Açaí seeds as a source of prebiotics (mannan-oligosaccharides)

S.L. Murillo-Franco, J.D. Galvis-Nieto, C.E. Orrego A.
Presenting author: slmurillof@unal.edu.co

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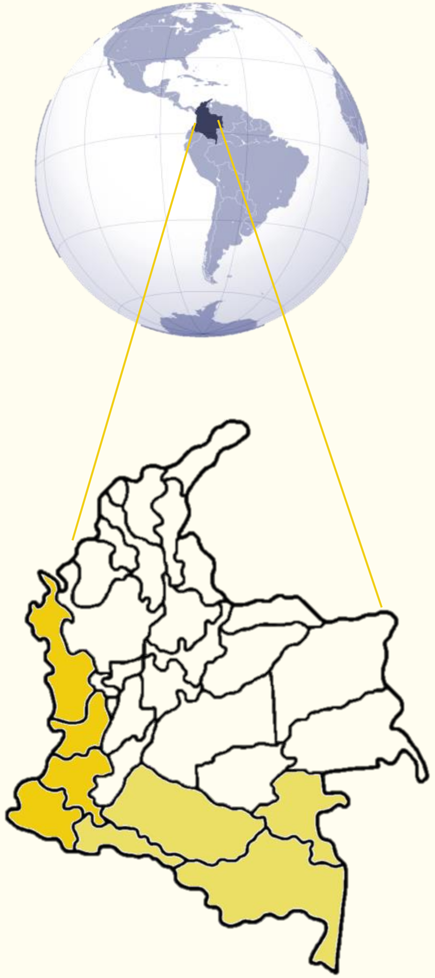
Content

Introduction

The açaí (*Euterpe oleracea*) is recognized as an exotic fruit with high antioxidant power.

Colombia is taking advantage of the areas where the açaí palm grows naturally to facilitate its extensive utilization.

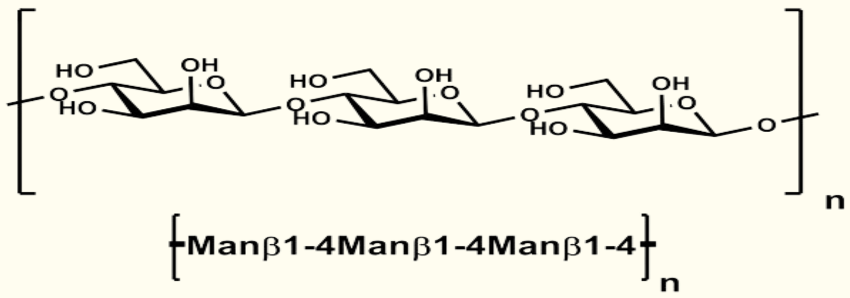


Introduction

The seed and fiber content of the açaí are about 85% or more of the total dry weight [1].

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

There are studies that show that the main component of the açaí seed corresponds to mannan (> 50%), a crystalline polysaccharide [2].



[1] Sato, M.K. *et al.* (2020) 'Biochar as a sustainable alternative to açaí waste disposal in Amazon, Brazil', *Process Safety and Environmental Protection*, 139, pp. 36–46. Available at: https://doi.org/10.1016/j.psep.2020.04.001.
[2] Monteiro, A.F., Miguez, I.S., Silva, J.P.R.B. *et al.* High concentration and yield production of mannose from açaí (*Euterpe oleracea* Mart.) seeds via mannanase-catalyzed hydrolysis. *Sci Rep* **9**, 10939 (2019). https://doi.org/10.1038/s41598-019-47401-3

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Introduction

The sources used to obtain substrates rich in mannan sugars are systems that usually require robust machines for their purification, since they present mannan percentages below 40% [1].

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Table 1. Mannan content in agroindustrial waste

Raw material	%Mannan	Reference
Palm Kernel Cake (PKC)	35.2	(Sathitkowitchai et al., 2022) [2]
Açaí Seed	53.8	(Rambo et al., 2015) [3]
Spent Coffee Ground (SCG)	39.3	(Jooste et al., 2013) [4]
Pine wood	15.79	(Ståhl et al., 2018)

[1] Jorge, F.T.A., da Silva, A.S. and Brigagão, G.V. (2022) 'Açaí waste valorization via mannose and polyphenols production: techno-economic and environmental assessment. https://doi.org/10.1007/s13399-022-02681-0.
[2] Sathitkowitchai, W., Ayimbila, F., Nitisinprasert, S., & Keawsompong, S. (2022). Selection of pretreatment method and mannanase enzyme to improve the functionality of palm kernel cake.. https://doi.org/10.1016/j.jbiosc.2022.06.016
[3] Rambo, M. K. D., Schmidt, F. L., & Ferreira, M. M. C. (2015). Analysis of the lignocellulosic components of biomass residues for biorefinery opportunities. *Talanta*, *144*, 696–703. https://doi.org/10.1016/j.talanta.2015.06.045.
[4] Jooste, T., García-Aparicio, M. P., Brienzo, M., van Zyl, W. H., & Görgens, J. F. (2013). Enzymatic Hydrolysis of Spent Coffee Ground. https://doi.org/10.1007/s12010-013-0134-1
[5] Ståhl, M., Nieminen, K., & Sixta, H. (2018). Hydrothermolysis of pine wood. *Biomass and Bioenergy*, *109*, 100–113. https://doi.org/10.1016/j.biombioe.2017.12.006

Presentation Objective

This is a preliminary study on the characterization of açaí seeds and the process of enzymatic hydrolysis to obtain a mannan sugar-rich substrate from the Colombian Pacific.

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Methodology

Determination of lignocellulosic content, crystallity and the presence of specific functional groups in açaí seeds

Structure Characterization

Table 2. International standard techniques for chemical characterization

Component	Technique
Cellulose	NREL / TP-510-42620
Holocellulose	ASTM standard (D-1104)
Hemicellulose	By difference
Lignin	TAPPI T222

X-ray diffraction

15 A, 30 mV, 2θ range from 2° to 80° with speed of sweep of 1°/min and a step angle of 0.2°.

Infrared spectroscopy

KBr pellet (95:5), Range 400-4000 cm-1, Resolution 4 cm-1.

Methodology

Pretreatment

Açaí seed samples were dried (70°C) and ground (particle size<0.4 mm).

Conditions of enzymatic hydrolysis

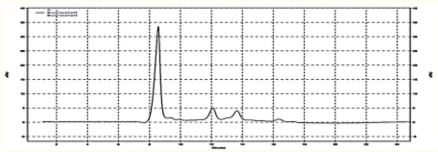
The seed powder was mixed with the enzyme coctel (enzymatic preparation containing mainly mannanase) in a specific enzyme-substrate ratio of 0.675% at 50°C and 350 rpm.

Sugar Quantification

Total soluble sugars (TSS) (Phenol-Sulfuric Method)

Reducing sugar content (RS) (DNS method)

***Estimated index of polysaccharide content (IPC)=** TSS-RS*



HPLC Analysis

Table 2. Conditions of enzymatic hydrolysis of açaí seeds

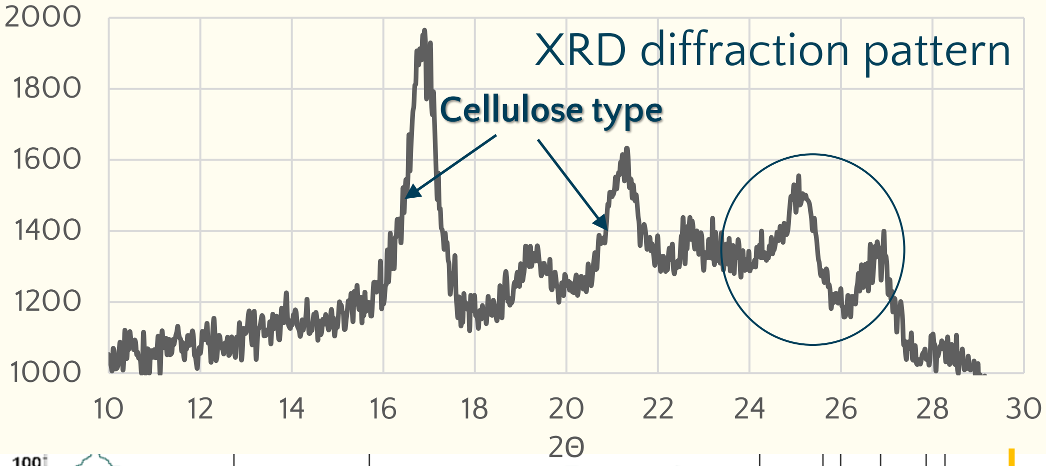
pH	Time
6.5	23
6.5	13
6.5	3
1.5	13
11.5	13

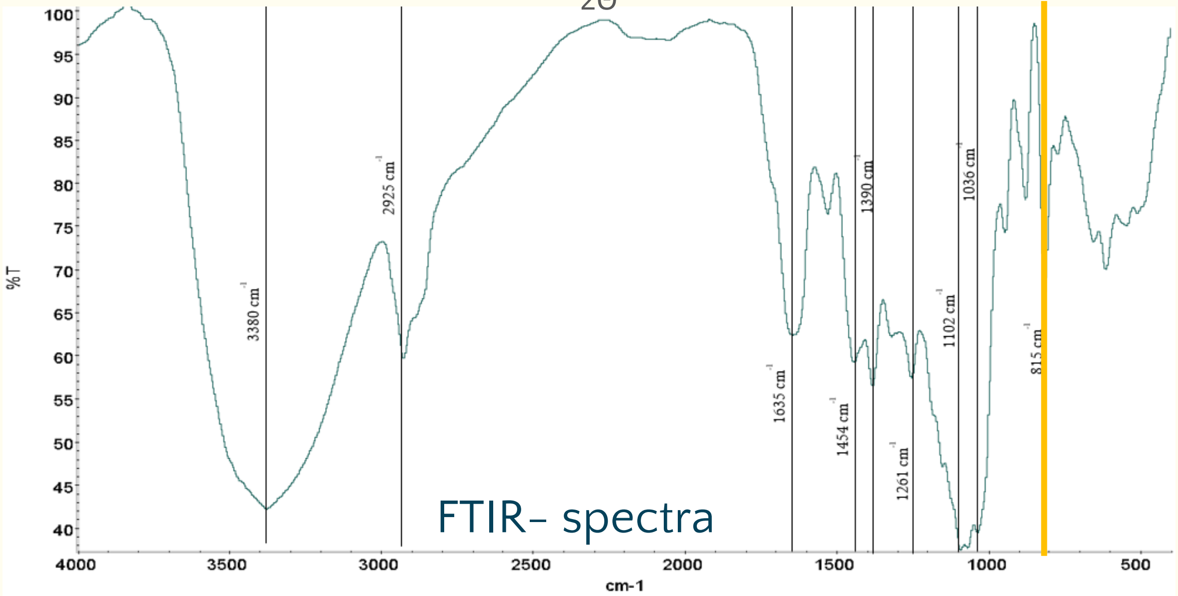
Results

The results show a high hemicellulose content, high crystallinity and spectral intensity typical of mannan-rich products.

Table 3. Chemical characterization of açaí seeds

Component	%Composition	
	This Work	Buratto, R.T. *et al.* (2021)
Cellulose	16.30±1.66	8.5±0.10
Holocellulose	69.61±0.64	-
Hemicellulose	53.30±2.19	48.1±0.45
Lignin	19.87±3.69	16.4±1.7





[1] Buratto, R.T. *et al.* (2021) 'Formulation of açaí (E. oleracea Mart.) Pulp and seeds extracts by co-precipitation in Supercritical Antisolvent (SAS) technology', *The Journal of Supercritical Fluids*, 169, p. 105090. Available at: https://doi.org/10.1016/j.supflu.2020.105090.

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Results

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For the extreme values of pH (1.5 and 11.5) mannose was mainly released and practically no polysacharides were present. In pH 6.5 tests, as the reaction time elapses, the increase in IPC indicated an increasing concentration of oligo and polysaccharides.

Table 4. Preliminary results of the hydrolysis of açaí seeds

pH	Time (Hours)	Carbohydrate Content	
		IPC*=TSS – RS [gr/L]	RS ** [gr/L]
6.5	23	3.18±0.46	8.64±0.27
6.5	13	1.62±0.29	6.73±0.05
6.5	3	0.25±0.03	3.82±0.05
1.5	13	0.029±0.012	7.38±0.02
11.5	13	0.047±0.017	11.16±1.96

** Estimated index of polysaccharide content´(IPC) ** Reducing sugar content*

Table 5. Comparative Studies

pH	Time (Hr)	Raw Material	Carbohydrate Content [gr product/L]	Ref.
6.0	5	Locust Bean	0.52	[1]
5.5	3	Spend Coffee Ground	1.20	[2]

[1] Kumar Suryawanshi, R., & Kango, N. (2021). Production of mannooligosaccharides from various mannans and evaluation of their prebiotic potential. Food Chemistry, 334, 127428. https://doi.org/10.1016/j.foodchem.2020.127428
[2] Wongsiridetchai, C., Chiangkham, W., Khlaihiran, N., Sawangwan, T., Wongwathanarat, P., Charoenrat, T., & Chantorn, S. (2018). Alkaline pretreatment of spent coffee grounds for oligosaccharides production by mannanase from Bacillus sp. GA2(1). Agriculture and Natural Resources, 52(3), 222–227. https://doi.org/10.1016/j.anres.2018.09.012

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Conclusion

- Açaí seeds can be considered as an alternative source for obtaining high amounts of mannose polysaccharides, oligosacharides and monosaccharides.

- At 1.5 and 11.5 pH levels (13 h), it is observed that the preferential reaction to obtain mannose, with a higher yield of total sugar content.

- At intermediate pH, when increase the reaction time also exist an increase in mannose content and in the soluble polysaccharides (including mannan-oligosacharides).

Future Work

1. Optimization for oligosacharide production
2. Validation of prebiotic activity for the product obtained
3. Heterogeneous enzymatic catalyst
4. Technoeconomical and enviromental assesment

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THANKS

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Presenting author: slmurillof@unal.edu.co

**Corresponding author: ceorregoa@unal.edu.co*

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