



**AN OVERVIEW OF ACAI BERRY (*EUTERPE OLERACEA*) AND ITS
PHARMACOLOGICAL ACTIVITIES**

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ABSTRACT

Acai berry (*Euterpe oleracea*) is a species of palm tree which comes under the family Areaceae which is mainly cultivate for its fruit. It is a fruit which comes under the class of berries. Berries is defined as a common edible fruit which is rich in nutritional compounds such as anthocyanins, flavonoids, and phenolic compounds. The Acai berry has been extensively studied for its various nutritional and pharmacological properties. Acai berry is purple colour berry which is natively grown in various areas of Amazon area in South America. The nutritional contents present in acai berry are calories, fats, carbohydrates, proteins, dietary fibre, vitamins etc. acai berry has been widely investigsted for its chemical composition the most commonly found chemicals are anthocyanins, flavonoids, phenols and glycosides. The other constituents are fatty acids, minerals, amino acids, carotenoids and vitamins. Due to its chemical composition it has various pharmacological activities such as antioxidant activity, anti inflammatory, neuroprotective activity, anticancer effect, it is also used to cure renal diseases. It is used in cosmetics and also in food industry.

KEYWORDS: Acai berry, *Euterpe oleracea*, anthocyanins, flavonoids, antioxidant activity, anti inflammatory activity.

1. INTRODUCTION

1.1 BERRIES

1.1.1 Definition

There are various definitions of 'berries' or 'berries'. The botanical definition of berries: Berries are striking fruits produced from a single flower and containing an ovary. Two common examples of 'botanical' berries are grapes and bananas.



Fig: 1.1: Grapes.^[1]

antioxidants, phytochemicals, flavonoids, carotenoids, polyphenols, vitamins, and minerals. It is these components of the berries that are known to be beneficial to the skin, and are most often used for their anti-inflammatory and antioxidant properties. In addition to antioxidants, berries are "juicy foods," meaning they contain mostly water. They also smell delicious. Vitamin C is a strong antioxidant found in berries. Eating berries rich in vitamin C will contribute to radiant skin and healthy hair, and can reduce the risk of arthritis, cataracts and muscle degeneration.

1.1.2 Examples of berries: bilberry, strawberry, raspberry, acai berry.

Berry is a common edible fruit. They are inherently packed with nutrient-rich building blocks like



Fig 1.2: Strawberry, Blueberry, Raspberry.

Table 1.1^[2]

S.no	Berry	Benefits
1)	Acai berry	High in antioxidants, stimulates healthy digestion, stimulates energy.
2)	Raspberry	Helps with anti-aging, antioxidants, good for bone health, weight loss.
3)	Strawberry	Source of vitamin C, helps control weight, is good for a healthy heart.
4)	Blueberry	Rich in antioxidants, reduces belly fat, promotes eye health.
5)	Blueberry	High in fiber, prevents dental caries, anti-inflammatory, treats urinary tract infections.
6)	Goji berry	Increases energy level, aids in detoxification, stimulates the immune system.

2. ACAI BERRY



Fig: 2.1 Acai berry.

2.1 **Synonym:** Brazilian super fruit.

4. **Common names:** Acai Berry, Acai Berry, jussara, Açai.^[3]

2.2 **Biological source**

The acai palm of *Euterpe oleracea*, is a species of palm (*Arecaceae*) that is cultivated for its fruits (acai berries, or simply acai), hearts of palm (a vegetable), leaves and trunk wood. Global demand for the fruit expanded rapidly in the 21st century, making the tree primarily cultivated for that purpose.^[4]

2.3 **Location and cultivation**

Euterpe oleracea is a genus of native tropical palms found growing indigenously in various areas of the Amazon area in South America.

There are three predominant species that produce edible fruits that are widely dispersed throughout the

Amazon: *Euterpe edulis* Mart., *Euterpe precatoria* Mart. and *Euterpe oleracea* Mart.^[5]

The first species produces a fruit called "jucara" or "acai", while the last two heterotypic species produce a fruit commonly called "acai", although there are other common synonyms. *E.edulis* is a major source of heart of palm, rather than its fruit, which is similar in appearance to *E. precatoria* and *E. oleracea*. The main difference between the two remaining species harvested for their fruit is how the palms grow. *E. precatoria* (*EP*) is a thin, single-stemmed palm with pinnate leaves that reaches heights of up to 20 m, with a diameter that reaches 25 cm. In comparison, *E. oleracea* (*EO*) is multi-stemmed with up to 25 stems growing 18-33 m from one group (Fig. 2.3.1). The two species also differ from each other in their phytochemical composition.^[6]

In the last decade, *EO* has received considerable attention as a new "super fruit" due to its high antioxidant capacity and possible anti-inflammatory effects.

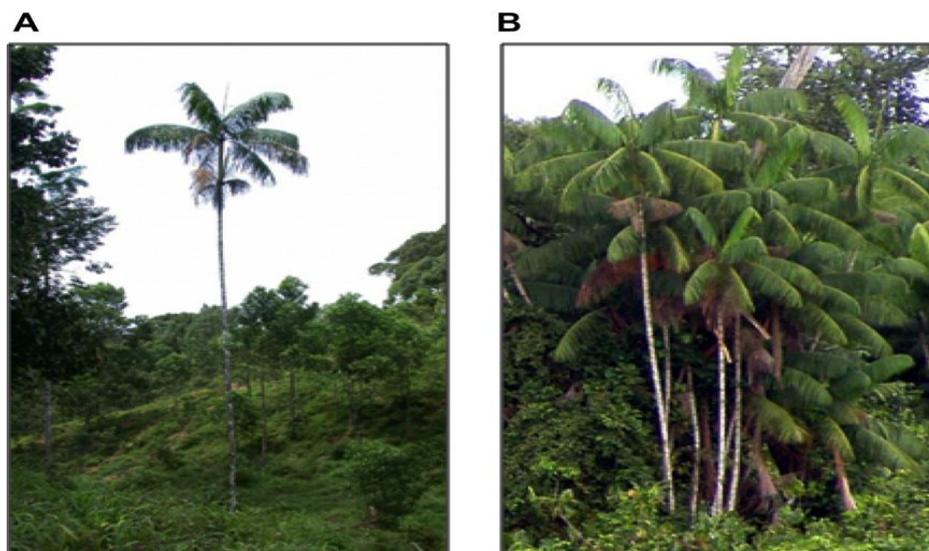


Figure 2.3.1 (A) Figure: 2.3.2 (B)

Acai " palms: the single stem, *Eutepe precatoria* (A) and a group of multiple stem *Euterpe oleracea* (B).^[7]

2.4 Botanical aspects

The acai palm belongs to the Arecaceae family. This family has around 200 genera and around 2600 species distributed in tropical and subtropical areas.^[8,9] Of the native species of Brazil, the most important are *E. oleracea*, *Euterpe edulis* and *Euterpe precatoria*. The former is popularly known as *Palmiteira*, *Acai de Para* and *Acai Real*. This species was the main source of raw material in the palm heart industry (pickled palm heart). The botanical classification of this species, according to Cronquist is.

Kingdom: Plantae;
Division: Magnoliophyta;
Class: Liliopsida;
Order: Arecales,
Family: Arecaceae;
Genre: *Euterpe*;
Species: *E. oleracea*.

The binomial name of this species is *E. oleracea* Martius.^[9]

3. MACROSCOPY

The fruits are approximately 1 to 2 centimeters (cm) in diameter and a deep purple color.

The seed makes up about 80 percent of the fruit.

The acai berry flavor has been described as a mixture of chocolate and berries, with a slight metallic flavor.

Stem: the palms Acai consist of thin stems 04.08 grayish brown, each of which measures about 25 meters (82 feet) high and usually not more than 20 cm (about 8 inches) in diameter.

LEAVES: The stems bear leaf-scarring rings and are crowned with a crown of 9–15 compound leaves; the leaves are approximately 1.2–4 meters (4–13 feet) long.

FLOWERS: The small purple brown flowers are staminate (male) or pistillate (female) and are born in

large branching inflorescences that hang from the top of the stems. The flowers are pollinated by small bees and flies and produce round drupes known as acai berries.

FRUITS: Fruits are approximately 1.5 cm (0.6 inches) in diameter and have a single large seed. They generally ripen from green to dark purple, although the fruit of some populations remains green at maturity.

Each acai stalk can produce up to eight bunches of fruit a year, and each bunch weighs up to 6 kg (13 lbs).^[10]

4. ACAI AND NUTRIENT CONTENT

^[11]The nutritional content of any edible item is essential for understanding the dosage amount of a particular edible item and for finding its nutritional content that is essential for maintaining a proper diet.

The nutritional content of acai berry per 100 g of dry weight is mentioned in Table 4.1.

Table 4.1.

NUTRIENTS	Per 100 g of dry weight
Total calories	533.9 cal
Greases	292.6 cal
Protein	32.5 cal
Carbohydrates	208.8 cal
Dietary fiber*	44.2 g
Sodium	30.4 mg
Vitamin A	1002 IU
Vitamin C	<0.1 mg
Calcium	260.0mg
Iron	4.4 mg

The nutritional content of the acai berry is made up of calories, fat, protein, carbohydrates, dietary fiber, inorganic compounds like sodium, calcium, iron. Vitamins like vitamin A and vitamin C.^[11]

5. CHEMICAL COMPONENTS

Species *E. oleracea* Mart has been extensively investigated for their chemical composition. Table 5.1 present all chemical compounds reported, until now, for

the fruit of *E. oleracea* Mart. The açai fruit pulp is rich in polyphenols like flavonoids and anthocyanins and content a diversity of fatty acids. Anthocyanins are glycosidic derived from anthocyanidins.^[12]

Table 5.1: Chemical compounds reported for the fruit of *Euterpe oleraceae* Mart.^[13-18]

Groups	Compounds
Anthocyanins	cyanidin-3-O-glucoside, cyanidin-3-O-rutinosídeo, cyanidin-3-arabinoside, cyanidin-3-arabinoside, cyanidin 3-acetyl hexose, peonidin 3-rutinoside, peonidin 3-glucoside, cyanidin 3-I sambubioside
Flavonoids	Quercetin, quercetin arabinopyranoside, orientin, isoorientin, isovitexin, rutin, epicatechin, catechin, taxifolin desoxihexose, apigenin, crisoeriol, 5,4'-dihydroxy-7, 3', 5' - trimethoxy flavone-, luteolin diglicoside, astilbin, quercetin rhamnoside, protoanthocyanidin, dimeric procyanidin, quercetin rutinoside, escoparin, kaempferol rhamnoside, kaempferol rutinoside
Phenolic	Ferulic, benzoic acid, p-hydroxybenzoic acid, gallic acid pirocatéquic acid, ellagic acid, vanillic acid, p-coumaric acid glycoside ellagic acid, chlorogenic acid, escoparine, dihydrokaempferol, velutine, pinosresinol, syringaresinol, 3-hydroxy-1 - (4-hydroxy-3,5-dimethoxyphenyl) -1-propanone, dihydroconiferyl alcohol, lariciresinol
Fatty acids s	Saturated: butyric, caproic, caprylic, capric, undecanoic, lauric, tridecanoic, myristic, pentadecanoic, margaric, stearic, nonadecanoic, eicosanoic, behenic, tricosanoic, lignoceric ; Monounsaturate d: tridecene, myristoleic, pentadecenoic, palmitoleic, margaroleic, oleic, elaidic, gadoleic, erucic, nervonic ; Polyunsaturated: linoleic, linolenic, gamma linolenic, eicosadiene, eicosatrienoic, homogamma linolenic,
Lignans	(+) - isolariciresinol, (+) - 5-methoxy-isolariciresinol, (+) - lariciresinol (8), (+) - pinosresinol), (+) - siringaresinol
Carotenoids	α -carotene, β - carotene, lutein, tocopherols A, B, C, D, chlorophyll

Chemically, the fruit berries of *E. oleracea* and *E. precatória* are characterized by the presence of bioactive substances. Some 90 substances have been described, of which approximately 31% consist of flavonoids, followed by phenolic compounds (23%), lignoids (11%) and anthocyanins (9%). Other classes include fatty acids, quinones, terpenes, and norisoprenoids. The chemical structures of the mentioned compounds can be seen in Figs. 2–5.

There are few studies that try to differentiate both species of *Euterpe*. Both have phenolic and anthocyanin contents that correlate with high biological activity.^[19,20] The amount of anthocyanins in the açai pulp is so high that lyophilized samples have been used to obtain isolated

standards of cyanidin-3-O-glucoside and cyanidin-3-O-rutinoside.

Anthocyanins are glycosides of anthocyanidins. They belong to the class of flavonoids and have, in their basic core, the 4-hydroxyflavilium ion. They have been characterized as the responsible compounds for the determination of the color of a variety of vegetables, including the purple color, and also for the antioxidant activity of açai.^[13] The chemical structures of anthocyanins found in açai are shown in Fig. 2.

Regarding the two species, the total content of anthocyanins was 50% higher in *E. precatória* than in *E. oleracea*.^[6]

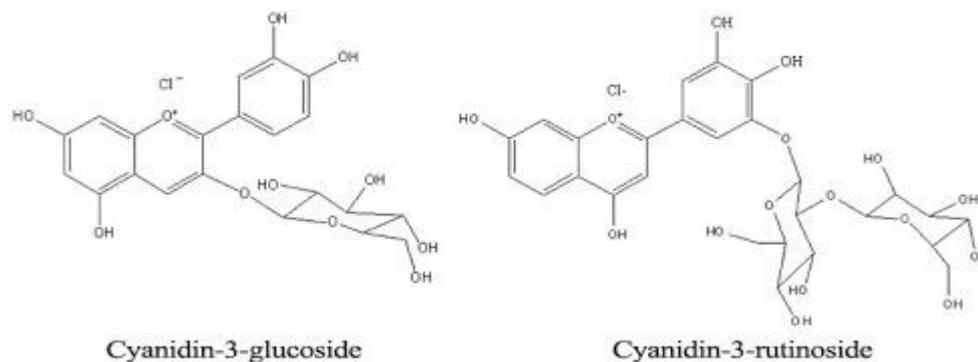


Fig. 5.1: Structures of Anthocyanins.

As for the profile phenolic, phenolic acids in descending order prevailing in the pulp *E. oleracea* were: acid ferulic, phroxibenzoico, gallic, protocatechuic, ellagic, vanillic acid, p-coumaric and acid glycoside acid ellagic. This profile of phenolic compounds was subsequently confirmed by other studies and, in addition, other substances were also described, for example, caffeic,

benzoic, syringic, chlorogenic and resveratrol acids (see Fig. 3).^[13]

A comparing the chemical profile with *E. precatória*, there were similarities with the acids p-hydroxybenzoic, vanílicos, siríceos, ferulic and protocatechuicos as the main components of both species.^[6]

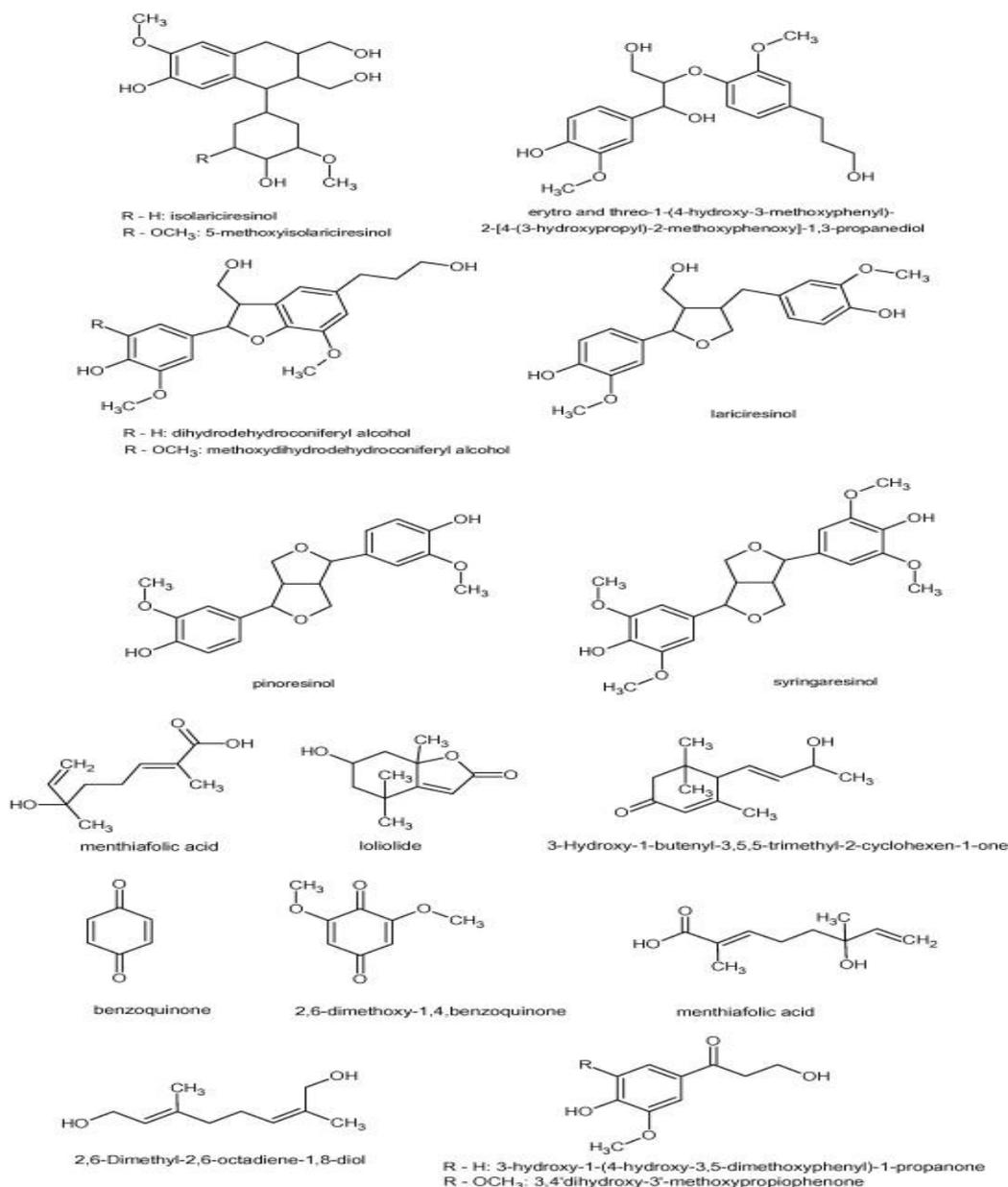


Fig.5.2 Structures of Phenols.

In *E. oleracea* fixed oils there was a profile similar to that described for pulps, where the main phenolic compounds were gallic acid, cyanidin-3-O-glucoside and cyanidin-3-O-rutinoside. The main difference was the presence of luteolin-C-8- glucoside (orientin) and luteolin-6-C- glucoside (homo- orientin) in larger amounts.^[12]

The other phenolic flavonoids described are epicatechin, catechin, rutin, orientin, homoorientin, isovitexin, escoparin, deoxyhexose taxifolin, apigenin, crisoeirol,

dihydrokaempferol, velutin, 5,40dihydroxy-7, 30, 50 - trimethoxy flavone, luteolin diglycoside and procyanidin Dimers.^[14]

In addition, acai fatty acids have also been reported. Linoleic acid, oleic acid and the acid palmitic reported as major polyunsaturated and monounsaturated fatty acids and acid linolenic,^[21] and quercetin hidroxilmetilglutaril-rhamnoside.^[22]

There was a predominance of unsaturated forms, which mainly include: oleic acid (45.1%, 45.7%, 45.5% for pericarp, endocarp and whole fruit, respectively), followed by palmitoleic acid to a lesser extent (4.2%, 4.8%, 4.3% for pericarp, endocarp and whole fruit, respectively). These acids represented more than 50% of the total fatty acids analyzed in the samples.^[23]

Acai oil, like olive and avocado oil, is rich in monounsaturated and polyunsaturated fatty acids, respectively (60% and 14% of its composition).^[24]

In *E. precatoria*, the main fatty acids found in fruit juice are: oleic acid (18: 1) with an average concentration of the order of 68.2%, followed by 17.5% palmitic acid (16: 0). With regard to polyunsaturated fatty acids, the acid Linolenic (18: 2, 7, 5%) and linoleic acid (18: 3, 1.7%) were the major compounds.^[25]

The composition of the lipid fraction of *E. oleracea*, which comprises approximately 71% unsaturated fatty acids, 60.8% monounsaturated and 10.4% polyunsaturated. Small amounts of carotenoids, for example, β -carotene, α -carotene, lutein, and α -tocopherol, were detected in the pulp of *E. oleracea*.^[16]

The acai pulp is rich in tocopherols (a-, b-, c- and d-tocopherol), which confirms the nutritional properties of acai with the presence of vitamin E (394 μ g/g of dry matter of α -tocopherol).^[18]

6. TRADITIONAL USE

Acai berry has been used by Native Americans of the South as a source of food and as an herbal remedy for ailments varieties include.

- **Virus and Bacteria- Borne Diseases:** The Acai berry has been used to fight virus and bacteria-borne illnesses including flu, malaria, colds, coughs and fever.
- **Menstrual cramps:** the acai berry can provide a soothing relief from pain and irritation associated with the measurement.
- **Pain reliever:** Acai berry is a good herbal remedy for body and joint pain including arthritis, gout, rheumatism and muscle aches.
- **Improves digestive function:** Acai Berry can improve the digestive system and can prevent and treat conditions such as diarrhea and constipation.
- **Diabetes:** Acai berry is a good herbal remedy to counter diabetes; Controls the level of sugar in the body.
- **Bleeding:** Acai Berry pulp is used to treat bleeding.
- **Diseases kidney:** The peoples indigenous Acai Berry also used to treat kidney - related problems.
- **Protects the liver:** The compounds contained in the Acai berry are believed to have hepatoprotective activity that protects the liver against various ailments. It is used in the treatment of hepatitis and jaundice disease.

- **Relaxing:** Acai berry is taken to relax the body and promote one good sleep and rest.
- **Improves the immune system:** The Acai berry is consumed to promote and strengthen the immune system of our body.

In recent years, its popularity has reached the United States and its advocates have claimed more health benefits from acai. Acai products began to be marketed from supplements to food products that promise varieties of health benefits that now include the following:

- **Anticancer activity:** It is known as a strong antioxidant and prevents the growth of cancer cells and tumors in the human body.
- **Anti-aging:** Acai berry is also widely used as an anti-aging elixir. Improves skin tone and texture while maintaining youthful looking skin.
- **Hair care:** Acai Berry has been used to maintain healthy hair. It is effectively used to maintain beautiful and shiny hair.
- **Care eyes:** Acai Berry is known for providing eye health benefits. It provides relief and tiredness and protects them against various eye problems.
- **Provides heart health benefits:** Acai has been used to correct irregular heartbeat and protect from other heart related illnesses. It is rich in vitamin B complex which is beneficial for maintaining healthy cells and prevent the development of other heart diseases that can include atherosclerosis, syndrome the tunnel carpal and anemia.
- **Erectile dysfunction:** Acai Berry is also used as a supplement to treat erectile dysfunction in men.
- **Weight loss:** Acai berry is popularly known as a weight reducing tonic by stimulating the body's metabolism, improving digestion, and burning and eliminating fats effectively.
- **High blood pressure:** It is also believed to reduce high blood pressure.
- **Cholesterol in the blood:** Acai is also taken to reduce the level of bad cholesterol while maintaining a good level of good cholesterol.
- **Improves brain and mental function:** The Acai berry has been used to stabilize mood, increase brain activity, and is considered a possible cure for Alzheimer's disease.^[26]

7. PHARMACOLOGICAL ACTIVITY

7.1 Antioxidant activity

Antioxidant activity is the most studied property of the *E. oleracea* Mart. The data on the antioxidant

potential of acai fruit disagree.^[13] that anthocyanins are the predominant factor in the antioxidant capacity of acai pulp. The predominant factor in the antioxidant activity of acai is the presence of seven flavonoids present in it (orientina, isoorientina, vitexina, luteolina, criseriol, quercetin and dihydrokaempferol). The antioxidant effect of natural extracts is the synergy between all the compounds present in the extracts, which are capable of efficiently inactivating reactive nitrogen and oxygen species.^[27]

Virtually all the compounds present in açai fruits are recognized antioxidants. The synergistic antioxidant action of fatty acids, vitamins, sterols, flavonoids, anthocyanins and phenolics makes the pulp of this fruit a powerful antioxidant.

Therefore, the richness in chemical compounds of these products could be exploited for this type of treatment, but other studies are needed.^[28]

7.2 Anti-inflammatory activity

The oily extract from acai fruit reduced the number of migrating neutrophils in a model of carrageenan-induced peritonitis in rats. These results suggested that oil fruit of açai has anti-inflammatory activity and antinociceptive.

It was attributed to the presence of flavonoids and a large amount of unsaturated lipids present in the extract.^[29] On the other hand, the pulp of the acai fruit showed potential inhibitory activity of COX-1 and COX-2 cyclooxygenases.^[21]

Acai extracts inhibited the production of interferon gamma lipopolysaccharide and nitric oxide (NO) in a macrophage cell line. Excessive NO production can lead to NO synthase activation, leading to the generation of cells that mediate inflammatory processes. The mechanism of action was associated with inhibition of NO synthase expression.^[4]

7.3 Neuroprotective activity

Acai was more effective in inhibiting A β 1–42 aggregations. Inhibition of β -amyloid aggregation may be the basis of a neuroprotective effect of acai.^[30]

B-amyloid proteins are strongly implicated in the disease of Alzheimer. A negative correlation was reported between acai polyphenol content and levels of lipid and protein damage. These data suggest that acai has a positive contribution to the prevention of the development of age-related neurodegenerative diseases.^[31]

7.4 Anticancer effect

Fractions containing Acai compounds polyphenolic reduced the proliferation of leukemia cells HL-60 through activation of caspase-3 in a dose dependent manner and time. The mechanism of action is associated

with polyphenolic phytochemicals that activate caspase-3, leading to cell death or apoptosis.^[13]

Anti-cancer activity was evaluated in different human malignant cell lines derived from breast and colorectal adenocarcinomas. After treatment, cell viability was measured and the morphological characteristics of the cell were observed. The study showed that acai has antitumor potential in the MCF-7 cell line. This fact demonstrated the need to identify the compounds responsible for this activity and the molecular target in the cell.^[32]

7.5 Uses of acai in cosmetics

The high content of anthocyanins and phenolic compounds with important antioxidant activity was used in the cosmetic preparation for the treatment and prevention of skin damage. Among these products, both the extract and the pulp of the acai fruits are used as wetting agents in creams, hair conditioners and shampoo. The açai fruit pulp has nutritional properties and hair shine. The oil extracted from the pulp is used in shampoos and body lotions.^[33]

The acai glycolic extract was used to prepare sunscreen (o / w) emulsions. The resulting cream showed good protection from UV-A and UV-B factor.^[34]

7.6 Pharmaceutical forms and foods based on acai

Due to the richness of phytochemicals present in the pulp of acai fruit, it is used in a variety of formulations. Freeze dried acai fruit pulp was used in a formulation for erectile dysfunction.^[35]

Acai tablets and capsules can be found on the market. Everything is marketed as a nutritional supplement. In these formulations, lyophilized acai pulp was used.^[36]

In general, many cosmetic and nutritional preparations can be found that contain acai fruit pulp, including juices, powders, capsules, liquids, creams, and lotions.^[37]

8. CONCLUSION

From the general study of the matter of the Acai berry (*Euterpe oleracea*) we conclude that the Acai berry (*Euterpe oleracea*) is a very useful fruit. The information above provides details on the acai berry fruit, its synonyms, biological source, location and cultivation, etc. They are packed with nutrient rich building blocks like antioxidants, phytochemicals, flavonoids, carotenoids, polyphenols, vitamins and minerals. It also has various pharmacological activities such as antioxidants, anti-inflammatories, anticancer, neuroprotective activity, etc.

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