WAVE

Microbial-based bioprocesses towards dairy wastewater reuse and conversion into new bioplastics

Abstract

The scarcity of freshwater is expected to have significant economic global impacts. Revalorizing and reusing all wastewater are a must to decrease the burden on freshwater demand. Application of treated or recovered water for different purposes instead of freshwater can be help mediating worldwide water stress.

Huge volumes of dairy wastewater are generated globally and dairies and cheese producers may invest in specialized treatment systems of challenging wastewater and whey. Based on this fact, this project proposes an innovative approach that maximizes the value of the entire wastewater matrix, aiming to recover clean water for irrigation and to produce bioplastics. This integrated solution contributes to reducing water stress and promotes circularity in both water and the economy.

The primary objective of this project is to develop an integrated process that incorporates microbial-based biotechnologies for the reuse and conversion of dairy wastewater into new bioplastics. To achieve this aim:

I. Dairy wastewater containing whey is used as feedstock to produce short-chain fatty acids (SCFAs) in an anaerobic fermentation.
II. SCFAs are converted into single cell proteins (SCP) by non-conventional yeasts.
III. A water effluent with low salinity for landscaping is obtained by increasing salt uptake and intracellular compartmentalization in D. hansenii.
IV. Bio-based and degradable plastics are produced from Debaryomyces-derived SCP
V. The sustainability of the proposed technology and demonstrating its contribution to a Circular Economy is evaluated.

WAVE is envisaged as a promising method for treating wastewater while generating two key outputs: treated water with low salinity suitable for irrigating urban green spaces, and bioplastics.

The success of WAVE is guaranteed by a multidisciplinary consortium with high expertise for setting cutting-edge and innovative solutions from complementary fields including Chemistry, Material Science, Biotechnology, Engineering and Economics. The expected outcomes of WAVE include technological advances that will open new venues of research. Dissemination efforts will target these groups using tailored materials and tools. The project aims to foster market and policy changes by establishing an international network of researchers, innovators, stakeholders, and policymakers to promote sustainable economic growth and protect vital water resources.

WAVE will deliver new knowledge on wastewater treatment and re-use of treated water while creating new tools for SCP production and conversion into bioplastics. WAVE expected results will clearly impact on increasing water resource efficiency and optimizing water use in water-dependent sectors and developing new materials more sustainable than products offered on the market and enabling new applications fostering industrial sustainability and competitiveness in Europe. Technological developments will put in place wastewater as a new circular feedstock. Furthermore, outcomes on bioplastics derived from yeast-based SCP will represent an important contribution to the scientific knowledge in the field of plastics.

WAVE will mitigate potential environmental and operational risks associated with water reuse practices. Environmental impact will also be reinforced by the replacement of highly polluting plastic wastes and the production of more environmentally friendly bio-based plastics building blocks. Additionally, the application of advanced technologies for bioplastics generation can boost the development of technology-based companies, as well as add value to the wastewater management sector.

There is no doubt about the social impact of WAVE. Environmental protection (water bodies) and economic growth will have a direct impact in social well-being.

KEYWORDS

dairy wastewater,
short-chain fatty acids,
halotolerant yeast, Debaryomyces hansenii,
landscaping, bioplastics

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