BIO RESCUE

BIOrescue:
A novel biorefinery concept for mushroom compost

www.biorescue.eu

Deliverable 5.1

Report on nanocarriers production rates and upscaling procedure

31 August 2017

Author: MPIP
Contributors: MetGen, CENER

PUBLISHABLE SUMMARY

One of the objectives of BIOrescue activities within Work Package 5 (Secondary conversion process) is the formulation of lignin-nano/microcarriers by miniemulsion polymerization and their loading with drugs (pesticides, antifungals, both hydrophilic and hydrophobic) as well as their upscaled production.

This report describes the synthesis and investigation of two different types of biodegradable, enzyme-responsive lignin nanocarriers by miniemulsion polymerization for drug delivery, obtained from the water-soluble lignin fraction from the thermochemical pretreatment of mixtures of the spent mushroom substrate (SMS) and wheat straw (WS) produced in Work Package 3 (Separation and Fractionation). The following strategies have been applied:

Maximization of the crosslinking density: in a direct miniemulsion, methacrylated lignin is crosslinked via a nucleophilic addition reaction at the interface. For this system, the crosslinking polymerization of lignin is tailored in order to maximize the particle density which prevents a premature and uncontrolled leaking of the loading. Furthermore, the physicochemical process parameters were studied and optimized (solid content, surfactant type, and concentration, etc.). The results obtained show that with most of the crosslinking agents employed, particles with a diameter of around 200-300 nm and an encapsulation efficiency of more the 95% were obtained. Furthermore, it was found that pyridine can be applied as an alkaline catalyst leading to an increased Sol-fraction. The latter observation could be an indication for a more efficient crosslinking.

High-pressure microfluidization: lignin nanocarriers were generated by selective polyaddition at the oil-water interface by the reaction of a selected organic compound with the lignin hydroxyl groups. This process was upscaled from current milligram amounts to liters. For the upscaling procedure, the external forces in the emulsion are applied from a homogenizator which is available in the department and will guarantee kilogram production level. The results obtained show that high-pressure microfluidization was

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 720708.

BIO-BASED INDUSTRIES Public-Private Partnership

Bio-based Industries Consortium

Horizon 2020 European Union Funding for Research & Innovation

established for the preparation of lignin nanocarriers. A standard protocol for the replacement of water with a selected solvent as continuous phase was developed.

Finally, water-soluble lignin-fractions obtained by CENER were investigated by different spectroscopy techniques. The results obtained show that the highest amount of lignin was achieved when using no catalyst during the hydrothermal treatment or a modified organosolv procedure.

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 720708.

BIO-BASED INDUSTRIES Public-Private Partnership

Bio-based Industries Consortium

Horizon 2020 European Union Funding for Research & Innovation