Açai is prone to microbiological contamination, mainly by molds, due to the lack of hygiene during harvesting and post-harvesting practices [28,29]. Molds and yeasts produce spores resistant to the process of dehydration and can grow in conditions of low humidity, representing a health risk due to the mycotoxins they produce [30].

### Total Polyphenols and Anthocyanin's

Total polyphenols content is presented in Table 3, expressed on a fresh weight basis for the açai powder and partially dry weight basis for the pulp, expressed at the same percentage of moisture in the powder for comparison purposes. There was a significant difference between pulp and powder's total polyphenols content. The powder was able to retain 21.6% of the total polyphenols initially contained in the pulp. Powder açai contains 46.4% of the anthocyanins initially contained in the raw material.

The açai pulp presented a total polyphenol content at around almost five (5) times higher than the powder. The pulp's total anthocyanin content was two (2) times higher than that of the powder. This result shows that the dehydration used affected the total content of the bioactive compounds. However, the values found for both samples are within or above the results reported in the literature. Others [31] indicate that an increase in temperature negatively influenced the capacity of Total phenolic content for açai pulp and açai seed from Belen, Brasil. [32] Reported for 56 different açai samples of the sale in the United States contain much less anthocyanin than what has reported in the literature for fresh or frozen açai. This study does not distinguish the more susceptible polyphenols to thermic processing neither the influence on antioxidant activity. Antioxidant capacity is concerned with the bioactive molecule's complex nature, thermal tolerance, and synergistic or antagonistic interactions between the mixes. Bioactive compounds depend on the season

**Table 2: Results of Microbiological Analysis on Dehydrated Açai Capsules**

Test	log CFU/g	Microbial Limit Requirements (cfu/g or mL)
Total aerobic microbial count	407	>10 <sup>5</sup>
Total combined yeasts and molds count	<10 Est.	>10 <sup>3</sup>
Bile-tolerant Gram-negative bacteria	<10 Est.	>10 <sup>3</sup>
<i>Salmonella spp.</i> in 10g	Absence	Absence
<i>E. coli</i> in 10g	Absence	Absence

**Table 3: Content of Total Polyphenols and Anthocyanins in Açai Pulp and Powder**

Sample	Total polyphenols mg GAE/100g	Total Anthocyanins mg C3GE/100g
Açai pulp (Partially dry weight)	4449.5 ± 159	2021.1 ± 82
Açai powder (Fresh weight)	962.7 ± 22.2	938.5 ± 19.1

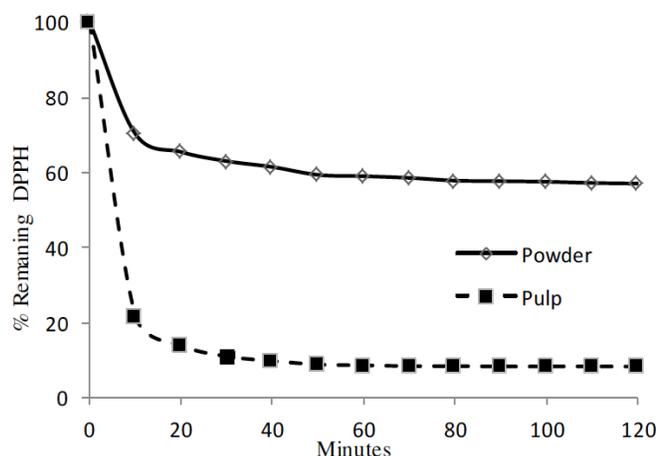
The results are expressed on a wet basis and on a partially dry basis at 8.46% moisture in mg/100g of sample. GAE = Gallic acid equivalents, C3GE = Cyanidine-3-glucoside equivalents.

and harvest areas, climatic conditions, maturity of the fruit, and storage conditions. In Venezuela, there are still few studies that have evaluated the açai fruit.

The anthocyanin's content was significantly different between açai pulp and powder. This reduction is probably due to the applied thermic processing. A significant decrease in anthocyanin's content maybe indicates a decrease in the antioxidant capacity of the powder. Others [33-40] have mentioned that the content of total polyphenols in the açai corresponds to approximately 96% of anthocyanins—the vast majority of this percentage represented by two specific anthocyanins, cyanidin-3-glucoside, and cyanidin-3-rutinoside. It was observed that the decrease of polyphenols is twice as much as the decrease in total anthocyanins. Maybe the polyphenols have a higher proportion of other thermolabile molecules that do not belong to the anthocyanin category. It could be that they exist other molecules that cause an overestimation in the measurement of polyphenols. Besides, the original polyphenols' original content is very different from the original content of anthocyanins, possibly attributed to extraction methods and accurate methods.

### Antioxidant Activity

The evolution of the antioxidant effect against time shown in Figure 2 indicates that after 30 minutes, reactions still have not stabilized; instead, they reach a plateau at 60 and 80 minutes, respectively. Açai powder in the constant state reaches a DPPH residual percentage of  $58.95 \pm 0.79$ , while the pulp in the same state presented a %RDPPH of  $8.334 \pm 0.05$ , meaning that there is the powder has a 14.13% of the original reduction power of the sample.



**Figure 2:** Evolution of the antioxidant effect of açai pulp and powder against time.

The antioxidant capacity of the dehydrated product decreased significantly. This makes it challenging to establish the linear relationship between the variables (total polyphenols, total anthocyanin's, antioxidant activity) and suggests that there may be complex (synergistic) interaction between the different reducing compounds in the mixture. Some researchers [41] suggest non-phenolic reducing compounds (carotenoids and ascorbic acid) detected by the Folin-Ciocalteu method. Glucose and fructose [42] present in fruits. Also reports of interactions of vitamin C < 0.1mg/100g in total phenols measurement [27,43]. If the amount of non-phenolic reducing compounds in the pulp is very high, this will be reflected in a very high antioxidant capacity because the DPPH test is also not very specific. Ascorbic acid is an unstable component [44], so at the end of the raw material processing, when its antioxidant activity is measured, there may be much interference.

### Stability Analysis of the Açai Capsules

The significant reduction of polyphenols, anthocyanins, and antioxidant capacity (Table 4) indicates that the bioactive components are sensitive to heat even in darkness and the absence of oxygen. The sample was hermetically packaged and placed in a chamber without light. So, the loss of bioactive components that occurred during the dehydration of açai pulp is mainly attributed to the thermolabile condition of these compounds (even at 37°C). The results indicate that it is preferable to keep the product stored under refrigerated conditions or frozen if possible.

### Anthropometric and Biochemical Markers

In the study, diet supplementation with açai capsules did not result in changes in weight, BMI, or WHR (Table 5). Because the participants' diets remained the same and therefore their total energy consumption did not change either because the dose and time of consumption of the product were too low to generate a significant change of this type. No significant change in blood glucose levels was observed at the end of the study. The measurement of blood glucose during fasting was used to detect any possible changes in the metabolic conditions of the participants. The oxidative stress increases insulin resistance and is, therefore, the underlying mechanism behind the risk of type 2 diabetes [45,46]. Supplementation with dehydrated açai did not cause significant changes in cholesterol.

**Table 4: Content of Bioactive Compounds and Antioxidant Capacity in the Dehydrated Açai Sample at 0 and 90 Days**

	0 days	90 days	% Losses
Total Polyphenols	962.7 ± 22.2 mg GAE/100g	577.4 ± 11.7 mg GAE/100g	40.02%
Total Anthocyanins	938.5 ± 19.1 mg C3GE/100g	341.1 ± 17.5 mg C3GE/100g	63.65%
VCEAC	14.07 ± 0.45 g VCE/100g	9.98 ± 0.679 g VCE/100g	29.05%
TEAC	643.63 ± 24.32 µmol TE/100g	477.35 ± 5.87 µmol TE/100g	25.83%

Results expressed as an average of 3 replicates ± standard deviation. AC = Antioxidant Capacity, GAE = Gallic Acid Equivalents, C3GE = Cyanidine-3-Glucoside Equivalents, VCE = Vitamin C Equivalents and TE = Trolox Equivalents.

**Table 5: Average Anthropometric Measurements of Volunteers at the Beginning and End of the Study, BMI Body Mass Index, WHR Waist to Hip Ratio, and Weight**

Index	Before	After	p
BMI (kg/m <sup>2</sup> )	23.69 ± 4.4	23.58 ± 4,4	0.170
WHR	0.878 ± 0.1	0.873 ± 0,1	0.136
Weight (kg)	63.94 ± 10.7	63.54 ± 11.2	0.117

Results expressed as the average of the values of all study participants ± standard deviation.

Low-density lipoprotein (LDL) cholesterol is considered to be atherogenic because LDL is damaged by oxygen-reactive species, or free radicals are absorbed by macrophages, which build upon the endothelial walls as fat spongiform cells during the initial stages of atherosclerotic. The lipid profile is generally used as a biological indicator of the risk of such a condition.

An increase in the antioxidant content should cause in the blood a decrease in LDL or an increase in HDL; however, the dose supplied by the diet with açai capsules did not generate any significant change in the concentration of LDL, HDL in the blood or the other cholesterol-related indicators (Table 6).

It cannot be argued that the lack of change is since the bioactive compounds in the fruit are not capable of

generating such a change. There is evidence that a diet supplemented with açai generates the expected changes in the lipid profile in populations of rats [8], rabbits [9], and humans [10]. However, in some studies, it was also observed that there was no change in anthropometric parameters or blood biochemistry. However, in some studies, it was also observed that there was no change in anthropometric parameters or blood biochemistry [11]. Another difference is that the studies mentioned above-used açai pulp preserved by freezing or dehydrated by lyophilization, which guarantees high conservation of the original polyphenol content in the sample.

Another possible explanation for the lack of changes is that the loss of polyphenol content by the heat treatment was not generated a sufficient increase in the blood to generate a decrease in LDL with the

**Table 6: Average Blood Glycemia Values and Lipid Indicators of Oxidative Stress in Volunteers at the Beginning and End of the Study**

Index	Before	After	p
Glycemia mg/dL	92.2 ± 7.3	92.4 ± 9.8	0.478
Cholesterol mg/dL	175.7 ± 58.5	179.1 ± 55.1	0.295
Triglycerides mg/dL	97.6 ± 47.7	87.7 ± 35.7	0.118
HDL mg/dL	42.7 ± 15.4	42.1 ± 16	0.372
LDL mg/dL	113.48 ± 57.6	119.46 ± 50.8	0.175
8-Isoprostane (pg/mL)	159 ± 48.7	91.6 ± 29.9	2.17*10 <sup>-4</sup>

Results expressed as the average of the values of all study participants ± standard deviation.

dose supplied. Possibly the dose given was very low, as studies have shown that a significant amount of polyphenols remains in the dehydrated product and that these have a remaining antioxidant capacity. Therefore, increasing the dose several times may result in a change in the lipid profile. However, the consumption of more than one capsule per meal is likely to result in low acceptability to a potential consumer. It is also possible that the consumption of the dehydrated product may lead to changes in biomarkers that may only be observed after long-term consumption.

Udani *et al.* [10] used an overweight population whose BMI, WHR, glycemia, and lipid profile values were very high. This population has a condition it is susceptible to the consumption of substances rich in polyphenols. Pala *et al.* made studies [11] by up of healthy women with standard metabolic indicators. Therefore, this population was probably not as sensitive to the consumption of polyphenols, and for this reason, no changes could see in most biological indicators. This study aimed to use a population composed of older individuals over the age of 32 to ensure a certain amount of oxidative stress injuries resulting from the aging process in humans. However, when analyzing the anthropometric and metabolic indicators of the population, it turns out that most of these have standard values, which is why when executing the intervention study, we find results similar to those of [11].

Of all the biomarkers used in the study, 8-isoprostane was the only one in which a significant change was detected, indicating that the product significantly reduced lipid peroxidation in the population analyzed. Lipid peroxidation is the reaction between free radicals and polyunsaturated fatty acids generating lipid peroxides. Fatty acids under free radical attack become a lipid radical with allylic double bonds. These double bonds can combine with oxygen to produce lipid peroxy radicals and ultimately lipid peroxides that usually decompose to form aldehydes (e.g., malonaldehyde) which can cross-link or change the structures of proteins, lipids, carbohydrates, and DNA, ultimately harming an organism in another word, these by-products are themselves, toxic [47].

As these injuries accumulate in the body, over time, they can develop into the following conditions: diabetes mellitus, atherosclerosis, rheumatoid arthritis, ischemia-reperfusion [48], hemolytic anemias, and pulmonary dysfunction [49]. However, it has been

suggested that only when lipid peroxidation takes place in uncontrolled free radical chain reactions that overwhelm antioxidant cell protection does lipid peroxidation cause cell damage [49].

Another negative characteristic of lipid peroxides is that they are more hydrophilic than normal unsaturated fatty acids, altering their ability to transfer metabolites through the cell membrane selectively. As a result, excess water may enter the cell, and inflammation may occur, triggering more  $O_2^-$  release, thus contributing to a positive feedback system that facilitates or propagates lipid peroxidation reactions and produces more aldehydes, moving the cell towards destruction [47].

The fact that lipid peroxidation can be decreased by açai powder (possibly due to its antioxidant content) can translate into a lesser amount of cell damage and interference of the positive feedback system that leads to increased oxidative stress. In short, it could significantly decrease the likelihood of suffering any of the conditions mentioned above.

## CONCLUSION

Acai pulp and powder is a natural alternative for the consumption of bioactive compounds necessary in human nutrition and that are useful in maintaining many functions. In the intervention study, no significant differences were observed between before and after the different biochemical markers with the exception of 8-isoprostane, suggesting that the consumption of dehydrated açai produces beneficial effects in the analyzed population.

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