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Effects of açaí consumption on human health: a systematic review

Efeitos do consumo de açaí para a saúde humana: uma revisão sistemática

Efectos del consumo de açaí sobre la salud humana: una revisión sistemática

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ABSTRACT

Objective: To systematically analyze the evidence on the effects of açaí consumption on human health. **Method:** This systematic review followed the PRISMA 2020 guidelines, adopting the PICO framework for eligibility criteria. Studies published between January 2014 and January 2024 in English, Portuguese, or Spanish were included. The search was conducted in the BVS, PubMed, Cochrane Library, and Embase databases, using standardized descriptors: açaí, health, child, adolescent, adult, and elderly. The initial selection was conducted using the Rayyan app, with a double-blind review by two researchers, and conflicts were resolved by a third reviewer. Studies involving humans, including clinical trials and observational studies, were included, while research involving animals or invalid methodologies was excluded. Methodological quality was assessed using the Newcastle-Ottawa scale, and its classification as good, fair, or poor, based on selection, comparability, and exposure criteria. The study was registered in PROSPERO, CRD42024512937. **Results:** 75 studies were identified, of which 12 met the inclusion criteria. Eight studies evaluated cardiovascular function, with two observing benefits. Six of the eight studies on lipid profile and adiposity found benefits in anthropometric and inflammatory parameters. Six of the seven studies on antioxidant effects observed a reduction in free radicals. Five of the six studies on inflammatory mediators reported improvement, but none of the six studies on glycemic profile found benefits. **Conclusion:** Açaí consumption has shown benefits to human health with no reported contraindications, but studies are heterogeneous. More studies with representative samples and standardized interventions are needed to evaluate the benefits.

Descriptors: Euterpe oleracea; Health; Adolescent; Adult; Elderly.

RESUMO

Objetivo: *Analisar sistematicamente as evidências dos efeitos do consumo do açaí para a saúde humana.* ***Método:*** *Esta revisão sistemática seguiu as diretrizes PRISMA 2020, adotando a estrutura PICO para critérios de elegibilidade. Foram incluídos estudos publicados, entre janeiro de 2014 e janeiro de 2024, em inglês, português ou espanhol. A busca ocorreu nas*

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bases BVS, PubMed, Cochrane Library e Embase, utilizando os descritores padronizados: açaí, saúde, criança, adolescente, adulto e idoso. A seleção inicial foi feita no aplicativo Rayyan, com revisão duplo-cega por dois pesquisadores e resolução de conflitos por um terceiro. Estudos em humanos, incluindo ensaios clínicos e observacionais, foram incluídos, excluindo-se pesquisas com animais ou com metodologia inválida. A qualidade metodológica foi avaliada pela escala Newcastle-Ottawa, com classificação em boa, razoável ou ruim, considerando critérios de seleção, comparabilidade e exposição. O estudo foi registrado no PROSPERO, CRD42024512937. ***Resultados:*** *Identificaram-se 75 estudos, dos quais 12 atenderam aos critérios de inclusão. Oito estudos avaliaram a função cardiovascular, com dois observando os benefícios. Seis, dos oito estudos sobre perfil lipídico e adiposidade, encontraram benefícios nos parâmetros antropométricos e inflamatórios. Seis, dos sete estudos sobre efeito antioxidante, observaram redução de radicais livres. Cinco, dos seis estudos sobre mediadores inflamatórios, relataram melhora, mas nenhum dos seis estudos sobre perfil glicêmico encontrou benefícios.* ***Conclusão:*** *O consumo de açaí mostrou benefícios à saúde humana sem contraindicações relatadas. No entanto, os estudos são heterogêneos, sendo necessário mais estudos com amostras representativas e intervenções padronizadas para uma melhor avaliação de tais benefícios.*

Descritores: *Euterpe; Saúde; Adolescente; Adulto; Idoso.*

RESUMEN

Objetivo: *Analizar sistemáticamente la evidencia sobre los efectos del consumo de açaí en la salud humana.* ***Método:*** *Esta revisión sistemática siguió las directrices PRISMA 2020, adoptando la estructura PICO para definir los criterios de elegibilidad. Se incluyeron estudios publicados entre enero de 2014 y enero de 2024, en inglés, portugués o español. La búsqueda se realizó en las bases de datos BVS, PubMed, Cochrane Library y Embase, utilizando los descriptores estandarizados: açaí, salud, niño, adolescente, adulto y anciano. La selección inicial de estudios se llevó a cabo en la aplicación Rayyan, con revisión doble ciego por dos investigadores y resolución de discrepancias por un tercero. Se incluyeron estudios en humanos, tanto ensayos clínicos como estudios observacionales, excluyéndose investigaciones en animales o con metodología no válida. La calidad metodológica fue evaluada mediante la escala de Newcastle-Ottawa, clasificando los estudios como de buena, razonable o baja calidad, según criterios de selección, comparabilidad y exposición. El estudio fue registrado en PROSPERO, CRD42024512937.* ***Resultados:*** *Se identificaron 75 estudios, de los cuales 12 cumplieron los criterios de inclusión. Ocho estudios evaluaron la función cardiovascular, observándose beneficios en dos de ellos. De los ocho estudios que investigaron el perfil lipídico y la adiposidad, seis reportaron mejoras en parámetros antropométricos e inflamatorios. De los siete estudios que enfocaron el efecto antioxidante, seis observaron una reducción en los radicales libres. Cinco de los seis estudios sobre mediadores inflamatorios reportaron mejoras; sin embargo, ninguno de los seis estudios que evaluaron el perfil glucémico encontró beneficios significativos.* ***Conclusión:*** *El consumo de açaí demostró efectos beneficiosos para la salud humana, sin contraindicaciones reportadas. No obstante, debido a la heterogeneidad de los estudios, se requieren investigaciones adicionales con muestras representativas e intervenciones estandarizadas para una evaluación más precisa de dichos beneficios.*

Descriptores: *Euterpe; Salud; Adolescente; Adulto; Anciano.*

INTRODUCTION

Açaí (Euterpe oleracea) is one of the most popular foods in the Amazon region, being a fruit of the native palm tree[1]. With a form of ingestion that covers multiple formats - such as juice, pulp, ice cream, smoothies, jelly, syrup[2] - in addition to its great added nutritional value, recent studies consider açaí to be a functional food, i.e. it can affect one or more target functions in the body beneficially, reduce the risk of disease and provide health maintenance[3-5].

Several studies have highlighted that the properties present in açaí are responsible for its beneficial effects on health, since it is a food rich in polyphenols and contains significant amounts of anthocyanins, a substance that belongs to the flavonoid group[4-6]. Anthocyanins act to modulate lipid metabolism and also have anti-inflammatory properties, which reduce the oxidative stress caused by chronic diseases and consequently their damage to the body[6].

As a functional food, açaí has the potential to be used as a nutritional tool for health promotion and has received increasing attention as a strategy to mitigate the impact of chronic non-communicable diseases, including obesity, type 2 diabetes, hypertension, and cardiovascular diseases[4,6-8]. These conditions represent global challenges, generating high costs for health systems and reducing the population's quality of life[5,9].

When it comes to improving blood glucose and blood pressure levels, açaí could be responsible for controlling these pathologies, since its intake has the potential to decrease low-density lipoprotein (LDL) levels and increase high-density lipoprotein (HDL) levels, which could lead to important benefits for individuals and public health, such as preventing and controlling the effects of metabolic syndrome and preventing cardiovascular effects[7].

Thus, considering the nutritional action of açaí, its widespread consumption in vulnerable regions throughout Brazil, and its potential role as an ally in health promotion, this study aims to systematically analyse the evidence on the effects of açaí consumption on human health.

METHOD

This systematic review, which followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, was presented to help systematic review reviewers report in a transparent and standardised way on the review production process[10].

Database searches were carried out in the VHL, PubMed, Cochrane Central Register of Controlled Trials, and Embase. The descriptors used were those contained in their respective controlled vocabularies, DeCS (Health Science Descriptor), MeSH (Medical Subject Headings), and Emtree, with all related variations: açaí, health, child, adolescent, adult, and elderly. Alternative terms were grouped using the Boolean operator OR, and different terms were grouped using the Boolean operator AND.

The articles selected by the search strategy were combined with the Rayyan web application for duplicate removal and the first selection stage. The first selection stage consisted of the title and abstract being read by two researchers, with the double-blind option active, and any conflicts being resolved by a third researcher. Finally, the articles considered eligible were thoroughly analysed when fully available to confirm that they met the inclusion criteria.

Clinical trials, cohort studies, case reports and observational studies investigating the relationship between the consumption of açaí in various forms (juice, pulp, supplements, extracts and other derivatives) and human health were included, including studies on its physiological effects, health benefits or possible risks, published between January 2014 and January 2024, in English, Portuguese or Spanish. The population of interest in this study was individuals of all genders and health conditions. Studies were excluded if they were carried out on animals, or if they did not focus directly on the relationship between açaí consumption and human health, or if their methodology jeopardised the validity of the results, or if they were not available in their entirety.

Following the PRISMA guidelines, the strategy presented in Table I was used to formulate the base of eligibility criteria pre-specified by the PICO framework (participants, intervention, comparability, results).

Table I. PICO strategy used to draw up the guiding question and inclusion and exclusion criteria. Belém, Pará, Brazil. 2024.

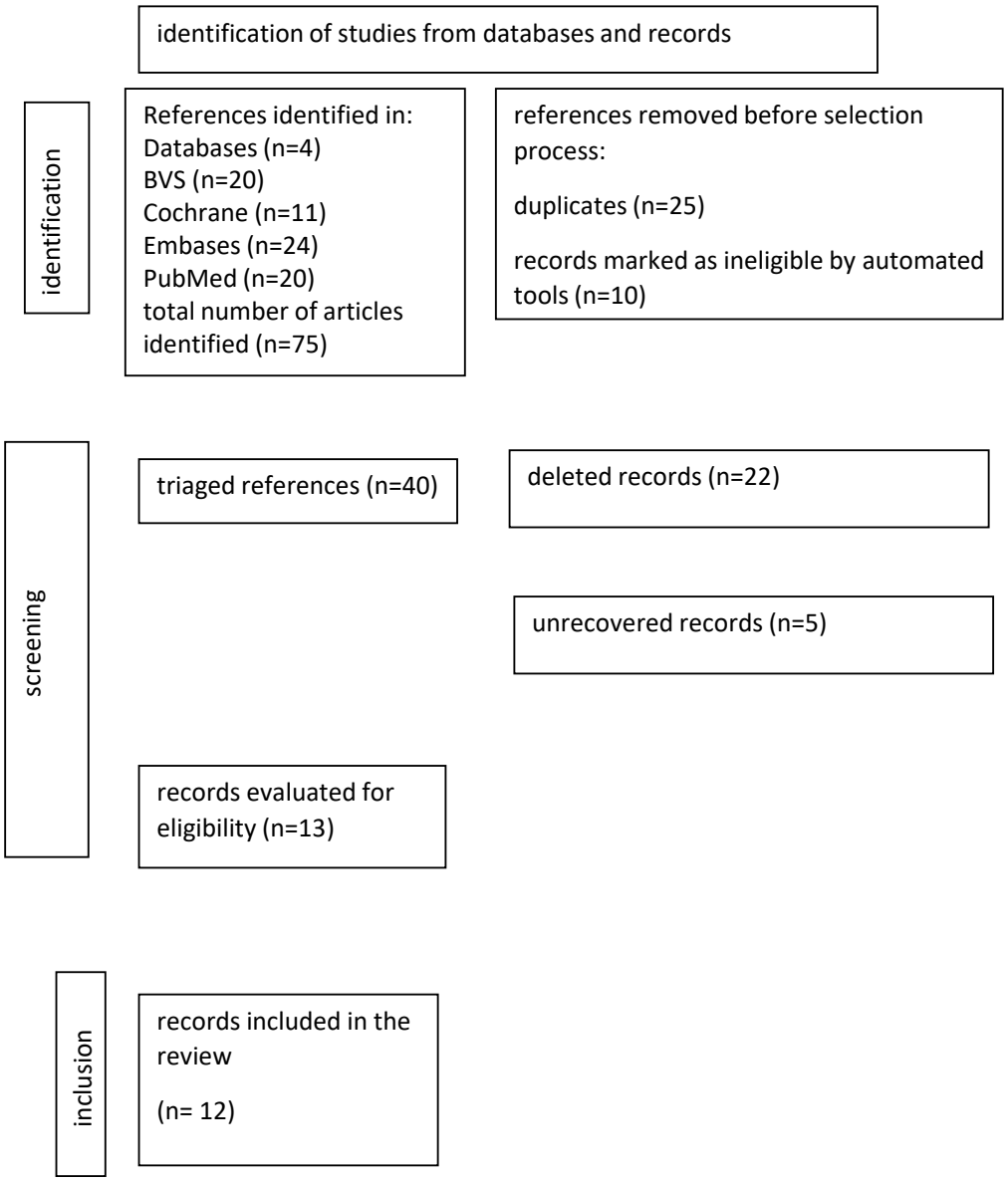
Population	Human beings of any gender and any health condition
Intervention	Regular consumption of açaí, whether in the form of fresh fruit, juices, supplements, or other derived products.
Comparison	Groups that do not consume açaí or the same group evaluated without consumption, and after consumption.
Results	Beneficial or harmful changes due to açaí consumption.

Source: Authors.

This study aims to answer the following question: What are the repercussions of açaí consumption on human health?

The search strategy used identified 75 studies with the potential to be selected. With the use of the publication period filter in each database, in which the studies had to be between January 2014 and January 2024, 65 studies remained; also, with the removal of duplicates, 40 publications remained. A screening by reading titles and abstracts to identify fulfillment of the eligibility criteria led to a provisional selection of 18 publications. Of these, five articles could not be retrieved because they were not fully available free of charge, and one was an animal study. After thoroughly analysing the articles, 12 studies met the inclusion criteria and discussed the health effects of regular açaí consumption in humans. A summary of this process is shown in the PRISMA flowchart in Figure 1.

Figure 1. Flowchart of the process for identifying, screening, and including studies.



Source: Authors. Model adapted from the PRISMA flowchart.

The Newcastle-Ottawa Scale (NOS) was used to assess the methodological quality of primary studies. This instrument awards up to 9 stars, based on three main criteria: selection of participants (maximum of 4 stars), comparability (maximum of 2 stars), and exposure (for prospective or cross-sectional studies) or outcome, for case-control studies (maximum of 3 stars)[11].

The methodological classification adopted followed three categories: good, reasonable, and poor, as recommended by a previous study[12]. Studies classified as being of 'good' methodological quality should receive 3-4 stars for selection, 1-2 for comparability, and 2-3 for exposure. The 'reasonable' category requires 2 stars for selection, 1-2 for comparability, and 2-3 for exposure. On the other hand, 'poor' methodological quality applies to studies with a maximum of 1 star in selection, none in comparability, and up to 1 star in exposure[12].

RESULTS

The data extracted from each of the 12 primary studies, obtained through the search strategy, were synthesised and are presented in Chart I.

Chart 1: Distribution of the studies included in the systematic review, according to author, year of publication, study design, sample data, objective, interventions and positive outcome. Belém, Pará, Brazil. (2014-2024).

Author/ Year	Study design	Sample size, age group, gender and health status	Study objective	Intervention and form of consumption	Positive outcome
Alqurashi et al. (2016)[13]	Randomized, double-blind clinical trial	n=23; 60-65 years old; male; healthy, but with BMI between 25-30kg/m².	To investigate the effect of açaí consumption on acute changes in vascular function and other markers of disease risk.	200g smoothie (açaí with banana), in the morning.	Clinically significant improvements in vascular function in overweight individuals.
Aranha et al. (2019)[14]	Randomized clinical trial	n=69; 20-59 years; both sexes; with BMI≥25 kg/m² and at least one alteration in the lipid profile.	To evaluate the effects of a hypoenergetic diet associated with the consumption of açaí on oxidative and antioxidant stress and inflammatory biomarkers in dyslipidemic and overweight individuals.	200 g/day of açaí pulp for 60 days at breakfast.	Reduction of oxidative stress and improvement in the inflammatory state in overweight and dyslipidemic individuals.
Barbosa et al. 2015[15]	Nutritional intervention study	n=35; 18-35 years; female; BMI between 18.5 and 29.9 kg/m².	To evaluate the effect of açaí pulp in preventing oxidative damage by measuring the antioxidant activity of enzymes and biomarkers of protein oxidation in women.	200 g/day of açaí pulp for 4 weeks.	Antioxidant benefit of dietary acai for healthy women.
Oppitz et al. (2021) [16]	Randomized clinical trial	n=30; >18 years; both sexes; affected by chronic tinnitus and some degree of anxiety.	To investigate the effects of antioxidant supplementation with açaí extract on the discomfort caused by chronic tinnitus and the relationship with anxiety levels and oxidative metabolism.	100mg/capsule of dry açaí extract, once a day, for 3 months.	Reduction in the perception and discomfort of tinnitus.
Liz et al. (2020)[17]	Single-blind randomized crossover study	n=30; 19-59 years; both sexes; BMI between 18.5 and 24.9 kg/m².	To evaluate the effects of moderate intake of açaí and juçara juice during fasting on glucose levels, lipid profile and biomarkers of oxidative stress in healthy individuals.	200 mL/day of juçara or açaí juice for 4 weeks, with a 4-week break.	Improvement in HDL-c levels and antioxidant enzyme activities, which can contribute to cardiovascular health.
Pala et al. (2017)[18]	Prospective study	n=40; 18-35 years; female; healthy, but with BMI between 18.5 and 30 kg/m², without change in body weight > 10% and other parameters.	Importance of evaluating açaí as a functional food.	200 g/day of açaí pulp for 4 weeks.	Improvement in redox metabolism and lipid transfers to HDL.
Pereira et al. (2015)[19]	Case-control study	n=40; 18-35 years; female; PARA<135x85 mmHg, body weight changes below 10%, and fasting blood glucose <100mg/dL	To evaluate the effect of açaí pulp consumption on inflammatory markers, anthropometric measurements, body composition, biochemical and dietary parameters in healthy women.	200g/day of açaí pulp for 4 weeks.	Increased insulin sensitivity in overweight women; reduced PAI-1 in overweight women; improved redistribution of body fat in the eutrophic group; reduced subcutaneous body fat in the eutrophic group; decreased BP in the overweight group.
Santamarina et al. (2019)[20]	Double-blind randomized clinical trial	n=27; 31-59 years; both sexes; BMI between 30 and 39.9 kg/m²	To investigate the effect of juçara pulp ingestion on the inflammatory state of monocytes in obese individuals.	5 g of juçara pulp freeze-dried for 6 weeks.	Combats the pro-inflammatory state of obesity.
Silva; et al. (2020)[21]	Cross-sectional, retrospective, and analytical study	n=150; 12-80 years; female; 20 were diabetic, 10 had heart disease, 34 had high blood pressure, 2 had previously had cancer.	To analyze the relationship between açaí consumption and the presence of chronic diseases in women living in the rural area of São Luís, Maranhão.	Different consumption numbers per week of açaí juice, pulp, and ice cream.	The study showed a tendency for açaí to reduce diabetes and hypertension in women.

Sousa et al. (2018)[22]	Prospective, self-controlled study	n=31; 18-35 years; female; healthy.	To evaluate the effect of açaí pulp consumption on biochemical, anthropometric, and dietary variables related to food intake in normal weight and overweight women.	200g of açaí pulp, for 4 weeks.	Increased ACTH concentration, reduced PYY and leptin in the eutrophic group; increased ACTH, α-MSH and NT, and reduced WC and ICQ in the overweight group; reduced average caloric intake of both groups after the intervention; improved body composition of overweight women.
Gale et al. (2014)[23]	Randomized, double-blind, placebo-controlled clinical trial	n=18; >18 years; both sexes; healthy	To evaluate the hemodynamic and electrocardiographic conditions of the effects of açaí in a healthy volunteer population.	500mg gel capsule only once.	No benefit.
Jamar et al. (2017)[24]	Randomized pilot study	n=36; 31-59 years; both sexes; overweight or obese	Analyze the effects of juçara supplementation on body composition, metabolic parameters and inflammatory processes.	50g of açaí pulp for 6 weeks.	Increased adiponectin and lean mass; reduced body fat.

The results of the methodological quality assessment using the NOS scale are shown in Table II. The classification adopted was good, reasonable, and poor[12]. Based on this classification, six studies were considered good. Of these, one achieved the maximum score of 9/9, three were considered reasonable, and three were poor.

Table II. Assessment of the methodological quality of studies using the Newcastle-Ottawa Scale (NOS). Belém, Pará, Brazil. 2024

Study	Selection				Comparability		Exhibition			Result
	1	2	3	4	1	2	1	2	3	9/9
Alqurashi et al. (2016)[13]	★	★	★	★	★	★	★	★	★	9/9
Aranha et al. (2019)[14]	-	★	-	★	★	★	★	★	★	7/9
Barbosa et al. (2015)[15]	-	★	-	-	★	-	★	★	★	5/9
Oppitz et al. (2021)[16]	-	★	★	★	★	★	★	★	★	8/9
Liz et al. (2020)[17]	-	★	-	-	★	-	★	★	★	5/9
Pala et al. (2017)[18]	-	-	★	★	★	-	★	★	★	7/9
Pereira et al. (2015)[19]	-	★	★	★	★	★	-	★	★	7/9
Santamarina et al. (2019)[20]	-	★	★	★	★	-	★	★	★	7/9
Silva; et al. (2020)[21]	-	-	★	★	★	★	-	★	★	6/9
Sousa et al., 2018[22]	-	-	★	★	★	★	-	★	★	6/9
Gale; Kaur; Baker (2014)[23]	★	★		★	★	★	★	-	★	8/9
Jamar et al. (2017)[24]	★	★	★	★	★	★	★	-	-	7/9

Caption: Scores on the specific item (★), does not score on the specific item (-).
Source: Authors themselves.

Of the articles selected, eight looked at aspects related to the cardiovascular system[13-15,18,19,21-23]. One randomised clinical trial[13], which used the ALT Ultrasound HDI-15000 system (ATL Ultrasound), combined with a semi-automated computerised analysis system (Brachial Analyzer; Medical Imaging Forms), had FMD (Flow-Mediated Dilation) of the brachial artery as the study's primary outcome measure. In this study, despite the short-term acute intervention, it was observed that there was an improvement in vascular function. In addition, of the eight studies that analysed blood pressure, six did not obtain a significant change in BP[14,15,18,21-23] and two observed a reduction in BP[13,23], while one showed a reduction in standing systolic blood pressure (SBP)[23]. The studies reported different ways of measuring blood pressure, such as the average measurement being taken three times with the OMRON-M6 device (HEM-7211-E8), using a questionnaire[21], following the protocol recommended by the Brazilian Society of Cardiology in 2016[22]. One of the studies does not report how the measurement was carried out[23], while others used the auscultatory method[14], the average of three alternating measurements using the OMRON 795 CP oscillometric device[15], and the measurement of blood pressure three times[18] and using the OMRON® pressure device (model HEM-705CP) [19].

Finally, in these studies, blood pressure was measured more than once, but no significant changes were obtained. In addition, the samples in these studies were small.

Of the studies selected, eight addressed the impact of açaí consumption on lipid metabolism and adiposity[13,14,17-20,22,24]. In addition, six identified benefits such as an improvement in LDL concentrations and modulation of the inflammatory response[13]; an increase in apolipoprotein A1, the main protein component of HDL, and greater transfer of lipids to HDL, which is essential for its metabolism[18]; an increase in HDL levels[17]; and positive effects on anthropometric, biochemical, inflammatory and dietary parameters through the beneficial action of açaí pulp intake. The latter include an increase in insulin sensitivity in overweight women, a reduction and redistribution of body fat, especially in the trunk region; a possible increase in intramuscular and visceral fat, as well as a reduction in subcutaneous fat[19]; inflammatory modulation in obesity[20]; regulation of endocrine biomarkers involved in food intake control and an improvement in the body composition of overweight women[22]; as well as an increase in adiponectin, an increase in lean mass and a reduction in body fat[24]. However, two studies identified no additional effects on anthropometric measurements, blood pressure, and lipid profile[14,15], and another study found no significant changes in total cholesterol, LDL, and HDL levels[18].

The antioxidant effects of açaí were evaluated in seven of the 12 studies selected for this systematic review[13-19]. Of these seven studies, only one[19] did not show a significant reduction in free radicals after intervention with açaí. A double-blind randomised clinical trial[13] used biomarkers to signal that its patients experienced improvements in antioxidant capacity after the intervention, as did another study that also used this same method to achieve its study objective([14]). A nutritional intervention study showed that açaí intake increased catalase activity and the body's total antioxidant capacity (TAC) and, as a consequence, reduced the production of reactive oxygen species (ROS). A reduction in the serum concentration of carbonyl proteins and an increase in total serum sulphydryl groups were also observed[15]. Another study which also observed changes in TAC was the prospective study which demonstrated in its analysis that the reactive oxygen species produced by neutrophils decreased by 21% after consuming açaí and TAC levels increased after ingesting açaí, thus suggesting that the fruit has the ability to promote a general improvement in oxidative status[18]. Two randomised clinical trials have shown that the reduction in free radicals, due to the antioxidant effect of açaí, contributed significantly to disease prevention[16,17]. However, a case-control study with a sample of 40 participants found no difference in TAC before and after the açaí intervention[19].

Another study that reported on the importance of the antioxidant effect of açaí was a prospective article that did not directly analyse the antioxidant effects using biochemical markers. However, the author recognised the antioxidant effect of açaí in his research[21].

Of the articles selected, six analysed the effect of açaí consumption concerning inflammatory mediators[14,17,19,20,22,24]. Of these, the double-blind randomised clinical trial with dyslipidemic and overweight individuals showed a significant decrease in plasma IL-6 levels in the group that consumed açaí, while IFN-γ levels decreased in both the control and experimental groups[14]. From this perspective, a single-blind randomised clinical trial found that açaí and juçara juice have a high content of bioactive compounds, such as anthocyanins (ACNs), which have a potential anti-inflammatory effect[17]. Another double-blind randomised clinical trial with obese people showed a reduction in TLR4 and IL-6, and an increase in IL-10 in the experimental group. In addition, a reduction in MYD88 expression was observed in the group that consumed juçara compared to the placebo. There was also a reduction in pIKKα/β and higher levels of Ob-R protein in the juçara group post-treatment compared to pre-treatment. In the juçara group with LPS, there was a reduction in the production of IL-6, TNF-α, and MCP-1 by monocytes, as well as an increase in IL-10, compared to pre-treatment and compared to the juçara group without LPS[20].

A case-control study observed that, for women, the effect of the intervention (consumption of 200g of açaí) in a free-living context over four weeks showed only a change in the increase in PAI-1 in the overweight and normal weight volunteers, as well as a change in EGF and PAI-1 in the overweight group[19]. On the other hand, a prospective study of overweight and normal-weight women revealed that there was no difference in the profile of inflammatory markers between the groups evaluated[22]. A randomised, double-blind pilot study with overweight or obese individuals evaluated the inflammatory profile, checking the levels of PAI-1 and adiponectins. The group that used juçara had a significant increase in adiponectin (0.95 µg/mL, $p = 0.01$), but PAI-1 levels showed no significant changes[24].

The double-blind randomised clinical trial with dyslipidemic and overweight individuals showed no differences in glucose levels[14]. A single-blind randomised crossover study with the consumption of açaí or juçara juice showed that the intake of açaí juice for four weeks raised glucose levels by 7.3%, while juçara juice had no effect[17]. A randomised double-blind pilot study with overweight or obese individuals found no differences in glucose levels between the group that used juçara and the group that didn't[24]. A prospective four-week study of 40 women found that the consumption of 200g of açaí pulp did not alter glucose and insulin levels in the volunteers, but the concentration of

APO-I in blood plasma increased after the consumption of açaí, and also showed an increase of approximately 23% in the volunteers' daily fibre intake[18]. A double-blind clinical trial of overweight men showed no significant changes in glucose levels between those who took açaí smoothie and those who took placebo, but it is worth mentioning that the experimental group had its first postprandial insulin peak and a higher incremental area under the curve for insulin (iAUC) than the placebo group[13]. Finally, a nutritional intervention study in women was presented, with no changes in glucose or insulin levels [15].

DISCUSSION

The studies analysed suggest that the consumption of açaí may be associated with cardiovascular benefits, demonstrating its potential to contribute to promoting the health of this system.

A randomised clinical trial revealed a possible improvement in vascular function[13], suggesting that the presence of polyphenols in açaí could be responsible for this effect. The cardioprotective effect of açaí is described in the literature[7], but other compounds may have caused this effect, since the mechanism by which phenolic compounds improve endothelial function is not completely clear. It's worth pointing out that this improvement may be related to its antioxidant action, which is well described in the literature[25]. Furthermore, as the study was carried out using an acute, short-term intervention[13], it is not possible to say whether this result will be maintained in the long term or whether there will be physiological adaptations that would compensate for the benefits reported in this short-term study.

Concerning blood pressure, six studies found no significant changes in the population that consumed açaí. However, two studies identified a positive influence for consumption[21,23], with a higher prevalence of hypertension in the population that did not consume açaí[21], as well as a reduction in standing systolic blood pressure (SBP) due to the açaí intervention. The reduction in blood pressure due to the açaí intervention has also been recognised in other literature[26,27].

Thus, even though no studies included in this review have reported side effects and some have reported possible benefits of açaí consumption for cardiovascular health, it is not possible to generalise these results due to the heterogeneity of the samples, the lack of standardisation in the studies and in the ways of measuring BP, as well as the small number of samples. However, despite these factors, and due to the high consumption of this food, especially by low-income populations in various regions of Brazil, açaí can become an ally in promoting cardiovascular health, which highlights the need for future research to understand the cardioprotective effect of açaí, as well as to strengthen the findings of this study, since this type of study is not commonly carried out in humans.

In addition, the effect of açaí consumption on lipid metabolism and adiposity was analysed, as it is known that this is a global pathology, which leads to an increase in pro-inflammatory substances and the genesis and worsening of various diseases, such as cardiovascular, metabolic, respiratory, osteoarticular and neurological diseases, among others[28].

Of the eight studies that analysed this parameter, it was possible to identify improvements in LDL concentrations, as well as a modulation of the inflammatory response, resulting in a reduction in cardiovascular risk and regulation of the immune system[13]. Similar results are found in the literature associating açaí consumption with a reduction in cardiovascular risk, although the heterogeneity of the studies and the need for more work on the topic are always emphasised[29].

Despite these positive results, one of the studies did not observe any changes in anthropometric measurements, blood pressure, or lipid profile during the intervention period[14]. This lack of impact may indicate that factors other than açaí consumption may influence these parameters or that the duration of the intervention may not have been sufficient to observe significant changes.

Although two studies found no significant changes in total cholesterol, LDL, and HDL levels[15,18], one study identified an increase in HDL concentrations in patients who consumed juçara juice regularly[17]. In addition, another study identified changes in anthropometric and biochemical parameters following açaí consumption, including an increase in insulin sensitivity and redistribution of body fat, especially in overweight women[19].

Inflammatory modulation, endocrine regulation[20,22], and the potential of açaí as a tool to tackle obesity and its metabolic complications were not uncommon factors in the literature researched for this study[7,15,18,19].

One study identified a significant increase in adiponectin levels and fat-free mass, along with a reduction in body fat after supplementation with açaí pulp[24]. These results suggest a potential positive effect of açaí on body composition and lipid metabolism, corroborated by other studies[7,15,18,19].

Therefore, more studies on the impact of açaí consumption on improving lipid profile and adiposity need to be

carried out. This food clearly has the potential to be used as a nutritional and therapeutic strategy to help combat obesity and, consequently, prevent the onset and worsening of various diseases, which could make açaí an ideal food for maintaining the health of the population.

Among the selected studies, we highlight seven that reported the antioxidant effects of açaí on the human body[13-19]. The articles were thoroughly analysed to contribute to a broad and integrated view of the subject, which considers the impact of consuming functional foods on promoting health and preventing diseases related to oxidative stress.

A randomized clinical trial showed that oxidative stress contributes to several pathologies such as dyslipidemia, hypertension, insulin resistance, and type II diabetes mellitus. Acai, therefore, appears to be an important factor that contributes to the reduction of free radicals with its antioxidant effect[14]. Similar results were corroborated by other clinical trials, which emphasized the fact that the fruit is rich in polyphenols, with the ability to eliminate free radicals from the body [13–16].

A nutritional intervention study was conducted with 35 women, aged 18 to 35, intending to demonstrate that açaí has a beneficial effect in preventing oxidative damage. The research demonstrated that regular consumption of the pulp increased catalase activity and total antioxidant capacity, decreasing the production of reactive oxygen species and serum concentration of carbonyl proteins, in addition to increasing total serum sulfhydryl groups[15]. Two other studies contribute to these findings by highlighting, in particular, the positive effects of regular consumption of açaí on plasma antioxidant capacity levels (TAC)[17,18].

However, a case-control study did not observe changes in the oxidative parameters of the participants in their research, which is due to several reasons, including the lack of control over the diet of their volunteers [19]. This variability demonstrates the importance of well-designed studies to control external factors that may influence the results[30].

The uniformity in the results between the studies is remarkable, demonstrating a convergence to the possible benefits of açaí consumption for the reduction of free radicals. Almost all of the articles analyzed demonstrated a significant improvement in the biochemical parameters related to the consumption of açaí. Only one study did not observe any change in oxidative parameters after the intervention, however, the author emphasized that this may, possibly be due to the volunteers consuming foods rich in other antioxidants, replacing the antioxidant effect of the anthocyanins in açaí[19].

The findings of these studies corroborate existing evidence, highlighting the antioxidant effects of açaí on health, as well as the potential of the fruit as a relevant resource in guiding dietary practices for health promotion and prevention of chronic diseases associated with oxidative stress[7,30].

Of the articles selected for this review, six evaluated the consumption of açaí in the diet, with results that demonstrate the consistency in the studies analyzed concerning the beneficial effects of açaí consumption on inflammatory mediators, with emphasis on people who are overweight or obese[14,17,19,20,22,24]. Furthermore, one of the studies that evaluated healthy individuals states that açaí and juçara juice have a high content of anthocyanin bioactive compounds (ACNs), which have a potential anti-inflammatory effect[17]. However, a prospective study did not show changes in inflammatory mediators in overweight and normal-weight women[22].

The effects found in the analyzed studies are in line with the literature, such as in an in vitro study that demonstrated that the hydroalcoholic extract of the pulp and peel of the açaí berry acted by reducing the elevation of pro-inflammatory cytokines (IL-1β, IL-6, TNF-α and IFN-γ, ROS and nitric oxide) and demonstrated the elevation of anti-inflammatory levels of IL-10 in an inflammatory model with macrophages[31]. Furthermore, an experimental and descriptive study found that the polyphenolic extract of açaí can exert an anti-inflammatory effect on intestinal cells, mediated, at least in part, by the inhibition of ROS and the expression of TLR-4 and NF-κB[32]. Even so, a prospective study did not show any difference in the concentrations of inflammatory mediators between the overweight and normal weight groups[22], which can be explained by the fact that the inflammatory profile of each individual is not shaped solely by obesity and that overweight individuals may be in inflammatory homeostasis, as pointed out in another study[33].

Despite the benefits demonstrated in these primary studies and the absence of side effects, more research needs to be carried out on the effects of açaí on anti-inflammatory mediators, as the selected studies are not standardized, and sample sizes are small. Furthermore, it is necessary to analyze the long-term effects in different populations, considering the dose of açaí and the nutritional and metabolic profile of the individuals.

The results presented by the selected articles can be used as a basis for creating measures for health promotion, as it presupposes a conception that does not restrict health to the absence of disease, but that acts on its conditioning factors and determinants[34].

Among the selected studies, seven studies analyzed the relationship between açaí consumption and glucose and insulin levels[13–15,17,18,24]. Of these, six studies did not observe changes in glucose levels[13–15,24], and only one

study observed an increase in glucose levels, with an increase of 7.3% after açaí intake[17]. This discrepancy can be explained by the participants' failure to follow the instructions on the correct way to consume açaí juice, in addition to having added other foods, which may have altered glucose consumption levels.

Four studies addressed insulin levels [13–15,24]. In two of them, no changes were observed in this parameter[13–15,24]. In the other two, however, changes occurred: one study reported a reduction in fasting insulin levels[35], while another showed an increase in postprandial insulin levels in men[13]. This increase is a normal response of the body and aims to regulate blood glucose levels after a meal. However, the increase in postprandial insulin may vary between different foods, due to their nutritional characterization and composition([36]), which could explain the result found[37] about insulin.

Thus, the discrepancies between the results found may be related to the methodological approaches used, such as the type of sample and time of açaí consumption in the different studies.

It is worth mentioning the limitations presented in the analyzed works, as some have a reduced sample size[14,17,18,24]. Furthermore, it was noted that there was no control or placebo group and that conducting human trials with dietary interventions is often difficult due to the large number of participants who drop out during the follow-up period [18]. It should be noted that one of the studies had as a limitation of a short period of use of açaí[13]. Finally, a limitation highlighted was the determination of whether or not the participants maintained their usual diet and/or physical activity levels during the intervention[15].

Thus, including açaí in the diet may have effects on glucose and insulin levels. On the other hand, it is worth noting that further studies with larger samples are needed regarding the effects of açaí on glucose and insulin levels in humans, especially considering that it may be relevant for dietary reeducation, which is a measure to promote the health of the population[38].

Another finding reported in the study was the increase in apo AI due to increased consumption of açaí[18], confirming the importance of this protein for the production of HDL particles[37]. There was also a 23% increase in daily fiber intake[18], with açaí being a food rich in fiber, which contributed to a considerable increase in daily fiber intake in the sample analyzed[39].

CONCLUSION

Based on the analysis of current literature and considering that the consumption of açaí has several health benefits, this review allowed a reflection on the topic. Thus, it was possible to identify that the impact of the consumption of Euterpe oleracea is associated with the improvement of inflammatory parameters, blood pressure, lipid profile, and adiposity, highlighting the relevance of its inclusion in the population's diet, especially in low-income regions in Brazil, where açaí is widely consumed.

In this context, the guiding question was answered, and the results discussed in categories were presented, highlighting the gaps and advances related to the benefits of açaí. The findings reinforce the need for more robust research, including studies conducted with humans, to strengthen the evidence on the potential of açaí to act as a nutritional and therapeutic strategy. Furthermore, the results of this study point to the health benefits of açaí consumption in improving the lipid profile and adiposity, preventing and controlling chronic diseases, in addition to positive effects on inflammatory mediators and glycemic and insulinemic control.

CONFLICT OF INTEREST

There were no conflicts of interest on the part of the researchers.

CONTRIBUTIONS

The authors contributed equally to the conception and design of the study, data analysis, writing, and approval of the final version of the manuscript.

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