ADVANCES IN FOOD TECHNOLOGY AND NUTRITIONAL SCIENCES

Openventio PUBLISHERS

ISSN 2377-8350 Open Journal http://dx.doi.org/10.17140/AFTNSOJ-1-101

Mini Review

*Corresponding author
Farid Menaa, MD, PhD, EMBA
Department of Oncology and Food Nanotechnology
Fluorotronics Inc. & Co.
San Diego, CA, USA
E-mail: dr.fmenaa@gmail.com

Volume 1 : Issue 1
Article Ref. #: 1000AFTNSOJ1101

Article History
Received: March 6th, 2014
Accepted: March 31st, 2014
Published: April 14th, 2014

Citation
Menaa 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

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

Farid Menaa*

Department of Oncology and Food Nanotechnology, Fluorotronics Inc. & Co. San Diego, CA, USA

INTRODUCTION

The palm Amazonian fruit açai (Magnoliophyta: Arecaceae, Euterpe oleraceae 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 beneficiating 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 cyandin 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 (O_2^-) and peroxyl (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 AÇAI 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

ISSN 2377-8350 Open Journal http://dx.doi.org/10.17140/AFTNSOJ-1-101

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 H_2O_2 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 O_2 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 Menaa, MD, specialist in nutrition and anti-aging medicine, for having kindly accepted to review this article.

REFERENCES

1. Plotkin MJ, Balick MJ. Medicinal uses of South American palms. *J Ethnopharmacol*. 1984; 10(2): 157-179. doi: 10.1016/0378-8741(84)90001-1

2. Sabbe S, Verbeke W, Deliza R, Matta VM, Van Damme P. Consumer liking of fruit juices with different açaí (Euterpe oleracea Mart.) concentrations. *J Food Sci*. 2009; 74(5): S171-176. doi: 10.1111/j.1750-3841.2009.01146.x

3. Gironés-Vilaplana A, Villaño D, Moreno DA, García-Viguera C. New isotonic drinks with antioxidant and biological capacities from berries (maqui, açaí and blackthorn) and lemon juice. *Int J Food Sci Nutr*. 2013; 64(7): 897-906. doi: 10.3109/09637486.2013.809406

4. Rodrigues RB, Lichtenthäler R, Zimmermann BF, et al. Total oxidant scavenging capacity of Euterpe oleracea Mart. (açaí) seeds and identification of their polyphenolic compounds. *J Agric Food Chem*. 2006; 54(12): 4162-4167. doi: 10.1021/jf058169p

5. Schauss AG, Wu X, Prior RL, et al. Phytochemical and nutrient composition of the freeze-dried amazonian palm berry, Euterpe oleraceae mart. (acai). *J Agric Food Chem*. 2006;

ISSN 2377-8350 Open Journal http://dx.doi.org/10.17140/AFTNSOJ-1-101

54(22): 8598-8603. doi: 10.1021/jf060976g

6. Pacheco-Palencia LA, Mertens-Talcott S, Talcott ST. Chemical composition, antioxidant properties, and thermal stability of a phytochemical enriched oil from Acai(Euterpe oleracea Mart.) *J Agric Food Chem*. 2008; 56(12): 4631-4636. doi: 10.1021/jf800161u

7. Chin YW, Chai HB, Keller WJ, Kinghorn AD. Lignans and other constituents of the fruits of Euterpe oleracea (Acai) with antioxidant and cytoprotective activities. *J Agric Food Chem*. 2008; 56: 7759-7764. doi: 10.1021/jf801792n

8. Del Pozo-Insfran D, Brenes CH, Talcott ST. Phytochemical composition and pigment stability of Açai (Euterpe oleracea Mart.) *J Agric Food Chem*. 2004; 52(6): 1539-1545. doi: 10.1021/jf035189n

9. Lichtenthäler R, Rodrigues RB, Maia JG, Papagiannopoulos M, Fabricius H, Marx F. Total oxidant scavenging capacities of Euterpe oleracea Mart. (Açaí) fruits. *Int J Food Sci Nutr*. 2005; 56(1): 53-64. doi: 10.1021/jf058169p

10. Seeram NP, Aviram M, Zhang Y, et al. Comparison of antioxidant potency of commonly consumed polyphenol-rich beverages in the United States. *J Agric Food Chem*. 2008; 56: 1415-1422. doi: 10.1021/jf073035s

11. Schauss AG, Wu X, Prior RL, et al. Antioxidant capacity and other bioactivities of the freeze-dried Amazonian palm berry, Euterpe oleraceae mart. (acai). *J Agric Food Chem*. 2006; 54(4): 8604-8610. doi: 10.1021/jf0609779

12. Jensen GS, Wu X, Patterson KM, et al. In vitro and in vivo antioxidant and anti-inflammatory capacities of an antioxidant-rich fruit and berry juice blend. Results of a pilot and randomized, double-blinded, placebo-controlled, crossover study. *J Agric Food Chem*. 2008; 56(18): 8326-8333. doi: 10.1021/jf8016157

13. Poulose SM, Fisher DR, Larson J, et al. Anthocyanin-rich açai (Euterpe oleracea Mart.) fruit pulp fractions attenuate inflammatory stress signaling in mouse brain BV-2 microglial cells. *J Agric Food Chem*. 2012; 60(4): 1084-1093. doi: 10.1021/jf203989k

14. Xie C, Kang J, Li Z, et al. The açaí flavonoid velutin is a potent anti-inflammatory agent: blockade of LPS-mediated TNF-α and IL-6 production through inhibiting NF-κB activation and MAPK pathway. *J Nutr Biochem*. 2012; 23(9): 1184-1191. doi: 10.1016/j.jnutbio.2011.06.013

15. Sun X, Seeberger J, Alberico T, et al. Açai palm fruit (Euterpe oleracea Mart.) pulp improves survival of flies on a high fat diet. *Exp Gerontol*. 2010; 45(3): 243-251. doi: 10.1016/j.exger.2010.01.008

16. Liedo P, Carey JR, Ingram DK, Zou S. The interplay among dietary fat, sugar, protein and açai (Euterpe oleracea Mart.) pulp in modulating lifespan and reproduction in a Tephritid fruit fly. *Exp Gerontol*. 2012; 47(7): 536-539. doi: 10.1016/j.exger.2012.05.001

17. Laslo M, Sun X, Hsiao CT, Wu WW, Shen RF, Zou S. A botanical containing freeze dried açai pulp promotes healthy aging and reduces oxidative damage in sod1 knockdown flies. *Age (Dordr)*. 2013; 35(4): 1117-1132. doi: 10.1007/s11357-012-9437-3

18. Fowler JF Jr, Woolery-Lloyd H, Waldorf H, Saini R. Innovations in natural ingredients and their use in skin care. *J Drugs Dermatol*. 2010; 9(6 Suppl): S72-81; quiz s82-83.

19. Baumann L, Woolery-Lloyd H, Friedman A. "Natural" ingredients in cosmetic dermatology. *J Drugs Dermatol*. 2009; 8(6 Suppl): S5-S9.

20. Del Pozo-Insfran D, Percival SS, Talcott ST. Acai (Euterpe oleracea Mart.) polyphenolics in their glycoside and aglycone forms induce apoptosis of HL-60 leukemia cells. *J Agric Food Chem*. 2006; 54(4): 1222-1229. doi: 10.1021/jf052132n

21. Stoner GD, Wang LS, Seguin C, et al. Multiple berry types prevent N-nitrosomethylbenzylamine-induced esophageal cancer in rats. *Pharm Res*. 2010; 27(6): 1138-1145.doi: 10.1007/s11095-010-0102-1

22. Fragoso MF, Prado MG, Barbosa L, Rocha NS, Barbisan LF. Inhibition of mouse urinary bladder carcinogenesis by açai fruit (Euterpe oleraceae Martius) intake. *Plant Foods Hum Nutr*. 2012; 67(3): 235-241.doi: 10.1007/s11130-012-0308-y

23. Fragoso MF, Romualdo GR, Ribeiro DA, Barbisan LF. Açai (Euterpe oleracea Mart.) feeding attenuates dimethylhydrazine-induced rat colon carcinogenesis. *Food Chem Toxicol*. 2013; 58: 68-76. doi: 10.1016/j.fct.2013.04.011

24. Rocha AP, Carvalho LC, Sousa MA, et al. Endothelium-dependent vasodilator effect of Euterpe oleracea Mart. (Acai) extracts in mesenteric vascular bed of the rat. *Vascul Pharmacol*. 2007; 46(2): 97-104. doi: 10.1016/j.vph.2006.08.411

25. Noratto GD, Angel-Morales G, Talcott ST, Mertens-Talcott SU. Polyphenolics from açaí (Euterpe oleracea Mart.) and red muscadine grape (Vitis rotundifolia) protect human umbilical vascular Endothelial cells (HUVEC) from glucose- and lipopolysaccharide (LPS)-induced inflammation and target microRNA-126. *J Agric Food Chem*. 2011; 59(14): 7999-8012. doi: 10.1021/jf201056x

26. Xie C, Kang J, Burris R, et al. Açaí juice attenuates atherosclerosis in ApoE deficient mice through antioxidant and anti-inflammatory activities. *Atherosclerosis*. 2011; 216(2): 327-333. doi: 10.1016/j.atherosclerosis.2011.02.035

27. Feio CA, Izar MC, Ihara SS, et al. Euterpe oleracea (açai) modifies sterol metabolism and attenuates experimentally-induced atherosclerosis. *J Atheroscler Thromb*. 2012; 19(3): 237-245. doi: 10.5551/jat.11205

28. Udani JK, Singh BB, Singh VJ, Barrett ML. Effects of Açai (Euterpe oleracea Mart.) berry preparation on metabolic parameters in a healthy overweight population: A pilot study. *Nutr J*. 2011; 10: 45. doi: 10.1186/1475-2891-10-45

29. Holderness J, Schepetkin IA, Freedman B, et al. Polysaccharides isolated from Açaí fruit induce innate immune responses. *PLoS One*. 2011; 6(2): e17301. doi: 10.1371/journal.pone.0017301

30. Skyberg JA, Rollins MF, Holderness JS, et al. Nasal Acai polysaccharides potentiate innate immunity to protect against pulmonary Francisella tularensis and Burkholderia pseudomallei Infections. *PLoS Pathog*. 2012; 8(3): e1002587. doi: 10.1371/journal.ppat.1002587

31. Jensen GS, Ager DM, Redman KA, Mitzner MA, Benson KF, Schauss AG. Pain reduction and improvement in range of motion after daily consumption of an açai (Euterpe oleracea Mart.) pulp-fortified polyphenolic-rich fruit and berry juice blend. *J Med Food*. 2011; 14(7-8): 702-711. doi: 10.1089/jmf.2010.0150

32. Ribeiro JC, Antunes LM, Aissa AF, et al. Evaluation of the genotoxic and antigenotoxic effects after acute and subacute treatments with açai pulp (Euterpe oleracea Mart.) on mice using the erythrocytes micronucleus test and the comet assay. *Mutat Res*. 2010; 695(1-2): 22-28. doi: 10.1016/j.mrgentox.2009.10.009

33. Spada PD, Dani C, Bortolini GV, Funchal C, Henriques JA, Salvador M. Frozen fruit pulp of Euterpe oleraceae Mart. (Acai) prevents hydrogen peroxide-induced damage in the cerebral cortex, cerebellum, and hippocampus of rats. *J Med Food*. 2009; 12(5): 1084-1088. doi: 10.1089/jmf.2008.0236

34. Córdova-Fraga T, de Araujo DB, Sanchez TA, et al. Euterpe Olerácea (Açaí) as an alternative oral contrast agent in MRI of the gastrointestinal system: preliminary results. *Magn Reson Imaging*. 2004; 22(3): 389-393. doi: 10.1016/j.mri.2004.01.018

35. Peris CS, Badaro E, Ferreira MA, et al. Color Variation Assay of the Anthocyanins from Açai Fruit (Euterpe oleracea): A Potential New Dye for Vitreoretinal Surgery. *J Ocul Pharmacol Ther*. 2013; 29(8): 746-753. doi: 10.1089/jop.2013.0003

36. Menaa F, Menaa A, Tréton J. Polyphenols against skin aging. In: Watson RR, Preedy VR, Zibadi S, eds. Polyphenols in human health and disease. San Diego, USA: Academic Press, Elsevier Publisher. 2013; 1: 819-827.

37. Mertens-Talcott SU, Rios J, Jilma-Stohlawetz P, et al. Pharmacokinetics of anthocyanins and antioxidant effects after the consumption of anthocyanin-rich acai juice and pulp (Euterpe oleracea Mart.) in human healthy volunteers. *J Agric Food Chem*. 2008; 56(17): 7796-7802. doi: 10.1021/jf8007037

38. Pereira KS, Schmidt FL, Guaraldo AM, Franco RM, Dias VL, Passos LA . Chagas' disease as a foodborne illness. *J Food Prot*. 2009; 72(2): 441-446.

39. Nóbrega AA, Garcia MH, Tatto E, et al. Oral transmission of Chagas disease by consumption of açaí palm fruit, Brazil. *Emerg Infect Dis*. 2009; 15(4): 653-655. doi: 10.3201/eid1504.081450

40. Barbosa RL, Dias VL, Pereira KS, et al. Survival in vitro and virulence of Trypanosoma cruzi in açaí pulp in experimental acute Chagas disease. *J Food Prot*. 2012; 75(3): 601-606. doi: 10.4315/0362-028X.JFP-11-233

41. Souza-Lima RD, Barbosa MD, Coura JR, et al. Outbreak of acute Chagas disease associated with oral transmission in the Rio Negro region, Brazilian Amazon. *Rev Soc Bras Med Trop*. 2013; 46(4): 510-514. doi: http://dx.doi.org/10.1590/0037-8682-1367-2013

42. Menaa F, Menaa A, Tréton J, Menaa B. Nanoencapsulations of Dietary Polyphenols for Oncology and Gerontology: Resveratrol as a Good Example. - Resveratrol Nano-Formulations: Suitable for Cancer Patients and the Elderly? In: Danik M. Martirosyan, ed. Introduction to Functional Food Science. Dallas, Texas, USA: *Functional Food Center, Food Science Publisher*; 2013: 383-404.

43. Menaa F, Menaa A, Menaa B. Polyphenols nanoformulations for topical dermal delivery ad skin tissue engineering. In: Watson RR, Preedy VR, Zibadi S, eds. Polyphenols in human health and disease. Vol 1. San Diego, USA: *Academic Press, Elsevier publisher*; 2013: 839-844.

44. Samuel VT, Shulman GI. Mechanisms for insulin resistance: common threads and missing links. *Cell*. 2012; 148(5): 852-871. doi: 10.1016/j.cell.2012.02.017

45. Seok J, Warren HS, Cuenca AG, et al. Genomic responses in mouse models poorly mimic human inflammatory diseases. *Proc Natl Acad Sci U S A*. 2013; 110(9): 3507-3512. doi: 10.1073/pnas.1222878110

46. Editorial. Of men, not mice. *Nature Medicine*. 2013; 19: 379.

47. Hulbert AJ. Membrane fatty acids as pacemakers of animal metabolism. *Lipids*. 2007; 42(9): 811-819. doi: 10.1007/s11745-007-3058-0

48. White CR, Seymour RS. Mammalian basal metabolic rate is proportional to body mass 2/3. *Proc Natl Acad Sci U S A*. 2003; 100(7): 4046-4049. doi: 10.1073/pnas.0436428100