

Mini Review

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Volume 1 : Issue 1

Article Ref. #: 1000AFTNSOJ1101

Article History

Received: March 6th, 2014

Accepted: March 31st, 2014

Published: April 14th, 2014

Citation

Mena F. The berry fruit açai (*Euterpe oleracea* Mart): Bringing health benefits and exotism to the modern table. *Adv Food Technol Nutr Sci Open J*. 2014; 1(1): 1-4. doi: [10.17140/AFTNSOJ-1-101](https://doi.org/10.17140/AFTNSOJ-1-101)

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The Berry Fruit Açai (*Euterpe oleracea* Mart): Bringing Health Benefits and Exotism to the Modern Table

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INTRODUCTION

The palm Amazonian fruit açai (Magnoliophyta: Arecaceae, *Euterpe oleracea* Martius) has been applied in folk medicine.¹ Nowadays, this exotic berry fruit is commonly used to make beverages (i.e. juices) and food preparations (e.g. ice creams).^{2,3}

Açai is widely distributed in northern South America where it is traditionally consumed.¹⁻³ In the recent years, açai has gained popularity abroad as a food and functional ingredient. It has then considerable both nutritional and economic importance (e.g. exportation). This is mainly due to both its content in bioactive molecules benefiting health.

Indeed, considerable research has been made on the fruit's pulp of açai. Some highlights include: (i) the relatively high presence of certain polyphenols (e.g. flavonoids especially proanthocyanins and, in a lesser extent, anthocyanins such as cyanidin 3-glucoside and cyanidin 3-rutinoside) as well as in carotenoids, ascorbic acid (*aka* vitamin C)⁴⁻⁸; (ii) the subsequent relatively strong anti-oxidant activity (e.g. scavenging of free Radical Oxygen Species (ROS) such as superoxide (O₂⁻) and peroxy (ROO⁻) radicals,^{4,6-7,9} which is discussed to contribute to the prevention of several inflammatory-state diseases (e.g. non-communicable pathologies such as diabetes, arthritis, cancers). In fact, it is commonly accepted that açai fruit represents an interesting functional food for disease prevention and therapy, and one of the berry fruits (along with blueberry and cranberry) that display the most anti-oxidant potency.¹⁰

HEALTH BENEFITS OF THE AÇAÍ FRUIT

Preventive and Therapeutic Effects

Açai's health benefits are based on consistent experimental studies that range from cells (e.g. microglial, cancer cells) to animal models (e.g. flies, rodents, zebrafish). Nevertheless, there is still a paucity of reports using different parts of the açai fruit other than the pulp, and so, the assessment of their comparative effects in humans is not relevant yet.

Briefly, this exotic "super food" is recognized for its potential against:

- (i) *Inflammation* (e.g. inhibition of NF-κB activation and MAPK pathway; inhibition of Cyclooxygenase (COX) 1/2 activities);¹¹⁻¹⁴
- (ii) *Aging* (i.e. increased longevity in flies submitted to a high Saturated Fatty Acid (SFA) diet or deficient in enzymatic anti-oxidants such Superoxide Dismutase 1 (SOD1); dermatological care against disorders such as psoriasis, atopic dermatitis; cosmetic care);¹⁵⁻¹⁹
- (iii) *Cancers* (e.g. induced apoptosis of leukemia cells; prevention of chemically-induced esophageal, bladder, or colon cancer in rodents);²⁰⁻²³
- (iv) *Cardiovascular disease* (i.e. vasodilatation effect mediated by Nitric Oxide (NO)/cyclic

Guanosine Monophosphate (cGMP)/Endothelium-Derived Hyper Polarizing Factor (EDHF) pathway; improvement of the lipid profile and attenuation of atherosclerosis);²⁴⁻²⁷

(v) *Metabolic syndrome* (e.g. amelioration of the lipid profile such as reduction of LDL-cholesterol (i.e. “bad” cholesterol) and improvement of the post-prandial increase in plasma glucose following the standardized meal in humans; possible prevention and control of Type-2 Diabetes (T2D) *via* Fenofibrate drug-like molecular mechanism involving Phosphoenolpyruvate Carboxykinase (PEPCK) down-expression in flies);^{15,28}

(vi) *Infections* (e.g. through stimulation of innate immune response);^{29,30}

(vii) *Pain* (e.g. reduction of C-Reactive Protein (C-RP) in humans, *albeit* not statistical significant);³¹

(viii) *DNA damage* (e.g. decreased damages induced by drugs such doxorubicin in murine erythrocytes, and those generated by H₂O₂ in several cerebral tissues of rats, *via* anti-oxidant activities).^{32,33}

Benefits of Açai for Disease Diagnosis and Biotechnology

Besides the preventive and potential therapeutic effects of the whole açai, the açai pulp can be used for disease diagnosis. Indeed, pulp açai has been shown to be valuable for biomedical imaging, specifically as an alternative oral contrast agent in Magnetic Resonance Imaging (MRI), due to its content in iron (Fe), manganese (Mn) and copper (Cu) ions.³⁴ Moreover, anthocyanins from the whole açai fruit can be used as potential dyes to enhance visualization of the intraocular microstructures during vitreoretinal surgery.³⁵ However, it is important to keep in mind that some polyphenols such anthocyanins have a low chronic systemic bioavailability after oral administration.³⁶ Nevertheless, in an acute human consumption trial or after repeated concentrations intake, açai’s anthocyanins can be found significantly increased in the plasma.³⁷ In this context, additional bioavailability studies are thus requested to determine the efficient minimal dose of açai’s anthocyanins (e.g. as a whole fruit, pulp or juice extracts, blend juice, pure derived-bioactive alkaloids).

PUBLIC HEALTH CONCERNS

According to recent studies,³⁸⁻⁴¹ açai fruit can be contaminated by the parasite *Trypanosoma cruzi*, which is responsible for Chaga’s disease. In this regard, mandatory sanitary vigilance of the açai products is requested before consumption and biotechnological uses. Besides, to the best of my knowledge, there is no relevant information about açai-induced toxicity in humans.

CONCLUSIONS: CHALLENGES AND PROSPECTS

Açai is a valuable functional food for healthcare. Likewise for resveratrol,^{42,43} considered as the most potent anti-oxidant, the nanoencapsulation of açai extracts, açai blends or pure açai-based alkaloids might improve the clinical outcome in patients with specific health conditions (e.g. skin disorders, inflammatory diseases). Nano-açai products may also be valuable for the development of innovative cosmetics. Eventually, human experiments from both açai extracts and derived-bioactive pure chemicals are requested in order to precisely evaluate their respective molecular effects in disease prevention, diagnosis and therapy as well in esthetics (e.g. açai-based cream formulations). If it is proven that açai extracts or derived pure molecules effects are valuable in humans, then it should be used in a routine clinical setting. Indeed, studies in rodent models are invaluable for understanding the potential cellular mechanisms for the pathogenesis of insulin resistance,⁴⁴ and genomic responses in mouse models poorly mimic human inflammatory diseases.^{45,46} An explanation is that, in terms of evolution, large mammals display a lower mass-specific basal metabolic rate (m-BMR in g/ml of O₂ per h) when allometrically compared with small ones (e.g. human species showed a 93.6% decrease in mass-specific basal metabolic rate compared with the mouse species).^{47,48} Therefore, rather than over-relying on animal models to understand what happens in humans, isn’t time to embrace the human ‘model’ to move forward?

ACKNOWLEDGMENTS

The author would like to thank Dr. Abder Mena, MD, specialist in nutrition and anti-aging medicine, for having kindly accepted to review this article.

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