Valorisation of lignin-rich food waste examined on the examples of cocoa particles and ground coffee waste

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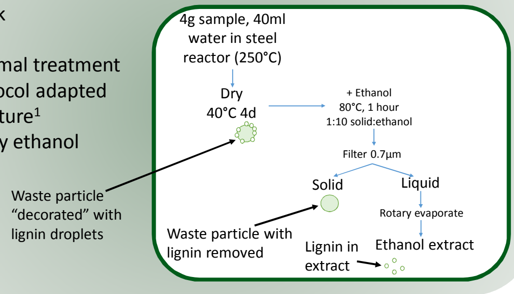
Introduction

Processing and consumer waste from coffee is a lignin-rich waste stream which has been demonstrated to be a suitable feedstock for the creation of functional food ingredients with emulsifying ability based on hydrothermal treatment (processing in aqueous suspension at elevated temperature under pressure)[1]. Similar functionality has been reported for cocoa particles. The possibility of creating lignin-based emulsifiers following extraction of the lignin-rich polymer fraction from softwood has also been reported[2].

The overall aim of this research is to explore the creation of hydrophobic or amphiphilic food particles from lignin extracted from food waste based on an understanding of the impact of feedstock and particle formation process on their functionality. The first objective is to develop an understanding of the extraction process and the material properties combining hydrothermal processing and ethanol extraction.

Feedstock: Source and processing

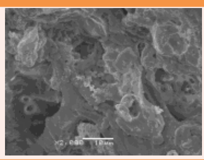
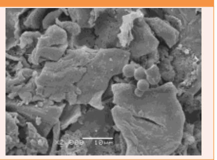
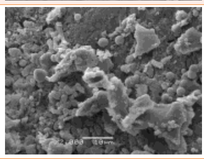
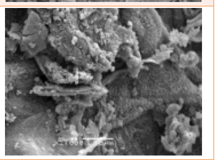
- Ground coffee waste from local outlet
- Cocoa husk
- Hydrothermal treatment using protocol adapted from literature[1] followed by ethanol washing



Results

Surface morphology

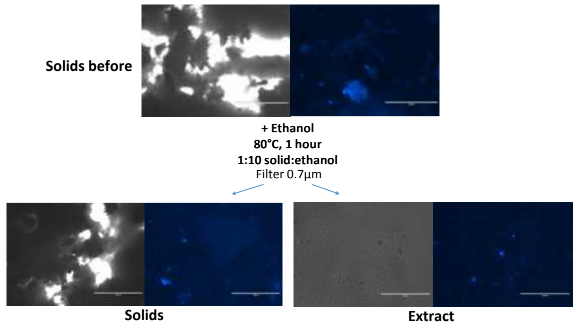
- Visualised via scanning electron micrographs acquired on the dried material after the hydrothermal treatment and ethanol extraction

	Solids after hydrothermal treatment	Solids after ethanol extraction
Coffee		
Cocoa		

- ➢ Surface of cocoa particle shows more droplets than surface of coffee particle
- ➢ Ethanol extraction has removed majority of droplets but seems less effective for coffee

Localisation of lignin

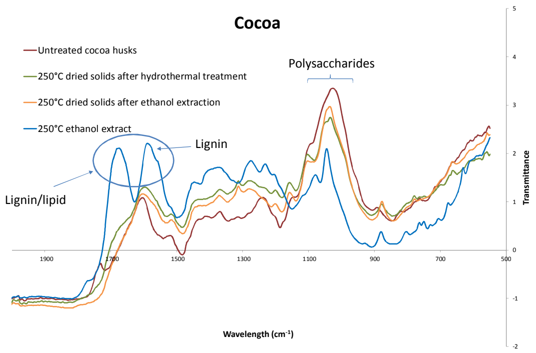
- Building monomers of lignin contain substituted benzene rings which render lignin auto-fluorescent[3]
- Microscopic examination of treated cocoa under bright field and fluorescence illumination



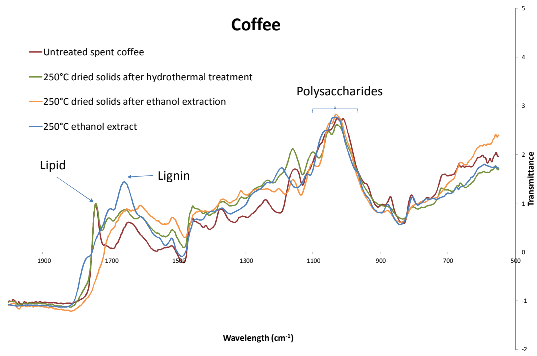
- ➢ Extract shows fluorescence → presence of lignin
- ➢ Extract in solid fraction → process optimisation is required

Chemical fingerprint

- FTIR analysis to determine and compare the functional groups present in the solid and ethanol extracts



- 1740cm^{-1}: lipid content of the biomass[4].
- 1665cm^{-1}: carbonyl stretching of lignin moieties as well as lipid content[4].
- 1580 cm^{-1}: aromatic stretching relating to benzene rings in lignin[5].
- 1050-1020cm^{-1}: polysaccharides including lignocellulose[6,7].



Conclusions

Lignin has been shown to relocate to the surface of the biomass following hydrothermal treatment and the majority of the particles can then be removed via ethanol extraction. Results show cocoa to produce a large amount of droplets which once extracted auto-fluoresce and have an FTIR spectra showing presence of lignin.

Next steps

To produce microparticles suitable as functional food ingredients based on suitable processing routes such as solvent exchange[8].

References
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