



**BIOBASED MATERIALS RESEARCH:** ADVANCES FROM ECOFUNCO AND BIONTOP EUROPEAN PROJECTS









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# ECOFUNCO Project -Overview of circular economy and green chemistry



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## **Circular Economy**

Food waste providers of European origin were identified, For example Cutin mainly produced in Italy (Virginio Chiesa farm) from tomato skin (BBIJU Demo AGRIMAX GA 720719)

#### A SUSTAINABLE AND CIRCULAR BIOECONOMY FOR EUROPE











Bioplastics have been designated a lead market by the European Commission. In line with the green movement analysts are expecting the bioplastic market to grow over 30% in 2030.



#### Source: European Bioplastics Association



# ECOFUNCO Consortium



## **ECOFUNCO Scheme**





CUTIN



PROTEIN

#### CHITIN AND CHITOSAN

**Barrier Function** 

Material Function













### Added value to packaging, table ware, personal care

Oxygen barriers comparable to conventional barrier materials (e.g. Ethylene vinyl alcohol-Copolymer, G-Polymer) and hydrophobicity comparable to polypropylene (PP) and polyethylene (PE), and significantly improve the shelf life of food products by a significant factor depending on the type of food selected.





https://www.grandviewresearch.com/industry-analysis/antimicrobial-packaging-market



- i) Use of biobased resources derived from by-products of food and agro-industrial sector, and of biobased functional molecules.
- ii) Highly performing, economically and environmentally sustainable bio-based coating for plastic and cellulosic substrates
- iii) Food packaging based on tray (at least two trays coated) and 3 films with 3 different coating (total of 9 films validated on ham and perishable food such as meat etc)
- iv) Tableware (paper plate and paper cup) and personal care cellulose-based prototypes (wipes), coated with ECOFUNCO formulated and validated at pilot level with the aforementioned materials.
  At least four demonstrators selected and validated (a plate, a cup, two types of wipes) by LUCENSE and its associated industrial members.

TRL progress from 2-3 to TRL 5 at the end of the project



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#### Demonstrators

- Food packaging based on tray (at least two trays coated) and 3 films with 3 different coatings (total of 9 films validated on ham and perishable food such as ham, cheese, fresh pasta), including multilayer structures and flexible packaging. Tableware (paper plate and paper cup) and personal care cellulose-based prototypes (wipes), coated with ECOFUNCO formulated and validated at pilot level with the aforementioned materials. At least four demonstrators selected and validated (a plate, a cup, two types of wipes).
- Paperboard box containing facial tissues, with the functions to protect tissue, increase shelf life and promote an anti-microbial as well as anti-oxidant activity. The tissue should have compatibility with skin, anti-oxidant and anti-inflammatory properties. Packaging paper is a paperboard, both in virgin and recycled cellulose, with grammage of 280 g/m<sup>2</sup>, currently on the market. Tissue paper is a 3 plies facial tissue in virgin cellulose, with each ply of 15 g/m<sup>2</sup> for a total grammage of 45 g/m<sup>2</sup>



Several new cross-sectorial interactions among companies, both large (ORGK, HUH) and SMEs (PLABIO, BIO-Mi, TIPA) inside the project, but even advisory board and stakeholders

Active biomolecules and macromolecules ,such as microbial cellulose, cutin, protein, chitin and chitosan, are extracted or produced from by products or waste of the agro-food sector. Innovative and green technology for extraction and production.

Biomass suppliers seeing new opportunities for their waste and by-products through SSICA and FRAUNHOFER contacts

Production of paper-based materials with enhanced barrier and hydrophobic properties, connecting paper industries with agriculture, food-feed sectors



#### New bio-based value chain

Food residues (shrimps, mushrooms for chitin, chitosan) or the crop residues used in the project: tomatoes, legumes, sun flower seeds, melon, leading to valuable molecules for the production of functionalized materials. Products are being obtained, leading potentially to the demonstration of a high number of individual circular value chains





# ECOFUNCO PRODUCTS

KPI2, to create at least **one new cross-sector interconnection in bio-based economy** is envisaged to be largely achieved



13

Biobased coatings, for barrier to gas, moisture and with antimicrobial activity.

KPI5 to create at least two new bio-based materials including bio-based coatings in their formulation has been achieved on laboratory scale, since more than two plastic and cellulose substrates were successfully coated, showing improve barrier and anti-microbial properties.



# New demonstrated 'consumer' products based on bio-based chemicals and materials

Biomolecules from agro-food biomass, with green and innovative methods assessed for extraction and purification, converted in coatings for cellulose and plastic substrates can generate consumers products such as table wares, non-woven tissues, trays, coated with either protein, chitin, cutin or mix of the three, with barrier to gas, moisture and anti-microbial activity.

The KPI8 related to validate at least one new and improved processing technology reflecting the 'TRL gain' since the start of the project, is reflected in inline image monitoring, innovative extraction methods for biomolecules form biomass, and innovative coatings based on cutin, protein, and chitin never applied together on plastic or cellulose.

ISSUES: Gas barrier by crosslinked protein coatings, Cutin colour and odour, sticky, scale up of Hot melts and coatings with multi materials (Chitin, cutin, proteins), adhesion on plastic !!

# <u>https://www.bbi-</u> europe.eu/projects/ecofuncoat









## Thanks for your kind attention!



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