Natural Nanoemulsions for Waterproofing and Softening Mycelium Textiles

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

To which design flagship did you submit your proposal?

B: Design Flagship Proof of Principles

What are you exploring? With what objective?

We intend to explore sorption of various 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 nanoemulsions (rapeseed oil bodies) with the biopolymers in order to waterproof and plasticize biomass-based textiles and films.

Why is this interesting scientifically?

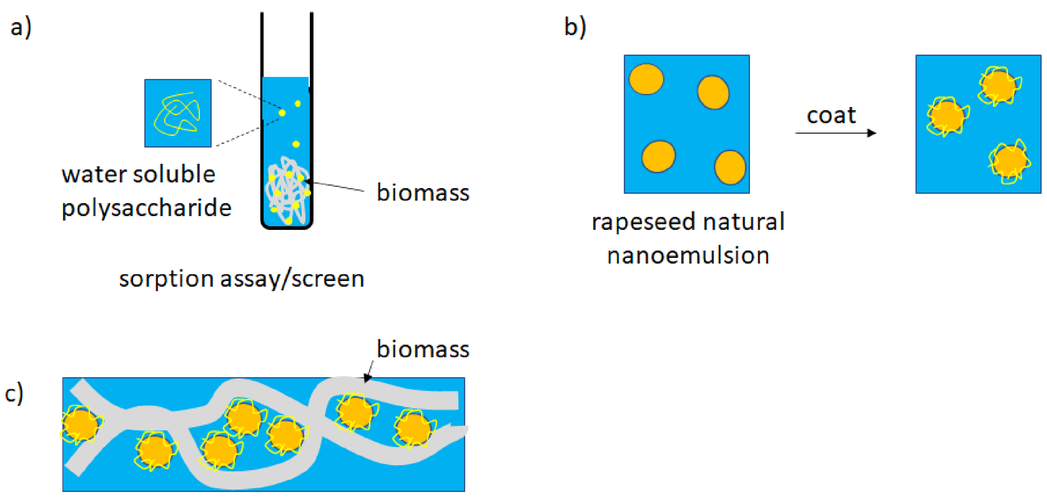
Most biomass is hydrophilic in nature and becomes brittle and glassy in the absence of water, its natural plasticizer. This presents a fundamental problem for turning biomass into flexible and water repellant materials such as textiles and films. For turning collagen-based animal skins into water repellant and flexible leather, "tanning" has evolved over many centuries as a solution to exactly this problem, but that process is not sustainable, nor easily generalized to other types of biomass. Hence, the underlying scientific issue that we think is interesting is: how can we replace water by hydrophobic plasticizers in biomass, in a sustainable way. We propose step one is the identification of suitable water-soluble biolpolymers that can act as "glue" between cargo (plasticizer nanoemulsions) and biomass.

How is this relevant to the materials transition?

Many industries are looking to use biomass as an ingredient for formulating new textiles and films, and all face the problem that it is exceedingly difficult to homogeneously distribute hydrophobic plasticizers in hydrophilic biomass. As a consequence, they either turn to less sustainable chemistries, or they formulate products with properties that are inferior to those of non-sustainable competitors. Hence, the problem we consider is a roadblock to the widespread acceptance of sustainably produced textiles and films formulated with biomass.

What are the key activities or steps?

- Choose set of water-soluble polysaccharides and windows of sorption conditions (pH, salt).
- Set up partition assay for measuring sorption of polysaccharides into biomass.
- Apply partition assay to fungal mycelium (Mylium) and citrus fruit peel (Hoogesteger).
- Coat rapeseed oil body nanoemulsions with water soluble polysaccharides identified with assay
- For polysaccharide-coated nanoemulsions in citrus fruit peel-based films: study oil distribution and impact on film properties



a) Partition assay/screen 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 screen
c) Polysaccharide coating facilitates sorption of nano emulsion droplets into biomass and ensures homogeneous distribution.

What are key deliverables?

- Comprehensive technical report for community detailing all methods and results
- Submission of manuscript to peer reviewed journal detailing application to citrus fruit peel–based films with selected results

One what issues would you like to get input from others?

- Applications beyond the two examples we are considering here
- Suggestions for water soluble polysaccharides with strong affinity to various types of biomass.

Wageningen University & Research
P.O. Box 123, 6700 AB Wageningen
Contact: name.surname@wur.nl
T + 31 (0)317 12 34 56, M +31 (0)6 12 34 56 78
www.wur.nl/xxxxx