Natural Nanoemulsions for Waterproofing and Softening Mycelium Textiles

Renko de Vries (WU-PCC), Costas Nikiforidis (WU-BCT), Jacqueline Donkers (WFBR) and Ben van den Broek (WFBR)

Flagship

Transformative bioeconomies: towards a materials transition that phases out fossil feedstock

B: Design Flagship Proof of Principles

Objective(s)

Most biomass is hydrophilic in nature and becomes brittle and glassy in the absence of water, its natural plasticizer. This presents a fundamental problem for turning biomass into flexible and water repellent materials such as textiles and films.
In this project we explore sorption of water soluble biopolymers into biomass that can be used for the sustainable production of renewable textiles and films. The water soluble polymers will be mostly polysaccharides, biomass will be fungal mycelia and citrus fruit peel. Our objective is to identify biopolymers and conditions that lead to strong sorption, such that we can subsequently exploit these for the homogeneous distribution of additives in the biomass. Specifically, we intend to coat natural biomass nano-emulsions (rapeseed oil bodies) with the biopolymers in order to waterproof and plasticize based textiles and films.

Approach

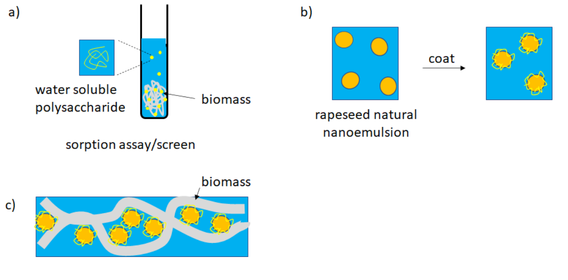

Figure 1. Project approach.
a) Partition assay/screening to determine sorption of water-soluble polysaccharides into biomass as a function of polysaccharide type and sorption conditions (time, pH, salt,...)
b) Coating of rapeseed natural nano-emulsions (oil bodies) with water soluble polysaccharides selected from screening
c) Polysaccharide coating facilitates sorption of nano-emulsion droplets into biomass and ensures homogeneous distribution.

First steps and progress

- Gum arabic and citrus pectin were chosen as water soluble polysaccharides.
- Fluorescene 5-thio semicarbazide (FTSC) was used as fluorescence probe.
- Glucose and galacturonic acid were included as model carbohydrates for coupling with FTSC.
- Three different coupling methods were applied (Figure 2).
- FTCS coupling with gum arabic seems successful. After the coupling reaction the mixture was dialysed and in the retentate (Figure 3A, lane 1) carbohydrates were present and it contained some fluorescence signal (Figure 3B, lane 1).

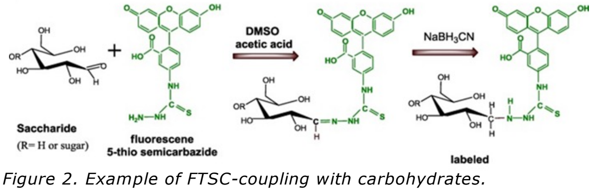

Figure 2. Example of FTSC-coupling with carbohydrates.

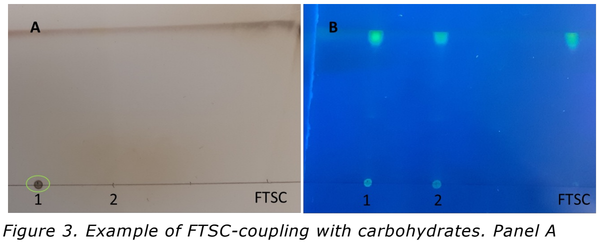

Figure 3. Example of FTSC-coupling with carbohydrates. Panel A shows after acid hydrolysis the presence of carbohydrates (green encircled). Panel B shows the fluorescence signal at 365 nm. Incubation mixture was dialysed and lane 1 shows the retentate and lane 2 the filtrate. FTSC is the fluorophore.

Present state and future steps

Coupling studies with FTSC will be optimized and quantified. Hereafter, the sorption assays will be performed with glucan-chitosan-complex (CGC). If the sorption screening is successful nano-emulsion will be prepared. Confocal laser scanning microscopy (CLMS) experiments were started to become familiar with the apparatus.

Wageningen University & Research
P.O. Box 17, 6700 AA Wageningen
Contact: ben.vandenbroek@wur.nl
T +31 (0)317 480104