



# BIORESCUE: Getting High Added Value Products from Mushroom Compost

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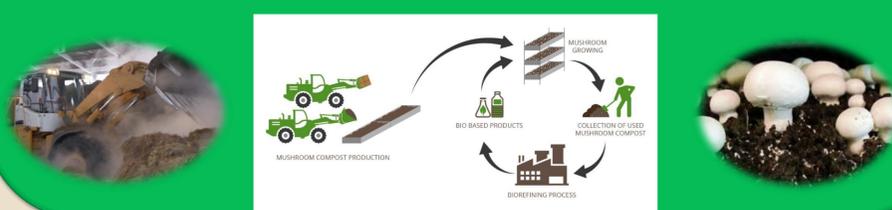
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## CELIGNIS BIOMASS ANALYSIS LABORATORY

- Celignis is a dedicated biomass analysis laboratory that provides our clients with the most precise data, allowing them to make best use of their biomass feedstocks and optimise biomass conversion processes.
- We offer a range of services relevant to the bioeconomy, including:
  - Characterisation of biomass for advanced biofuel production.
  - Evaluation of anaerobic digestion feedstocks and process outputs.
  - Properties related to biomass combustion (e.g. calorific value).
  - Physical properties of biomass (e.g. particle size of wood chips).
  - Analysis of aquatic biomass (e.g. seaweed).
  - Profiling of the liquid outputs of biomass conversion processes.
  - Fermentation trials.
- We are in Limerick and are a spin-out from research at UL which led to significant improvements in the analysis of biomass. We are also currently active in several biomass research projects funded by Horizon 2020.

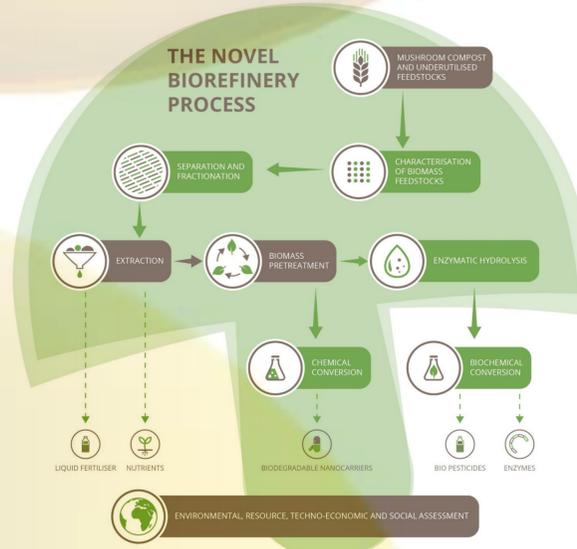
## BIORESCUE PROJECT: THE CHALLENGE

- Spent mushroom compost (SMS) is the residual waste generated by the mushroom production industry, with 3 million tons of this residue generated each year in Europe, resulting in disposal costs of €150m.
- The BIOrescue project, part-funded by the Bio-Based Industries Joint Undertaking, aims to develop an innovative biorefinery strategy to valorise spent mushroom compost together with other underutilised lignocellulosic feedstocks.
- Celignis + 10 partners are involved, including Monaghan Biosciences.



## FEEDSTOCK SUPPLY, CULTIVATION & ASSESSMENT

- ✓ A wide variety of under-utilised feedstocks from different European regions have been analysed to select the best combinations with SMS.
- ✓ Optimal feedstock mixtures of compost, wheat, oat and barley straw have been proposed for a mushroom-farm-based biorefinery based in Ireland.
- ✓ Compost and straw have been collected and analysed over a one-year period in order to determine the variability in their composition. Rapid analysis models, based on the near infrared (NIR) spectra of samples, have been developed by Celignis to predict the composition of compost and straw.
- ✓ These models are accurate, even when the spectra of wet unprocessed samples have been used, and allow for the time for analysis to be reduced from weeks (using standard chemical analysis methods) to seconds.



## SEPARATION & FRACTIONATION

- ✓ CENER conducted preliminary extraction assays on mushroom compost which showed the release of a high amount of soluble compounds.
- ✓ Thermochemical pre-treatment tests were undertaken on SMS alone and in combination with wheat straw (WS) and the underutilised feedstocks barley (BS) and oat straw (OS) using different process conditions. These feedstocks were blended with SMS making out binary (SMS & WS), at a 40:60 wet-basis ratio, and ternary (SMS, WS and OS or BS) blends at a 40:30:30 ratio.
- ✓ Binary and ternary blend slurries composition showed: similar glucan contents but highly-variable soluble xylose; ternary blends had higher variability regarding soluble acetic acid compared to binary mixtures.

## ENZYMATIC HYDROLYSIS

- ✓ MetGen conducted an extensive screening of tailored enzyme solutions (MetZyme® SUNO™) together with hydrolysis conditions for the optimal saccharification efficiency of pre-treated biomass.
- ✓ Best enzyme formulations showed high reducing sugar yields and 80-100% glucan to glucose conversion ratios within the first 24 h of hydrolysis.
- ✓ Aspects like processability and production cost of the enzyme cocktails have been considered, enabling the selection of the most techno-economically feasible solution for the subsequent pilot-scale hydrolysis assays.
- ✓ UNINA has expressed two new cellulases in recombinant forms and characterized them, selecting the best enzyme in terms of catalytic and stability properties.

## CHEMICAL CONVERSION – NANOCARRIER PREPARATION

- The liquid fraction obtained after the pre-treatment was used as a feedstock to produce two different types of biodegradable enzyme-responsive lignin nanocarriers by mini-emulsion polymerization for drug delivery.
- The recalcitrant fraction that remains after enzymatic hydrolysis is also currently being used for nanocarriers production whilst reducing biorefining wastes.

## SUSTAINABILITY ASSESSMENTS

- Initial definition of the biorefinery system boundaries and settings for the environmental, techno-economic and social impact assessments.
- Technical assessments of selected sustainable feedstocks to be used in combination with SMS for different EU regions: Southern → pruning from vineyards; Western → barley straw, oat straw, and poultry litter; Northern → sugar beet pulp; Eastern → apple pomace.

## PROJECT CONSORTIUM



## ACKNOWLEDGEMENTS

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