Food Packaging Film - BIOMAC Test Case #3

BIOMAC, as an open ecosystem, focuses on the creation and validation of new supply and value chains where technologies that are being scaled up and validated to TRL 7, accelerating their exploitation potential. The BIOMAC OITB has been built to address 5 Test Cases (interTeCs) for the validation selected based on their complexity in order to involve different pilot lines as well as the supporting services and thus provide holistic feedback for the operation of the OITB as a whole.

The TeC3 "Food packaging film" is led by Eversia and it aims at developing of high-performance, sustainable, and bio-based food packaging films.

1. Materials and processes

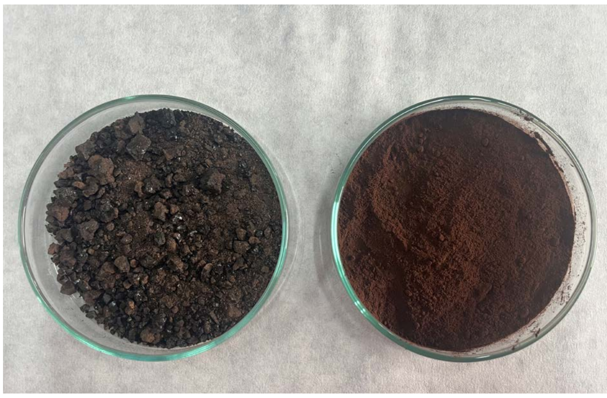

Figure 1: Organosolv lignin before (left) and after (right) 1h ball milling and 4h US treatment in water.

The food packaging films developed in this TeC are based on polylactic acid (PLA) reinforced with bacterial nanocellulose (BNC) and nanolignin (NL). The starting point is the use of lignocellulosic biomass, such as forest residues, to extract its main components: cellulose, hemicellulose, and lignin. PLA (polylactic acid), in turn, is produced from renewable resources through a process that includes enzymatic hydrolysis, fermentation, and polymerization. Simultaneously, BNC is produced through microbial fermentation and NL through an environmentally friendly sonication process.

The production process is divided into several phases, each managed by a specialized BIOMAC partner, indicated in the parenthesis together with the associated Pilot Line (PL):

Organosolv pretreatment (PL1-LTU) fractionates the biomass into its components. Hydrolysis and BNC production (PL2-RISE) transforms cellulose into BNC through fermentation. Nano lignin (PL4-CNANO) is produced with the aid of ultrasound, avoiding the use of harmful chemicals. Hydrothermal and acid/base pretreatment (PL5-BBEPP) extracts the useful fractions of the biomass. Monomer production (PL7-ATB) optimizes the production of lactic acid (LA), a precursor of PLA.

Reactive extrusion for PLA (PL11-AIMP) transforms lactide into PLA, with the possibility of adding nano additives. Mechanical treatment of cellulose (PL13-ITENE) leads to the production of nanocellulose (NFC). The formulation of coatings (PL14-ITENE) based on nanocellulose improves the barrier properties of packaging materials.

Finally, nano structuring and thermoforming (PL17-NNT) create surfaces with specific functionalities, such as superhydrophobicity (repelling water).

2. Characteristics of the final products

The packaging films obtained in this process have the following characteristics:

Figure 1: Demonstrator completed

- Thickness between 20 and 120 µm and width between 100 and 1500 mm.
- They are biodegradable and compostable according to the EN 13432 standard.
- Impact resistance greater than 50 g.
- Oxygen transmission is less than 1 cm3/(m2·day), and water vapor transmission is less than 5 g/(m2·day) (38°C / 90% RH).
- The addition of nanolignin can increase the shelf life of food by 15%, while nanoimprinting can improve surface cleaning and antibacterial action by 20%.
- The film surface exhibits bacterial repellency greater than 90% and a water contact angle greater than 160°.

The environmental benefits are remarkable, as the adoption of these kinds of products can help reduce the dependence on fossil fuels by using renewable resources. Biodegradable and compostable materials are used, helping to solve the problem of massive plastic waste and at the same time providing items that can boost a circular process rather than a linear one which creates more waste.

In conclusion, BIOMAC's TeC3 represents an important step forward in the development of bio-based food packaging materials. It demonstrates the possibility of a more sustainable and ecological packaging industry, with a positive impact on the environment and society.

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PARTNERS

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