

# ULTIMATE EXPLOITATION OF AGRO-INDUSTRIAL RESIDUES: A PROLIFIC CONTRIBUTION TO THE DEVELOPMENT OF BIOCOMPOSITES

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Bio-based Industries Consortium





# ULTIMATE EXPLOITATION OF AGRO-INDUSTRIAL RESIDUES: A PROLIFIC CONTRIBUTION TO THE DEVELOPMENT OF BIOCOMPOSITES



"Integrated cascade PROcesses for the extraction of proteins and bioactive molecules from Legumes, Fungi and Coffee agro-industrial side streams"

Starting: 1° September 2017 Duration: 48 (+2) months

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Horizon 2020 European Union Funding for Research & Innovation



Bio-based Industries Consortium



# The project



# The numbers

- 4.7 Million €
- 17 Partners
  - (Industry/SME, Research Institution, University)
- 8 Countries
- 4 Industrial sectors
- 16 Product Prototypes



### The aim: valorization of untapped biomass streams











# Value chains of coffee residues





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## Residues characterization: thermal degradation

TGA curves

TGA derivative curves





### Residues characterization: thermal degradation



r-CSS-ua is thermally stabler than r-CSS.

Conversely from the defatting treatment, the bleaching increases the thermal stability.

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The selected polymeric matrix A polymer both bio-derived and biodegradable



# The composite preparation

Melt mixing at 140°C in a Brabender microcompounder

Amount of residue in the range: 5-30 wt%

**PBS** poly(1,4-butylene succinate) from pttMCC Biochem - FZ91PM





### Molecular weight of composites



- M<sub>w</sub> of PBS slightly increases with the thermal treatment.
- All residues seems to increase the M<sub>w</sub>, except r-LGB.
- Particularly promising results are obtained with r-LC and r-CSS-ua.





#### Thermal stability of composites

- The thermal stability decreases with the increment of the residue. All the composites are thermally stable up to 360°C.
- The bleaching treatment seems to improve the thermal stability of the composites prepared with r-CSS.
- r-CSS-ua increases the T<sub>ONSET</sub> as well as r-CGB.



# Tensile properties of composites



The worsening in the tensile properties entails weak adhesion between the phases of filler and PBS.

Basically, the composites based on r-LC, r-CSS-ua, and r-CGB-liq show the best appearance, even retaining the PBS flexibility.

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#### COMPOSITES PREPARED WITH RESIDUES OBTAINED FROM SCALED-UP EXTRACTIONS



For both the residues, molecular and thermal properties result roughly confirmed.



#### COMPOSITES PREPARED WITH RESIDUES OBTAINED FROM SCALED-UP EXTRACTIONS



The composites prepared with the scaled-up extracted residues exhibit tensile properties roughly comparable with those of lab-scale.

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## Conclusions

- The preparation of bio-composites based on PBS and various agro-wastes demonstrated the feasibility of the further valorization of the residues remaining after the extractions.
- Thermal and mechanical properties are only slightly modified if a low amount of residue is added, while the material cost decreases.
- The composites based on r-LC, r-CSS-ua, and r-CGB-liq turned out to retain the main properties of the matrix, confirming themselves as the most interesting fillers.
- The dCGB and LC residues derived from the scaled-up extractions allowed producing bio-composites with reproducible properties.



# https://www.prolific-project.eu/

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