



ACAI (*EUTERPE OLERACEA MART*): ANTIOXIDANT CAPACITY AND ITS PERSPECTIVE FOR THE PREVENTION OF MULTIPLE DISEASES IN THE PERUVIAN AMAZON – A REVIEW

Rafael Julian Malpartida Yapias^{1✉}, Franklin Ore Areche², Jimmy Pablo Echevarria Victorio¹, Walter Javier Cuadrado Campo¹, Alfonso Ruiz Rodriguez², Elmer Robert Torres Gutiérrez¹, Jhon Adolfo Quincho Astete¹, Guillermo Gomer Cotrina Cabello³, Jesús Manuel More López⁴, Eneida Lilia Condor Quinte², Denis Dante Corilla Flores²

¹Altoandina National Autonomous University of Tarma, Tarma – Peru

²National University of Huancavelica, Huancavelica - Peru

³Daniel Alcides Carrión National University, Cerro de Pasco – Peru

⁴Santiago Antunez de Mayolo National University, Huaraz - Peru

✉rmalpartida@unaat.edu.pe

<https://doi.org/10.34302/SI/232>

Article history:

Received:

18 December 2022

Accepted:

19 January 2023

Keywords:

Bioactive

Compounds;

Antioxidant;

Free radicals.

ABSTRACT

The acai (*Euterpe oleracea mart*), is considered a small and round berry, is native to the Amazon rainforest of South America, prevailing in the diet of different indigenous peoples, within the composition of this fruit is recognized different bioactive compounds, where the most impact in reference to health is given to the antioxidant capacity that provides anthocyanins, impacting the slowing of free radicals, this in turn infers in the delay of carcinogenic activity infiriendo in diseases such as: breast cancer, stomach cancer. This fruit is currently generating worldwide expectation, due to its properties, which is why the European continent is one of the largest traders of this fruit, likewise, the United States is considered the largest importer of acai pulp, where this product is not only emphasized to the food industry, it is also diversified for the production of dyes and industrial supplements. The purpose of this work consisted of a systematic review, oriented to the compilation of information on the antioxidant capacity of this berries, influencing in different types of diseases through the importance of its properties, within the search facilities, databases were used attached to keywords in relation to the topic, considering articles from the last five years of publication, finding 41 articles, then hierarchized by filters to obtain only 15 articles focused on the most relevant to the topic.

1.Introduction

The acai (*Euterpe oleracea Mart*), is a small, round berry that is green when immature and purple when ripe, this fruit is native to the Amazon jungle of South America, its main production is given in the swamps and floodplains of the Amazon in northern Brazil, in the Amazon region it is currently considered a fundamental nutritional contribution, especially for indigenous peoples (Baltazar et

al., 2018). There are two main varieties of Acai called black acai and white acai, the black variety is the most popular in the Amazon, as in Peru (Lichtenthaler et al, 2005); The Ministry of Agrarian Development and Irrigation, indicates that, in the department of Loreto, mainly in the province of Ucayali, is the place where the greatest amount of black diamond from the Peruvian Amazon (Acai) is produced.

Brazil is considered the largest producer and exporter of acai. In recent years, this fruit has taken the initiative regarding its implementation as a functional food due to its great antioxidant potential as well as its high vitamin C content. This berry is consumed without cooking, mostly in countries that include the Amazon, likewise it is consumed in drinks in countries where this fruit is not produced. On the other hand, there are companies that are industrially transforming various products such as syrups, jellies, liqueurs, functional and energy drinks, contributing to their commercialization (Montenegro and Rosales, 2015).

In the composition of the acai there are several bioactive compounds, one of which contains considerably anthocyanins, which are flavonoids that contain sugar in position 3, on the other hand, when the anthocyanins known as sugars are delimited as anthocyanidins, to refer to the type of anthocyanins it has. It is necessary to know the sugar units and the type of carbohydrate, among the monosaccharides that are mostly joined to exemplify these compounds we have glucose, galactose, xylose and arabinose (Castillo et al., 2017).

The acai fruit, especially the *oleracea* variety, is characterized by its functional activity due to its antioxidant content and capacity, preventing cardiovascular diseases and delaying carcinogenic activity. Within customer expectations, we can classify this fruit into two qualities: medium and premium, where the difference is the water content, obtaining in the premium quality a higher performance in its useful life when subjected to the lyophilization process (Baltazar et al., 2018). It can not only prevent the diseases mentioned, but also the endemic diseases of the Amazon. According to the National Center for Epidemiology, Prevention and Control of Diseases of the Ministry of Health of Peru (2020), it indicates that the main Amazonian diseases are: malaria, dengue, Zika and chikungunya.

The acai fruit is a product that is currently having an impact on the world market due to its

properties, the countries where it is sold in greater quantities are mainly the United States, Japan and the European continent, likewise the North American country is the world's largest importer of acai pulp, the use of this fruit is not only used in the food industry, it is also diversified for the production of cosmetics, industrial dyes, nutritional supplements, among others (Montenegro & Rosales, 2015). Alarcon (2020) indicates that acai exports in the case of Peru were around \$220.1 million dollars.

The objective of this study is to analyze information on the antioxidant capacity of acai and its health benefits in the population of the Peruvian Amazon.

2. Botanical description

The Acai is a plant belonging to the *Palmae* family, where its fruits have a green coloration during its immature state and a purple pigmentation when its maturation process is finished, in relation to the development of exports there is a very significant variety such as *Euterpe oleracea* Mart, which is found in the estuary of the Amazon River, in Brazil, its harvest season is between the months of July and December, likewise there is another variety such as *Euterpe precatoria* Mart, which has referenced its harvest periods between December and August (Montenegro & Rosales, 2015).

Within the characterization of the fruits of *Euterpe oleracea* Mart, it is made known that it has a smaller diameter in consideration with the fruits of *Euterpe precatoria* Mart, where each berry has a large seed of 7-10 mm, this in turn represents most of the volume of the fruit, Within this seed it is possible to identify different thin fibrous layers and a fat coating, which alludes to the mesocarp of the seed, on the other hand the epicarp is purple considered a very thin layer (Montenegro & Rosales, 2015). Acai productivity in terra Firme forests is 10,000 to 12,000 kilograms of berries per hectare. (Baltazar, Sandoval and Toledo, 2018).

3. Antioxidant capacity of acai

Phenolic compounds are divided into three groups: polyphenols, flavonoids and phenolic acids, the antioxidant capacity of phenolic compounds depends mostly on the number and position of hydroxyl groups, double bonds, these various structural forms reference in the bioavailability of certain compounds, as in the absorption of the gastrointestinal tract and metabolism (Castillo et al., 2017). According to Chang et al (2018), the Acai fruit has main compounds such as total phenols (529 mg GAE/100 g), flavonoids (91.3 mg/100 g), anthocyanins (111 mg/100 g), Vitamin C (84mg/100g).

These phenolic compounds are the ones that insert or provide the capacity of characteristics such as flavor and color in fruits, which are divided into anthocyanins and anthoxanthins, being the most important anthocyanins due to their daily requirement within the diet, which is estimated to be an average of 180 and 215 mg/day, anthocyanins are determined fundamentally by the presence of cyanidins within their structure, this type of compounds are found in cereals, as well as in fruits as well, likewise the intake of these products decreases the risk of cardiovascular disease, tumors, neurodegenerative alterations (Castillo et al., 2017). The main nutraceutical components that acai possesses are monomeric anthocyanins 37.6 mg C3G/100 g and phenolic compounds 257.15 mg GAE/100 g. (Tibérico et al., 2020)

This berry within its composition, the importance of flavonoid content is given, highlighting by the anthocyanin type, the antioxidant capacity of this fruit is estimated at 47.6 μmol , this in turn demonstrates a greater superiority to the capacity given by other types of berries, within a series of investigations it was proposed to determine the content of anthocyanins and their antioxidant power, where the samples made of acai, reacted against free radicals, compared to other types of fruits (Castillo et al., 2017). About the content of the main minerals present in acai are iron (23 mg/100 g), potassium (200 mg/100g)

and calcium (373 mg/100g). (Sanabria & Sangronis, 2007)

4. Attributes and health benefits

The acai is a food that contains antioxidants and many health benefits, within it stands out the acai juice which presents minerals such as calcium, phosphorus, iron, unsaturated fatty acids such as omega 6 and omega 9, amount of vitamin A that its conditioning is of greater compared to other fruits, on the other hand acai pulp provides a necessary caloric intake coming to contain up to 246 calories per 100 grams of pulp consumption (Baltazar et al., 2018).

In case the açai seed meal experienced in the diets of mice reduced lipogenesis preventing the development of fatty liver disease and hypertrophic obesity, this is an indicator that this product can act in obesity treatment. (Cristina et al., 2018). Another study indicates that feeding acai pulp to mice attenuated colon carcinogenesis (Ribeiro et al., 2015)

Acai contains 13.8 g/100g of protein (Sanabria & Sangronis, 2007), a higher proportion than bovine milk, 3.2 g/100 g (Agudelo et al, 2005). The acai fruit contains a protein similar to that found in milk, this fruit in recent years is giving the order around the export positioning a market in the United States and some European countries, according to some practices elaborated in laboratory it could be evidenced that an extract of acai causes a destructive reaction on cancer cells of leukemia in a percentage of 85%, however it is necessary to emphasize that the high amount of antioxidants and pigmentation of the fruit is because of the content of flavonoids (Baltazar et al., 2018).

5. Methodology

5.1. Type of research

The present work is designed on the basis of a systematic bibliographic review, which has the object of study oriented directly to the search for information on the antioxidant capacity of this Peruvian Amazonian berrie and

its influence on the different types of diseases in this area, so that it seeks to have a broader picture regarding its properties and its influence on human health by referring to the Peruvian agro-industrial interest.

5.2. Research design: Search strategies and study selection.

The main sources and databases considered for the systematic review were: Scopus, Scielo and Google Scholar, as well as keywords such as the scientific name "Euterpe oleracea Martius", "Euterpe Olacea mart.", açai, antioxidant capacity, phenolic compounds; the language (English, Portuguese and Spanish) and the last five years of publication were also taken into account.

5.3. Inclusion criteria

For the selection of information, scientific articles with more relevance in the concept and description of açai (Euterpe oleracea Martius), published in Spanish, English and Portuguese

were taken into account, in addition the year of publication was also excluded, taking into account only from 2018 to 2022, excluding articles from previous years.

The process considered for the search of information, was of utmost importance to be able to resort to this information the following databases were used: scopus, scielo, Google academic.

5.4. Exclusion criteria

Articles with content that did not contribute significantly to the objective of the study were excluded, such as those referring to other varieties outside the national territory, as well as those that developed research topics in agronomy and irrelevant information on the subject of the study.

Forty-one documents as in Figure 1 were obtained with information on açai (Euterpe oleracea Martius), data exported to a database to store the articles.

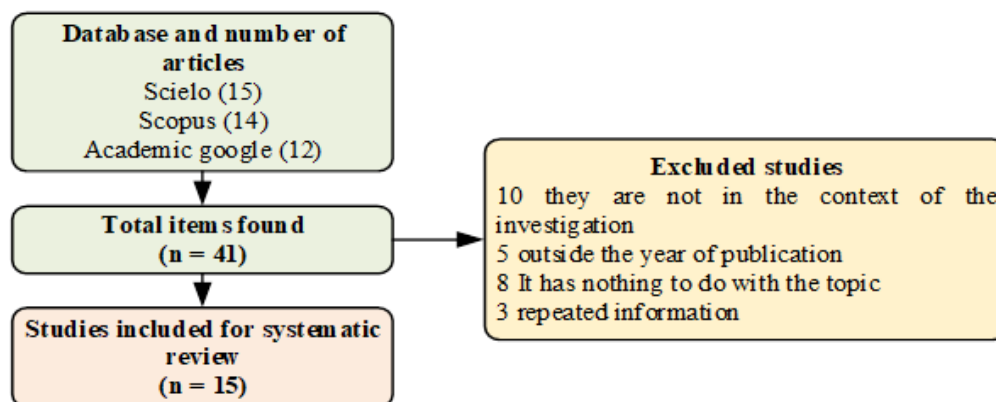


Figure 1. Inclusion and Exclusion criteria

With the keyword Euterpe oleracea Martius 29 articles were found and 12 articles with the keyword açai in all the documents were the keyword antioxidants.

Three databases were reviewed, where 41 review articles referring to Euterpe oleracea

Martius were found, 10 were eliminated for being out of the research context, 5 for being out of the relevant years, 8 articles for information unrelated to the topic and 3 articles for repeated information.

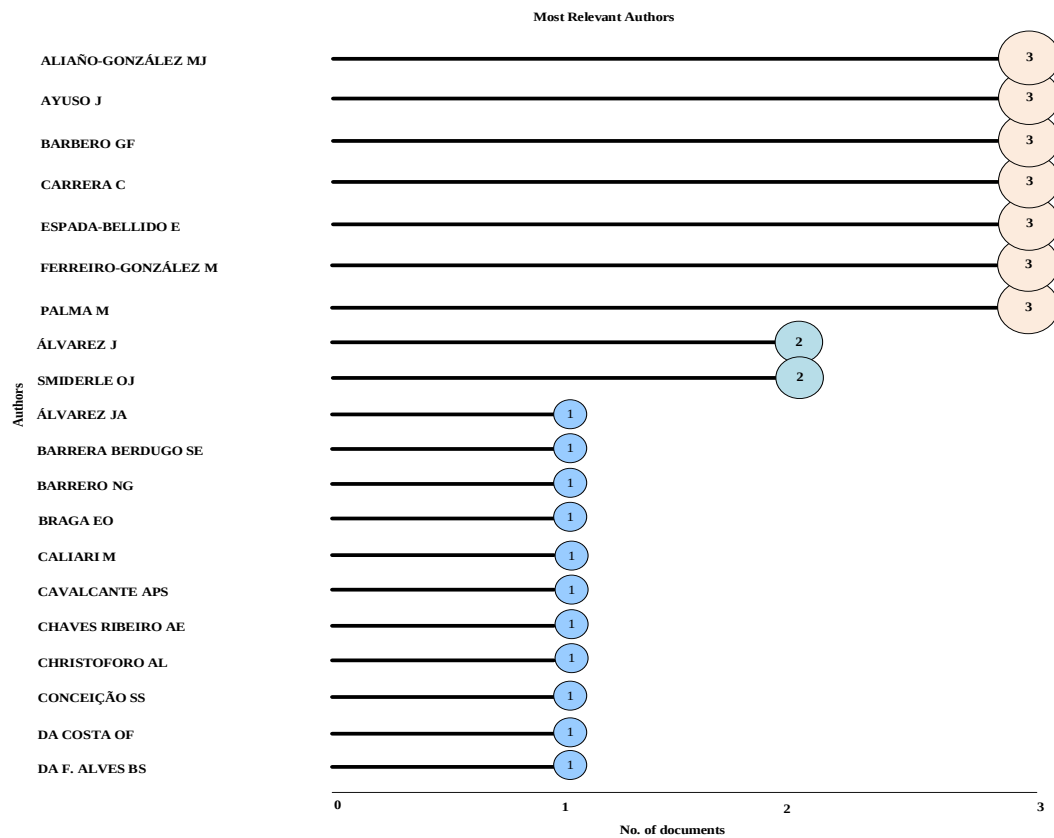


Figure 2. Results of authors with more relevance

Note: The figure shows the number of results on the most relevant authors. Source: biblioshim for bibliometrix (2022).

It can be observed that the authors with the most experience and mastery of the subject are

7 followed by 2 authors who also refer to the knowledge of the subject (Figure 2).

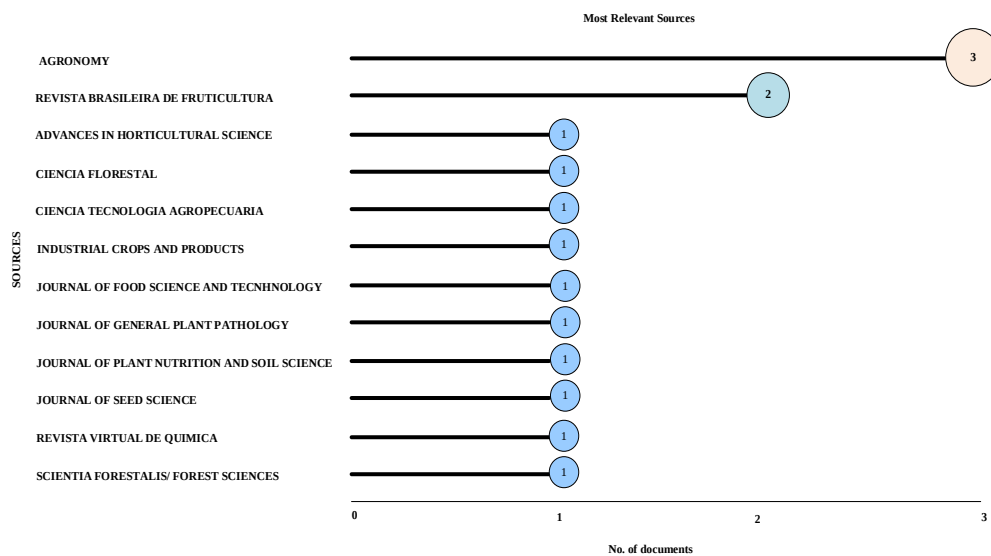


Figure 3. Most relevant sources

Note: The figure shows the relevant sources with respect to the number of citations by various authors. Source: biblioshim for bibliometrix (2022).

The figure visualizes the most important sources, where the authors visited the following

sources as they are the most relevant to obtain information on açai (*Euterpe oleracea* Martius).

Year	Agronomy	Brazilian Magazine of Fruit Growing	Advances in Horticultural Science	Forest Science	Agricultural Science Technology	Crops and Industrial Products	Food Science and Technology Magazine	Journal of General Plant Pathology	Journal of Plant Nutrition and Soil Science	Seed Science Magazine	Virtual Magazine of Chemistry	Scientia Forestalis
2018	0	1	0	0	0	1	0	0	0	1	0	0
2019	0	1	0	1	0	1	1	0	0	1	0	0
2020	3	2	1	1	0	1	1	0	0	1	1	0
2021	3	2	1	1	1	1	1	0	1	1	1	1
2022	3	2	1	1	1	1	1	1	1	1	1	1

Figure 4. Dynamics of origin

Note: The figure shows the exclusion criteria and the origin of the different journals found in the search for information.

Source: biblioshiny for bibliometrix (2022).

In Figure 4 of origin dynamics we can visualize the articles destined to the fields of study such as fruit growing, horticulture, forestry, agricultural technology, agroindustrial products, technology in food, general vegetable, nutrition and soil science, seed science, chemistry virtual, health, science and forestry, in addition they are organized according to the year of publication ranging from 2018 to 2022 this helps us to be able to refer to the subject according to the different branches of study.

In conclusion, the systematic review is of utmost importance to be able to develop of the topic, since it helps us to be able to use articles with greater relevance to develop our specific topic, in addition it can be mentioned that by performing the filter of each article we can exclude terms and topics that are not in relation to the topic to be investigated.

5.5.Population and sample size

For the systematic investigation, information from 10 scientific articles was reviewed after the specific filtering process considering that they have relevance before the contribution in the foundation and theoretical support.

5.6.Method of analysis

In the present research work was developed under the PRISMA methodology (Preferred Reporting Articles for Systematic Reviews and

Meta-Analyzed); the PRISMA methodology is a useful tool in systematic review, it is not only applicable to health reviews, but also to various disciplines (Urrútia & Bonilla, 2010). The application of this method consisted in making a filtering list checking the fundamental information according to the bibliographic search and considering the data flow diagram identified on research studies, so as to facilitate the selection of articles besides allowing to optimize the systematic review through classifications of relevant information considering the inclusion and exclusion criteria.

5.7.Population and sample size

For the systematic investigation, information from 10 scientific articles was reviewed after the specific filtering process, considering that they are relevant in terms of their contribution to the theoretical foundation and support.

6.Results and discussions

The Ministry of Health [MINSA] (2022) reported that the main chronic disease condition suffered by the Peruvian Amazonian citizenry is cervical cancer with 34.9% followed by other types of cancer such as breast cancer occupying second place, and skin cancer in third place.

Song et al. (2021) mention that acai is a source of anthocyanins, is used as a dietary supplement and is an active ingredient for the

pharmaceutical industry. It obtained results of treatments for obesity induced by HFD (high fat), hepatic steatosis and insulin resistance, managing to change the structure of the intestinal microbiota and significantly enriching the intestinal bacteria Akkermansia.

On the other hand, it is evidenced that acai presents antioxidant effects against reactive species that allow the generation of cancer cells, they were found in cells called SH-DY5Y, the hydroethanolic extracts of these fruits act with neuroprotective effects preventing the formation of free radicals and has high content of carotenoids, likewise, the main anthocyanins found cyanidin 3-glucoside and cyanidin 3-rutinosides (Torma et al., 2017).

It was evidenced that the consumption of purple and white acai commercial pulps presents decreased antioxidant capacity in the gastrointestinal digestion stage in vitro, although the content of total phenolic compounds (TPC) are bioaccessible and has higher percentages of minerals such as Calcium with 90%, Magnesium 74.30% and Manganese 64.52%. These are the highest values determined, however, digesting them does not affect the absorption to obtain health benefits for the prevention or reduction of any disease such as cancer, which in the Peruvian Amazon was diagnosed as a type of cancer suffered by citizens in this area of the country (Minighin et al., 2020).

Cedrim et al. (2018) mention that this fruit is a source of anthocyanins that allow modulating lipid metabolism in order to reduce the damage caused by oxidative stress, which affects the development of chronic disease activation, therefore it was shown that the intake of acai pulp by humans reveal that it produces benefits in reducing lipid peroxidation in oxidative stress increasing the protective function of cells in charge of oxygen due to its cellular antioxidant protective effect found in erythrocytes.

7. Conclusions

The research represents a search for information on an Amazonian berry, called acai

(*Euterpe oleracea* Mart), this fruit contains bioactive compounds, such as anthocyanins that stand out for their functional activity due to their antioxidant capacity, contributing to the decrease in the proliferation of cancer cells. counteracting free radicals. Undoubtedly, this berry should be recognized as a potential medicinal food, thus increasing its consumption in society, benefiting from its bioactive components. Consequently, this will generate economy by importing from European countries, as well as its commercialization in Latin America.

8. References

- Agudelo, D. A., & Bedoya Mejía, O. (2005). Composición nutricional de la leche de ganado vacuno. *Magazine Lasallista de Investigación*, 2(1), 38-42
- Alarcon, D. (2020). Plan de Negocio para la Exportación de pulpa congelada de Acai para los Estados Unidos de América (EEUU). Lima, Perú.
- Arias-Giraldo, L. F., Sebastián, Ceballos-Peñaloza, Adela M., Gutiérrez-Mosquera. (2019). Evaluación de los parámetros del proceso de congelación para la pulpa de Açaí. *Magazine Technological*, 22, 29-42.
- Baltazar, V., Sandoval, E., and Toledo, M. (2018). Applied research for the study of acai as an alternative crop for the benefit of the native communities of the low jungle of Peru.
- Carvalho, J. & Oliveira, W. (2018). Technological innovations in the propagation of Açaí palm and Bacuri. *Revista Brasileira de Fruticultura*, 40. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452018000104002&lang=es
- Castillo, Y. M. C., Gómez, M. S. H., & Lares, M. (2017). (*Euterpe oleracea* Mart. Y *Euterpe precatoria* Mart.) y su efecto sobre la salud. *Archivos Venezolanos de Farmacología y Terapéutica*, 36(3), 58-66.
- Cedrim, P., Barros, E., & Nascimento, T. (2018). Antioxidant properties of acai (*Euterpe oleracea*) in the metabolic

- syndrome. *Brazilian Journal of Food Technology*, 21.
<https://doi.org/10.1590/1981-6723.09217>
- Chang, S. K., Alasalvar, C., & Shahidi, F. (2018). Superfruits: Phytochemicals, antioxidant efficacies, and health effects – A comprehensive review. *Critical Reviews in Food Science and Nutrition*, 1–25. doi:10.1080/10408398.2017.1422111
- Cristina, R., Batista, A., Ferraz, D., Moura, N., Correa, J., Aguiar, C., Castro, A., & Beltrame, J. (2018). Açai (*Euterpe oleracea* Mart.) seed flour prevents obesity-induced hepatic steatosis regulating lipid metabolism by increasing cholesterol excretion in high-fat diet-fed mice, *Food Research International*, 111, 408-415, ISSN 0963-9969.
<https://doi.org/10.1016/j.foodres.2018.05.043>.
- Da Silva, S., Moyses, R., & Dos Santos, L. (2021). Contribution of breeding to agriculture in the Brazilian Amazon. I. Açai palm and oil palm. *Crop Breeding and Applied Biotechnology*, 21.
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1984-70332021000500207&lang=es
- De Melo, A., Magalhães, V., Guerreiro, L., & Mansanares, V. (2019). Characterization of acai particles aiming their potential use in construction. *Matter (Rio de Janeiro), Magazine Materia*, 24.
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1517-70762019000300347&lang=es
- De Sousa, G. O., Viégas, I. D. J. M., Galvão, J. R., Conceição, S. S., Yakuwa, T. K. M., Pacheco, M. J. B., & Viana, T. C. (2021). Biochemical modulations in açai palm (*Euterpe oleracea* Mart.) under vegetative stages in an agroforestry system of the Amazon. *Journal of Plant Nutrition and Soil Science*, 184(1), 76-87.
<https://doi.org/10.1002/jpln.202000240>
- De Souza, E., Froder, J., De Oliveira, P., Ferreira, F., Pires, P., Mascarenhas, I., Camargo, M., & Maistro, E. (2019). Cytotoxic effects of *Euterpe oleracea* fruit oil (açai) in rat liver and thyroid tissues. *Revista Brasileira de Farmacognosia*, 29, 54-61.
- Ferreira, E., Rogez, H., & Herman, C. (2018). Effect of the combination of enzymatic preparations on the aqueous extraction yield of the oil from the pulp of *Euterpe oleracea* fruit. *Bioprocess engineering*, 35, 1193-1201.
- Ferreira, J., Cotta, I., Lima, E., Aparecida, A., De Souza, A., & De Paiva, F. (2021). Morphoanatomical and histochemical studies of the seed development of *Euterpe oleracea* (Arecaceae). *Rodriguésia*, 72.
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S2175-78602021000100239&lang=es
- Lichtenthaler R, Rodrigues RB, Maia JG, Papagiannopoulos M, Fabricius H, Marx F. Total oxidant scavenging capacities of *Euterpe oleracea* Mart. (Açai) fruits. (2005). *International Journal Food Sciences and Nutrition*; 56 (1):53-64. doi: 10.1080/09637480500082082
- Medeiros-de-Freitas-Carvalho, M.-L., Mayara, Lélis-Teixeira-Reis, Larissa, Márcia-Macedo-Lopes, Juliana, Nunes-Lage, Nara, Ferreira-da-Costa-Guerra, Joyce, Porto-Zago, Helena, de-Freitas-Bonomo, Larissa, Pereira, Renata-Rebeca, de-Lima, Wanderson-Geraldo, Silva, Marcelo-Eustáquio, Pedrosa. (2018). Açai improves non-alcoholic fatty liver disease (NAFLD) induced by fructose. *Nutrición Hospitalaria*, 35, 318-325.
- Minighin, E., de Souza, K., Valenzuela, V. del C., e Silva, N. de O., Anastácio, L., & Labanca, R. (2020). Effect of in vitro gastrointestinal digestion on the mineral content, phenolic compounds, and antioxidant capacity of commercial pulps of purple and white açai (*Euterpe oleracea* Mart.). *Journal of Food Science and Technology*, 57(5), 1740-1752.
<https://doi.org/10.1007/s13197-019-04207-5>

- Ministerio de Salud [MINSA], (2022). Boletín Epidemiológico-CDC MINSA. CDC MINSA.
<https://www.dge.gob.pe/portalnuevo/>
- Ministerio de Salud del Perú. (2020). Análisis de Situación de Salud de los Pueblos Indígenas de la Amazonía viviendo en el ámbito de las Cuatro Cuencas y el Río Chambira. Lima – Perú.
- Montenegro, S., & Rosales, M. (2015). Fruto de la naidí (*Euterpe oleracea*) y su perspectiva en la seguridad alimentaria colombiana. *Entramado*, 11(2), 200-207.
<https://doi.org/10.18041/entramado.2015v11n2.22238>
- Navegantes, J. A. R., Patricia Cardoso Andrade, Oliveira, Maria do Socorro Padilha de, Nunes. (2018). Genetic parameters of traits at the juvenile stage of different assai palm tree progenies. *Pesquisa Agropecuária Brasileira*, 53, 815-823.
- Pessanha, R. L. de O., Kênia Letícia Ferreira, Farias, Mônica Guimarães, Carvalho, Carlos Wanderlei Piler, Godoy. (2018). Starch Films Added of Açaí Pulp (*Euterpe oleracea* Martius). *Brazilian Archives of Biology and Technology*, 61.
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-89132018000100504&lang=es
- Ribeiro, A., Chaves, A., Resende, É., Da Silva, M., Soares, J., & Caliar, M. (2019). Grãos de arroz partidos com farinhas pré-gelatinizadas incorporadas com polpa liofilizada de açaí e o efeito da extrusão nas suas propriedades físico-químicas. *Journal of Food Science and Technology*, 56(3), 1337-1348. <https://doi.org/10.1007/s13197-019-03606-y>
- Ribeiro, G., Franco, M., Galhardo, R., Pessanha, M., Henrique, A., Barbisan, L. (2015). Protective effects of spray-dried açaí (*Euterpe oleracea* Mart) fruit pulp against initiation step of colon carcinogenesis. *Food Research International*, 77, (3). 432-440, ISSN 0963-9969,
<https://doi.org/10.1016/j.foodres.2015.08.037>.
- Sanabria, N. y Sangronis, E. (2007). *Archivos Latinoamericanos de Nutrición*, 57(1), 94-99. Recuperado en 11 de enero de 2023, de http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0004-06222007000100013&lng=es&tlng=es.
- Silva, J. C. T., Heitor Ribeiro da, Assis, Daniele da Cruz de, Prada, Ariadna Lafourcade, Silva Júnior, José Otávio Carrera, Sousa, Mayara Brito de, Ferreira, Adriana Maciel, Amado, Jesus Rafael Rodríguez, Carvalho, Helison de Oliveira, Santos, Abrahão Victor Tavares de Lima Teixeira dos, Carvalho. (2019). Obtenção e caracterização de antocianinas a partir de extracto seco de *Euterpe oleracea* (açaí) para nutracêuticas e preparações alimentares. *Revista Brasileira de Farmacognosia*, 29, 677-685.
- Siqueira, Y., Silva, A. Santos, K., Barbosa, Thaís Alves, Freire, Lucas de Alvarenga Santos, Camêlo. (2018). Diferenças tecnológicas entre as polpas de açaí e juçara e os seus sorbets. *Brazilian Journal of Food Technology*, 21.
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1981-67232018000100416&lang=e
- Song, H., Shen, X., Deng, R., Zhang, Y., & Zheng, X. (2021). O extracto de açaí rico em antocianina protege da obesidade induzida pela dieta, da esteatose hepática e da resistência à insulina com modulação da microbiota intestinal em ratos. *Nutrição*, 86(111176).
<https://doi.org/10.1016/j.nut.2021.111176>
- Tibérico, A., Cristianini, M., Medina, N., Maróstica, M. (2020). Effects of high hydrostatic pressure on the microbial inactivation and extraction of bioactive compounds from açaí (*Euterpe oleracea* Martius) pulp, *Food Research International*, 30, 108856, ISSN 0963-9969.
<https://doi.org/10.1016/j.foodres.2019.108856>.

- Torma, P., Brasil, A., Carvalho, A., Jablonski, A., Rabelo, T., Moreira, J., Gelain, D., Flôres, S., Augusti, P., & Rios, A. de O. (2017). Extractos hidroetanólicos de diferentes genótipos de açaí (*Euterpe oleracea*) apresentavam potencial antioxidante e protegiam células semelhantes a neurónios humanos (SH-SY5Y). *Food Chemistry*, 222, 94-104. <https://doi.org/10.1016/j.foodchem.2016.12.006>
- Urrutia, G. y Bonfill, X. (2013). Declaración PRISMA: una propuesta para mejorar la publicación de revisiones sistemáticas y metaanálisis. *Revista Española de Salud Pública*; 87 (2); 507 -511.