VALORBIO

Valorizing agrifood wastewater through advanced biorefining techniques for sustainable packaging solutions

Water4All
Water security for the planet

Abstract

Traditionally regarded as waste streams requiring treatment and disposal, wastewaters are increasingly recognized as valuable resources within the framework of the circular economy. Wastewater treatment plants can evolve into resource recovery facilities capable of simultaneously producing clean water, renewable energy, and valuable bioproducts. Among these resources, biodegradable biopolymers produced by microorganisms represent a promising alternative to conventional petroleum-based plastics. As global plastic production exceeds 400 million tonnes annually and plastic waste continues to accumulate in terrestrial and marine environments, developing sustainable bioplastic production platforms based on waste-derived feedstocks offers an important opportunity to reduce environmental impacts while creating value from wastewater streams.

VALORBIO proposes an integrated approach to convert agri-food wastewater into high-value biodegradable bioplastics while assessing opportunities for water reuse. The project focuses on recovering microbial biomass rich in polyhydroxyalkanoates (PHAs) and extracellular polymeric substances (EPS), two natural biopolymers produced during biological wastewater treatment. PHAs are widely recognized as promising alternatives to conventional plastics due to their biodegradability in diverse environments. However, their large-scale production remains limited by high costs and low recovery yields. A major factor contributing to these limitations is the simultaneous production of EPS during microbial growth, which is typically discarded during conventional PHA extraction processes.

VALORBIO addresses this challenge by developing a strategy for the simultaneous recovery and valorisation of both PHAs and EPS. By treating these biopolymers as complementary resources, the project aims to increase overall biopolymer recovery and improve the economic feasibility of wastewater-based bioplastic production. To achieve this, VALORBIO will develop an innovative co-extraction method based on sustainable ionic liquids, enabling the recovery and blending of PHA and EPS directly from microbial biomass without the use of toxic solvents. The recovered biopolymers will be then used to produce transparent films and coatings for food packaging. In addition, the project will explore the biodegradation of these materials through co-fermentation processes that generate volatile fatty acids (VFAs), which can be recycled as carbon sources for further biopolymer production, creating a circular production system.

VALORBIO brings together a multidisciplinary consortium of six research groups with expertise in environmental engineering, microbiology, polymer chemistry, materials science, and environmental and socioeconomic assessment. The agri-food sector will serve as the main case study due to its high water consumption, generation of biodegradable wastewater, and extensive use of packaging materials.

The project aligns with the objectives of the Water4All 2024 Joint Transnational Call on “Water for Circular Economy”, contributing to innovative solutions for resource recovery from wastewater and sustainable water management. By transforming agri-food wastewater into biodegradable packaging materials while evaluating water reuse opportunities, VALORBIO supports the development of circular water-based value chains and reduces environmental pressures associated with wastewater management and plastic production.

Project coordinator

Maite PIJUAN - FUNDACIO INSTITUT CATALA DE RECERCA DE L’AIGUA - SPAIN

Project partners

- IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE - UNITED KINGDOM
- DELFT UNIVERSITY OF TECHNOLOGY - THE NETHERLANDS
- KTH ROYAL INSTITUTE OF TECHNOLOGY - SWEDEN
- INSTITUT POLYTECHNIQUE GRENOBLE - FRANCE
- AARHUS UNIVERSITY - DENMARK

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Contact

Maite PIJUAN
mpijuan@icra.cat

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