Nanocellulose Extraction and Characterization from Banana Production Residues

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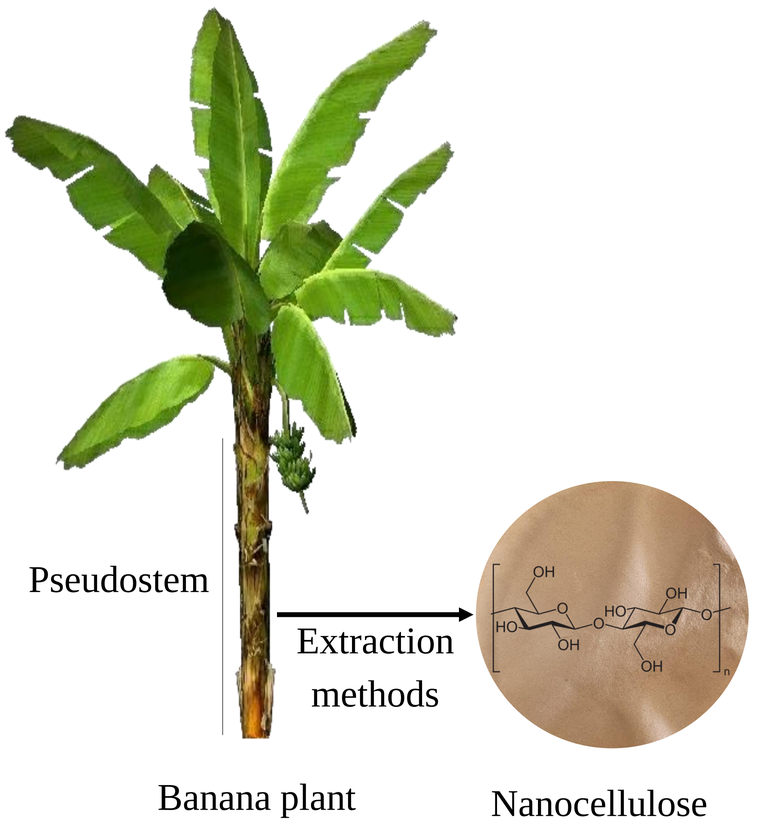
Motivation and Goals

- Banana is the cheapest and most popular fruit throughout tropical and subtropical regions of the world
- Only 12wt% of the plan is used, generating more than 220 tons residues/ hectare of crop
- Nanocellulose is a nano-structured cellulose and present unique properties, such as renewable nature, biocompatibility, small dimensions, anisotropic shape, excellent mechanical properties and enhanced specific surface
- Nanocellulose market is expected to grow from USD 297 million in 2020 to USD 783 million by 2025

This work aims to study different extraction methodologies of the main residue generated from banana production – the pseudostem (PS) – in order to obtain compounds with economic value – as nanocellulose (NC) –, considering the development of an application to these residues that respects the principles of circular economy



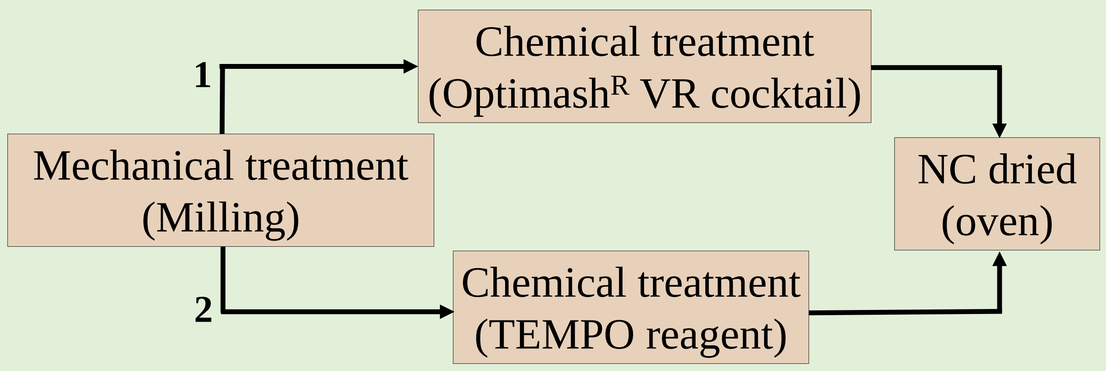
Experimental

Materials

- PS from *Musa acuminata* Colla (Madeira island, Portugal)
- Fiber size used: **≤180 µm and ≥2000 µm**

NC extraction Methods

- **Enzymatic hydrolysis** with Optimash^{R} VR enzymatic cocktail [1]
- **TEMPO oxidation** with 2,2,6,6-tetramethylpiperidine-N-oxyl (TEMPO) [2]

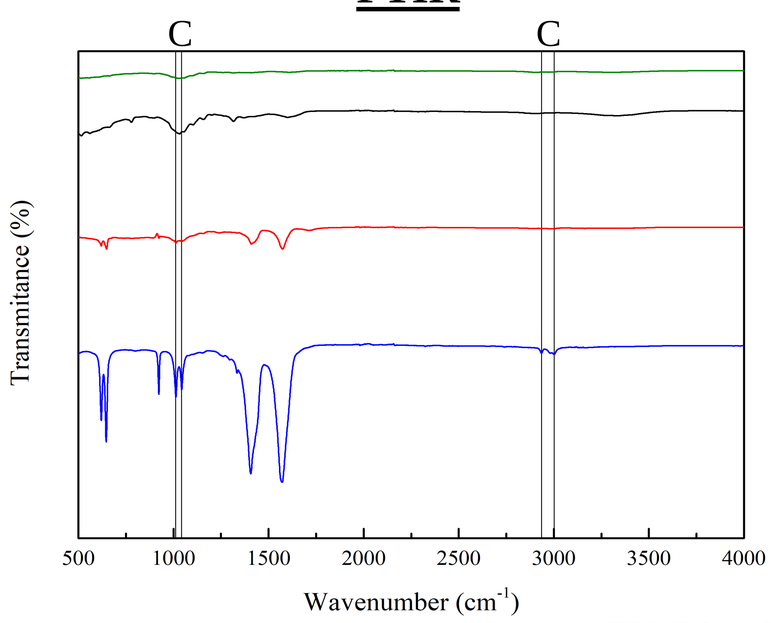


NC characterization: Glucose quantification; Composition by FTIR; Thermal stability by TGA and Crystallinity by XRD

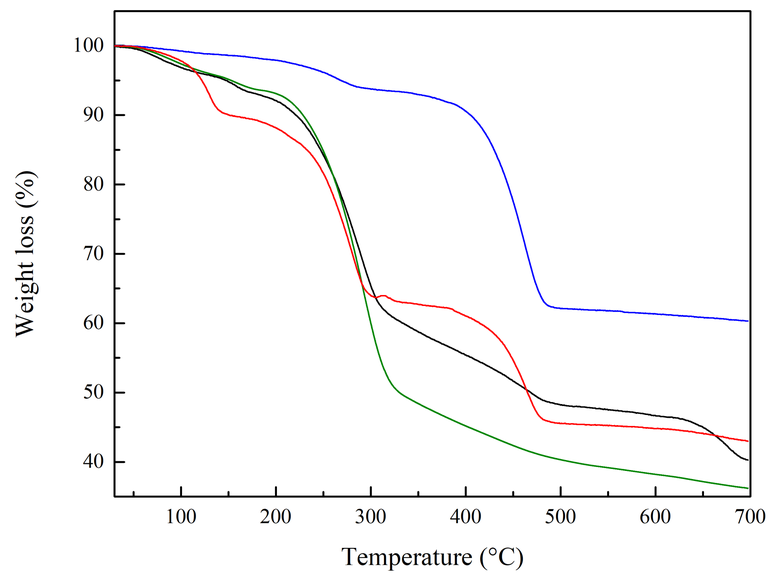
Results and Discussion

- NC successfully extracted from Banana PS
- Increase of thermal stability and crystallinity with the decrease of fiber size
- Most promising results obtained for: fiber size ≤180 µm with the enzymatic extraction method

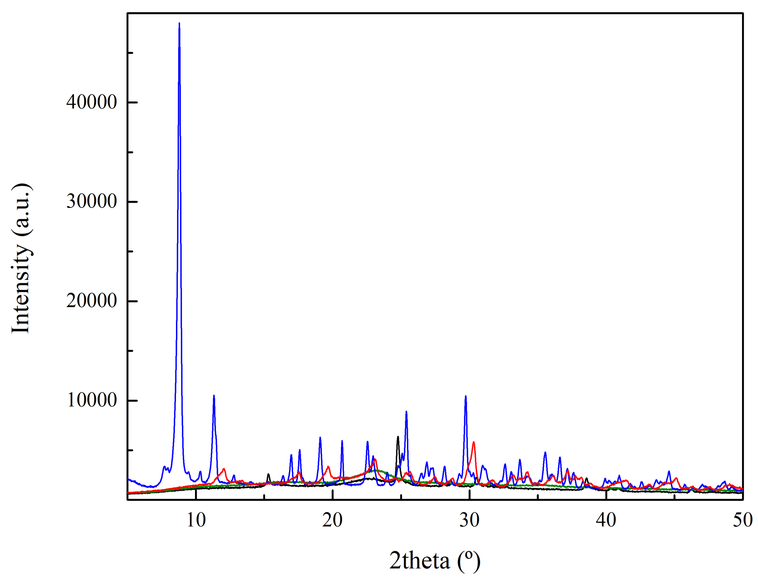
FTIR



TGA



XRD



TEMPO ≤180 µm; TEMPO ≥2000 µm; enzymatic ≤180 µm; enzymatic ≥2000 µm; C = cellulose.

On Going Work

- NC extraction by alkaline-acid hydrolysis and a more green approach by using ionic liquids
- Preparation of polymeric structures based on nanocellulose extracted from PS

References

[1] R.H. F. Faradilla, G. Lee, J. Arns, J. Roberts, P. Martens, M. H. Stenzel, J. Arcot, Characteristics of a free-standing film from banana pseudostem nanocellulose generated from TEMPO-mediated oxidation, *Carbohydrate Polymers*, 174 (2017) 1157.
[2] M. Martelli-Tosi, M. M. Masson, N. C. Silva, B. S. Esposto, T. T. Barros, O. B.G. Assis, D. R. Tapia-Blácido, Soybean straw nanocellulose produced by enzymatic or acid treatment as a reinforcing filler in soy protein isolate films, *Carbohydrate Polymers*, 198 (2018) 62-63.

Acknowledgements

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