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Bioproducts of Açaí (*Euterpe* spp): a review study on the composition and applications (Amazon, Brazil)

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Abstract

Açaí is a species of plant of the genus Euterpe, which is part of the tribe Euterpeinae and belongs to the family Arecaceae (Palmae), distributed in the Brazilian biome, mainly in the Amazon rainforest, cerrado and Atlantic forest, throughout Central America and up to the north of South America. Traditionally, açaí pulp has been used for artisanal consumption in the form of sweets, ice cream, creams, yoghurts, liqueurs, popsicles, jellies, porridge, sweets, nectars, teas, shakes, smoothies, energy and isotonic drinks, in natura, juices, fermented drinks, given its chemical properties and the presence of bioactive compounds, being also used for therapeutic and medicinal purposes. As a food, açaí is rich in vitamins, minerals, protein, lipids and phenolic substances, mainly anthocyanins from the flavonoid group. In the pharmacological and therapeutic sector, the genus Euterpe spp. it has several important biological implications, such as antioxidant, hypoglycemic, anti-inflammatory, antimicrobial, antiproliferative, immunomodulatory, cardioprotective, antidiarrheal, anticarcinogenic, reducing reactive oxygen species, inflammatory cytokine production and muscle stress markers. The present review summarizes the knowledge about the chemical composition, pharmacological and therapeutic effects, clinical, food and medicinal applications of the genus Euterpe spp.

Keywords: *Euterpe*; Açaí; Composition; Applications; Products

1. INTRODUCTION

Açaí is an Amazonian fruit with high nutritional value and economic potential pointed out by its consumption, which is related to its chemical characteristics, nutritional, pharmaceutical properties and the various health benefits.

Although there are different species of açaí, in Brazil, the best known, *Euterpe oleracea* Martius or "açaí-do-pará", *Euterpe precatoria* Martius or "açai-do-amazonas", *Euterpe edulis* Martius or "juçara", (Martinot, Pereira & Silva, 2017), *Euterpe* Catinga Wallace or "Açaizinho", *Euterpe* Longibracteata Barbosa Rodrigues or "Açaí da Terra firma" (Kang et al., 2012; Schauss, 2010).

In the eastern Amazon the palm trees Oenocarpus bacaba, Attalea maripa, Astrocaryum aculeatum, *Euterpe oleracea* and *Euterpe precatoria* are known. However, only açaí species native to the Amazon region *Euterpe oleracea* and *Euterpe precatoria* are used commercially (Yamaguchi et al., 2015).

Previous studies have shown that the exploitation of the palm *Euterpe* spp. it was commonly made for subsistence, from the manual pulping of the fruits, followed by the extraction and commercialization of the heart of palm, however these data did not appear in the statistics of production and sale (Parente et al., 2003).

In contemporary times, the commercial production of açaí *Euterpe* spp. it cuts across the important contribution to the economy and food security of local communities, involves micro enterprises, organized in associations and cooperatives formed by professionals from indigenous, caboclos / riverside ethnic groups, traditional rural communities and local family businesses (Pinto, 2018). Due to its management approach that support biodiversity and the ecosystem processes that support fruit production in low-lying humid areas, in the Amazon and Midwest regions of Brazil.

Several scientific studies report the potential effect of the pulp of the fruit of *Euterpe* spp. to human health, related to its nutritional, phytochemical composition enriched in polyphenols, has diversified bioactivities, with anti-inflammatory, antiproliferative, cardioprotective and against oxidative stress (Bastos, 2015; Belda-Galbis et al., 2015; Carey et al., 2017; Carvalho-Peixoto et al. 2015; De Moura; Resende, 2016).

In view of this panorama, this work aims to review the main results of the studies that investigated the composition and applications of the species *Euterpe* spp., as well as the functional potential of the fruit pulp.

2. METHODOLOGY

This is a literature review study, with a descriptive approach. Research was carried out on various electronic mechanisms, such as Google Scholar, and global digital databases popular in the scientific field, including Science Direct, Springer, PubMed, Web of science, Scielo, Scopus, in January, February and March, without limited time, but with the following terms: açaí and Euterpe and applications to obtain the relevant information. The inclusion criteria were: articles closely related to the theme. The selection was based on titles and / or abstracts, availability of the full article and publication in English and / or Portuguese. Those who did not meet the previously established criteria were excluded. After careful screening, data related to the current topic were extracted from 72 articles published from 1948 to 2021.

3. BOTANICAL PROFILE OF AÇAÍ (*Euterpe* spp.)

The species *Euterpe* spp. they differ in the way the palm trees grow. The genus *Euterpe oleracea*, known locally as açaí-do-Pará, is common in lowlands, in flooded forest areas of the Amazon estuary and adapted to a hot, tropical climate, high cloud cover and high relative humidity, is distributed from North Atlantic coast, from Maranhão to the outskirts of Parintins, south of the Amazon River (Matos, 2017). The palm forms clumps around 20 stems (Figure 1A), whose tillers may be in different stages of growth, produces small round fruits (1.0 to 1.4 cm in diameter), dark purple in color.

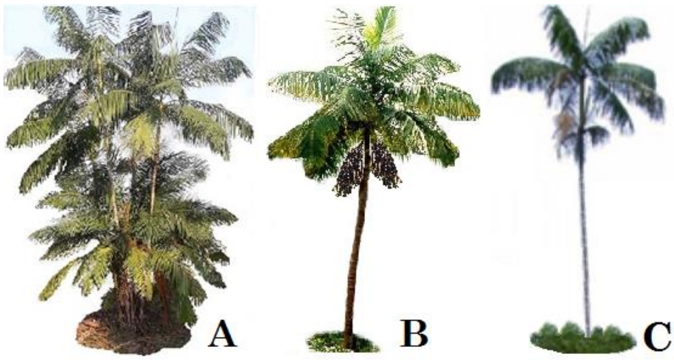

Figure 1. Photo: aspects of the *Euterpe oleracia* Martius plant (A), aspects of the *Euterpe edulis* Martius plant (B), aspects of the *Euterpe precatoria* Martius plant (C). Source: the Author

In contrast, the genus *Euterpe edulis* known as juçara or içara, also called jiçara, palmito-juçara, palmito-doce and palmiteiro, is an allogamous, evergreen, ombrophilous, mesophilic or slightly hygrophilous, single-stemmed (Figure 1B), not tillering and not regrowth, they can grow to a medium height (Costa Silva, Martini & de Araújo, 2009). It is an annual and seasonal flowering palm, being the peak of fruit supply between September and October, with ripening from April to November. It occurs from the south of Bahia to the north of Rio Grande do Sul, with distribution along the Brazilian coast, in the Atlantic Rain Forest (Mantovani & Morellato, 2000).

The genus *Euterpe precatoria* commonly known as açaí-solitário, açaí-do Amazonas, açaí-solo, açaí-de-terra-firma, açaí-da-mata and açaí-native, is a neotropical, perennial, under-canopy palm (Figure 1C), of single stipe, being unable to produce tillers and sprout, they can grow up to a maximum height of 22 m. They are allogamous plants, perennial, with more frequent occurrence in Western Amazonia with average annual temperature above 26°C, relative humidity between 71% and 91%, and precipitation above 1,600 mm per year (Martinot et al., 2013) .

They produce inflorescences made up of rachis that form bunches of about 2,000 to 5,000 globose seeds measuring 0.9 to 1.3 cm in diameter and succulent mesocarp about 1 mm thick, maturing from green to dark reddish purple in about 175 days, with a solid and homogeneous endosperm, it weighs about 2g and corresponds to about

10% of the final weight. In adulthood, individuals produce 1 to 4 bisexual inflorescences per flowering period, with numerous male and female flowers (Yamaguchi et al., 2015).

In the Amazon estuary, flowering and fruiting peaks occur spontaneously with seasonality characteristic of the crop intrinsically linked to the geographical location, the harvest period of Euterpe precatoria varies from December to May in the rainy season (Peixoto, 2016).

In Amazonas, the species can be found throughout the year, but the greatest production occurs between the months of July and October, characterized by a dry period (Küchmeister et al., 1997). However, the harvest can anticipate, as the communities are closer to the headwaters of the rivers (Martinot et al., 2013).

3.1. PROPERTIES OF AÇAÍ (*Euterpe* spp.)

In a general aspect, the chemical constituents found in fruits, roots, leaf stems, seeds of the main species of *Euterpe* spp., are the target of extensive investigations, due to their nutritional, phytochemical and bioactive composition, as they are the most popular functional foods of natural occurrence only in the Amazon basin. western region, including the Peruvian region. In view of the high nutritional, energetic and caloric value, the açaí fruit has 794 kcal 100 g-1 of pulp, considerable amounts of constituents such as: calcium, copper, magnesium, manganese, zinc and iron (Da Silva Santos et al., 2014; Dias-Souza et al., 2018).

Several authors, (Carey et al., 2017; Schauss, 2015) claim that the açaí pulp consists of a variety of phenolic acids and polyphenols, especially anthocyanins, belonging to the group of flavonoids such as pelargonidin, cyanidin, delfinidine , peonidine, petunidine and malvidin found in the açaí fruit (Schulz et al., 2016). In addition to these, other flavonoids from the group of flavonols and flavones (vitexin, luteolin, crereriol, quercetin, homoorientin, orientin, isovitexine, scoparin, taxifoline, deoxyhexose, deoxyhexose, isoorientin and vanillic acid).

According to Peixoto (2016), the edible part of açaí is rich in calcium, magnesium, potassium, phosphorus, glycides, proteins (8.91%). Ascorbic acid, α-tocopherol around 135 mg / 100g-1, B vitamins (thiamine, riboflavin, niacin), essential amino acids, fat-soluble compounds (41.85%) and tannins (proanthocyanidin) (Gan et al., 2018; Schulz et al., 2016).

According to De Moura Rocha (2015) and Schulz et al. (2016) açaí also contains soluble fibers, carbohydrates, fatty acids: palmitic, linoleic and oleic responsible for reducing the oxidation of LDL cholesterol, together they represent 90% of the calories present in the fruit and can be monounsaturated and polyunsaturated.

The study by Pacheco-Palencia, Duncan & Talcott (2009) identified flavonoids from the group of phenolic compounds in the fruit of both genera, with emphasis on the total anthocyanins content in *Euterpe precatoria*, considered higher than in *Euterpe oleracea*, this represented almost 90 % of antioxidant capacity. These results, when tested by liquid chromatography (HPLC-ESI-MSn), revealed a predominance of cyanidin-3-glucoside and cyanidin-3-rutenoside derivatives in both genders. The difference was the presence of pelargonidin-3-O-glucoside in *Euterpe precatoria* and peonidin-3-rutinoside in *Euterpe oleracea* (Yamaguchi et al., 2015). It is known that in nature, anthocyanins occur in heterolicosidic form, with cyanidin, pelargonidine, peonidine, delfinidine, petunidine and malvidin being added from the groups fixed on the aromatics.Guided by this approach Galotta et al. (2005), identified from hexanic extracts, in ethyl acetate and methanolic root and hexanic extracts and in ethyl acetate from the leaf stalk of *Euterpe precatoria*, sitosterol-3-O-ß-D-glucopyranoside, stigmasterol and acid p-hydroxy-benzoic as a chemical constituent. They also elucidated significant amounts of flavonoids with various biological and pharmacological activities demonstrated by cytotoxic triterpenes. These compounds have a chemical structure consisting of two aromatic rings, linked by a chain of three carbon atoms and demonstrate the ability in vitro and in vivo to sequester free radicals (Peixoto et al., 2016).

Several publications demonstrate that *Euterpe edulis* contains nutritional, phenolic and bioactive compounds such as anthocyanins, flavonoids and phenolic acids that are related to antioxidant activity in vitro and in vivo (Maria do Socorro et al., 2010; Oyama et al., 2016; Schulz et al., 2016).

Recently, studies by Tavares et al. (2020), De Lima et al. (2019) Monteiro et al. (2019) identified high levels of lignocellulose containing glucose, cellulose, hemicellulose, lignin, xylose and mannose as a chemical constituent in the fresh, treated and mature fibers of *Euterpe oleracea* seeds. One of them (Melo et al., 2021) reported strong antioxidant activity in vitro against free radicals DPPH and ABTS. Due to the analysis, he identified in the seed extract Procyanidin B1 and B2, catechin and epicatechin.

In modern times, the large number of studies that deal with the physical and chemical properties of açaí, were linked to the marked use of the raw material, nutritional wealth, capacity to fight diseases and harmful agents to the organism. In view of this, the industrial logic was installed in the agribusiness of açaí, through the planting of new açaí trees in upland areas, in the growth of the pulp market, in the new forms of consumption / food, appropriating new technologies such as the improvement of seeds and fertilizers, linked to the cultivation link (Coelho et al., 2017; Moraes, 2018). In defining the traditional culture of family work, for example, it has given space to the industry with new technologies for training the workforce and extracting fruit, driving growth with the purpose of meeting the new niches in the food, cosmetic and food markets. nutraceutical adding value to the final product.

The commercialization of açaí, previously restricted to artisanal beaters and points of sale in the neighborhoods, encountered competition from markets, supermarkets and factories that incorporate product, process and management technologies operating in the national and international markets, attested to in the new form of production process in the fruit, according to Bill nº 178 of 2010 (Ribeiro, 2016).

In the late 1990s, açaí, which was just an exotic fruit of extractive production and artisanal processing, served as staple food and domestic consumption of low-income populations in the Amazon economy, won over many fans, mainly sportsmen and physical activity practitioners. (Bernaud & Funchal, 2011).

In the period between the 1990s and 2000s, the production and value of açaí remained at the same level, oscillating around 100,000 tons of fruit and R$ 55,000. In the period between 2002 and 2004, the production and value of açaí increased four times more, the fruit started to lead the national market and exports reached 500 thousand tons / year (Pagliarussi, 2010).

With technological advances, the foreign market grew about 20% per year in the period from 2003 to 2006. For this reason, the sale of açaí concentrated in the food industry with smart packaging, mixed with other fruits (Homma, 2014). This scenario led the industries to improve their products, processes, incorporation of technologies, strategic management of production and costs, specialization in local, national and international markets.

Such practices, however, resulted in the sending of açaí abroad, mainly in countries such as Japan, the Netherlands, South Korea (Carvalho et al., 2017). United States, Australia, Brazil and Canada which, according to the MINTEL GROUP (2016), of all industrialized foods containing açaí, launched in these countries between the years 2010 to 2015, 22% were juices, 12% sports and energy drinks, 9 % snacks, 7% desserts and ice cream, 5% dairy products and 3% confectionery, but Portugal and England are among the importers of the product.

Açaí has become one of the most important crops in the world and, in the Amazon estuary, the main producers of *Euterpe precatoria* are the municipalities of Codajás, Anori, Coari, Carauari, Humaitá, Itacoatiara, Tapauá, Manicoré and Lábrea which, in 2019 , produced approximately 43,855 tonnes of fruit, with monetary value of production of US $ 97.08 million (IBGE, 2019).

Euterpe edulis, is found and produced in the Midwest and Southeast regions of Brazil. However, the North region is the largest national producer, only the state of Pará, produced / managed 87% of the fruit, that is, about 369,148 tons (*Euterpe oleracea*) and, of this production, 60% is in the state, 35% it goes to other regions of the country and 5% goes directly abroad and, from there, it is sold by almost 50 companies in the state (IBGE, 2019). Between the years 2016 to 2017, Brazil registered 196,319 ha of areas destined to permanent açaí crops (IBGE, 2019).

4. APPLICATIONS OF AÇAÍ (*Euterpe* spp.)

The nutritional, phytochemical composition, bioactivity and the varied raw material of *Euterpe* spp. it is used as a basic source of food and multiple needs by many populations native to the Amazon and other regions of Brazil, associated with biological and pharmacological activities.

However, the first records on the first applications using the functional properties of Euterpe were claimed in 1945, focusing on the potential of the pulp, which was used as a raw material in the juice production agribusiness (Homma, 2001).

For decades, the interest in the use of açaí has been motivated by the functional and medicinal capacity to affect human health and well-being, in addition to having adequate nutritional effects associated with chemical compounds, mainly attributed to bioactive substances against the metabolic syndrome (Cedrim et al., 2018).

When it comes to the therapeutic implications of açaí, there are reports with suggestions that the indigenous ethnicities, cabocla and riverside communities, native to the Amazon region, naturally made the basic use of the added values of the leaves, roots, stems and fruits of the açaí, both as a medicinal plant and as a food, were recorded by Chaves and Pcchnik (1948).

In ethnomedicine, for example, Amerindian peoples use the anti-inflammatory tannins found in the roots of açaí *Euterpe precatoria* as a medicinal food in the treatment and relief of malaria and *leishmaniasis*, against liver and kidney infections (Galotta; Boaventura, 2005; Jensen; Kvist ; Christensen, 2002; Prance & Silva, 1975). Decoction formulations also have applications against anemia, diabetes, liver and kidney pain (Bourdy et al., 2000).

Rojas et al. (2003) report promising interventions with nutritional supplements from *Euterpe precatoria* in the treatment of hepatitis, dysmenorrhea and diarrhea, and root extracts against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*, with an inhibitory halo of 13 mm in diameter, while Deharo et al. (2004) describes its administration in inflammatory diseases and, in the form of decoction or syrup, relieved muscle pain in the back, sciatica or in the liver.

In inhibiting the process of liver infections, proliferation of worms, intestinal disorders and anti-hemorrhagic treatment, when applied after tooth extractions (Bastos, 2015).

In addition to these, other works with the stem of *Euterpe precatoria* leaves are used against snake bites, muscle and chest pains, the seeds provide handmade products, cooking oil, hair care and are anti-diarrheal (Campos & Ehringhaus, 2003) . There are reports on the alternative use of açaí palm in nature in food, in muscle treatment and snake bites (Santana; De Jesus, 2012).

Due to the functional potential of açaí, the works by Belda-Galbis et al. (2015) and Kang et al. (2012) found biocomposites with antioxidant activity and biological functions contained in the pulp and wine. The functional properties existing in biocomposites are associated with the anti-inflammatory, antimicrobial and therapeutic properties attributed to phenolic compounds, by inhibiting the activation of the nuclear factor kappa B (NF-kB) induced by lipopolysaccharide. Such functional properties are also capable of donating hydrogen atoms, which break oxidation chains and chelate ions from transition metals, inhibiting the formation of hydroxyl, peroxyl, peroxynitrite and superoxide anions (Barbosa, 2016; Schauss, 2015).

The works of Heinrich et al. (2011) and Carvalho-Peixoto et al. (2015) suggested that the general pharmacological properties of the açaí pulp are related to its antiproliferative, anti-inflammatory, antioxidant and cardioprotective effects. Additionally, studies by Dias-Souza, (2018) and Kang et al. (2012) indicated glycemic inhibition, combating metabolic disorders, progression of neurodegenerative diseases, prevention of inflammatory diseases, protection of the cardiovascular and carcinogenic system due to the presence of anthocyanins, polyphenols, fibers, α tocopherol and lipids (Carey et al., 2017 ; Schauss et al., 2010; Sadowska-Krępa et al., 2015).

Studies such as that by Poulose et al. (2014) with rats, show that the açaí pulps *Euterpe oleracea* and *Euterpe precatoria* protect against dopamine-induced calcium dysregulation in primary neurons of the depolarized hippocampus, preventing the loss of autophagy function.

In humans, the pioneering study by Jensen et al. (2008), evaluated the antioxidant effect of açaí juice composed with other ingredients, for this purpose, twelve volunteers of both sexes participated in the study. The results indicated an increase in the antioxidant capacity of the serum after the consumption of açaí. It was also possible to observe an effect in decreasing lipid peroxidation. The findings suggested that the ingestion of the compound juice, was able to increase the antioxidant capacity and protect the cells from oxidative damage.

Pacheco-Palencia, Duncan, Talcott (2009) cite that the high nutritional and functional value of the pulp of fruits of the species *Euterpe* spp., The lyophilized pulp stand out for presenting high antioxidant activity demonstrated by in vitro study, with cell culture models and in vivo with work on animals and humans.

In 2014, Peixoto and collaborators administered a supplemental energy gel, the product was composed of lyophilized açaí enriched with sugars (xanthan gum, maltodextrin, fructose, sucrose and glucose) and citric acid for treatment and prevention of the effects caused by oxidative stress and muscle fatigue , metabolic control in high performance athletes. The authors found that the product can be used as a therapeutic and prophylactic route, for treatment and prevention of the effects caused by oxidative stress and muscle fatigue. Likewise, Moura and Resende (2016) used the components of the skin and the seed of açaí, to suggest that the properties have a vaso dilatory, antihypertensive, cardioprotective, renal protective, anti-dyslipidemic, anti-obesity, species-reducing effect reactive oxygen, antidiabetics in cardiovascular and metabolic disorders and, because it inhibits pro-inflammatory cytokines and DNA damage, as well as immunomodulator and anti-convulsant (Dias-Souza, 2018).

Viana et al. (2017) reported that the açaí gel was effective in inhibiting oxidative stress on the biochemical parameters related to the immune profile and biomarkers in the muscle and liver of individuals who practice physical activities. They observed that the gel modulated the immunological parameter, reduced lymphocyte activity and muscle stress and the activity of liver enzymes.

Recent studies addressing the therapeutic benefits contained in foods of plant origin in the Amazon rainforest biome, have become relevant to the medical and pharmaceutical fields. In this context, the study by Matos et al. (2018) obtained the first fundamental insights into the chemical production of antibacterial and antioxidant biofilms using brown sugar, kefir grains, açaí (*Euterpe oleracea* Mart.) And cupuaçu pulp (*Theobroma grandiflorum Schum*). This research has shown that the biofilm surface can be used as a natural curative material.

The research published by Carvalho-Peixoto et al. (2015), Fantini (2017) and Sadowska-Krępa et al. (2015) evaluated the anti-inflammatory properties of freeze-dried acai and observed a successful effect of biocomposites to reduce the production of inflammatory cytokines, pain and muscle stress, as well as increased range of motion and physical performance. during high intensity training.

In another study, Silva (2017) studied the effects of açaí pulp as a function of its bioactive substances. For this, the study was carried out in an animal model with liver injury induced by non-alcoholic fat. He found that the treatment showed an improvement in the oxidant / antioxidant balance, with an increase in the serum and liver activity of Paraoxonase-1, an increase in the gene expression of Paraoxonase-1 and apolipoprotein A-I and an increase in the protein expression of Paraoxonase-1 in the liver, preventing the oxidation of LDL.

It is known that the bioactive substances in açaí are potentially unstable against environmental stresses. Thus, based on water-in-oil encapsulation and emulsification technologies Rabelo et al. (2018) formulated nanoemulsions with different concentrations, in order to maintain the chemical and physical stability of the nanoemulsions loaded with açaí extract for 30 days of storage.

With this challenge in mind, the studies by Souza (2018) and Freitas (2018) also tracked the effects of supplementation with pasteurized pulp of açaí on biochemical markers of oxidative stress, inflammation and aerobic capacity in athletes with resistance cycling.

The results showed that there was an increase in the antioxidant capacity of the serum, and a reduction in lipid peroxidation. It has been suggested that supplementation of pasteurized açaí pulp contributed to minimize lipid peroxidation, improved aerobic capacity, prevents oxidative damage to DNA, supporting the hypothesis that supplementation with açaí pulp may favor adaptive responses to training in resistance athletes.

Despite the alleged pharmacological and nutritional value of açaí, more recently, Alegre et al. (2019) related their bioactive substances to supplementation metabolism in the process of reversing ischemia-reperfusion in rats, based on reducing the formation of reactive oxygen species generated in mitochondria by restoring oxygen flow. There was an improvement in energy metabolism and a decrease in oxidative stress, but there was no decrease in the infarcted area or an improvement in left ventricular function in the global ischemia-reperfusion model.

Cruz et al. (2019) evaluated the antioxidant effect of chronic consumption of açaí pulp on the muscle damage of male street runners. The results showed that supplementation with açaí promoted protection against muscle damage. It was also possible to observe a reduction in the plasma concentration of creatine kinase, demonstrating that chronic consumption of açaí prevents muscle damage.

4.2. BIOPRODUCTS BASED ON AÇAÍ (*Euterpe* spp.)

Energy drinks based on açaí pulp have a strong market expansion, due to the association as a source of energy, proven antioxidant capacity and use in nutraceutical / functional products.

In the past, the trade of açaí derivatives in the Amazon resorted to artasanal consumption of pulp in the form of sweets, ice cream, creams, yoghurts, liqueurs, popsicles, jellies, porridge, sweets, nectars, teas or accompanied by fish and tapioca flour. or cassava (Santana & De Jesus, 2012; Silva, 2017).

Recently, the increase in the use of açaí as energy drinks, shakes, smoothies, isotonic drinks, microencapsules, juices and alcoholic fermentations has allowed a significant increase in scientific research, with studies showing its chemical properties and the presence of bioactive compounds (De Souza Pereira et al ., 2017).

The new scenario of the consumer market, seeks new alternatives for the exploration of açaí, in order to meet current and future expectations. For example, in the food industry, the main use of açaí is the extraction of the pulp, which varies from 5 to 15% of the volume of the fruit, used for a variety of applications, such as natural dyes, energy drinks, soft drinks, liquor from açaí, guarana syrup with açaí (Tateno, 2001; Da Silva, Souza, & Berni, 2005; Yamaguchi et al., 2015), dietary supplements, among others (Dias-Souza, 2018).

In the scope of production of dehydrated products, there are the technological processes of pasteurization, lyophilization, microencapsulation, drumdryer, spray-drier, vacuum dehydration, among others.

Thus, Boeira et al. (2020) produced a new alcoholic beverage by the same elaboration process, from Euterpe precatoria fruits from different regions of the state of Amazonas. The results showed an alcohol content of 10.3% to 11.7% and quantification of methanol according to the limits established in different global markets.

The oligosaccharide fruits and sucrose were added to the açaí juice of the *Euterpe oleracia* species to evaluate the fermentation process of Lacticaseibacillus casei in organic acids, anthocyanins, polyphenolic compounds and antioxidant activity. The authors suggest that the inclusion of probiotic microorganisms and prebiotic oligosaccharide fruit increased the content of bioactive compounds during the shelf life of the juice, which makes açaí juice a viable matrix for symbiotic food (Freitas et al., 2021).

5. CONCLUSIONS

A substantial number of studies have shown that the energy components present in Euterpe spp., have come to be used by the pharmaceutical, cosmetic and food industries, due to the wide approach involved in subsidies for actions aimed at human health.

We assume that açaí, as a fruit rich in anthocyanins, can play a beneficial role in preventing or controlling oxidative damage and neurodegenerative diseases. However, the bioavailability of the main compounds of Euterpe spp. must be considered for new approaches and innovations. In this perspective, instruments with sophisticated configurations still need to be designed.

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