Biotechnological Valorization of PLA Hydrolysates via Microbial PHA Synthesis by *Pseudomonas* spp.

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Abstract

Plastic pollution is a growing global concern, with nearly 10 million tons of waste entering the ocean annually. Biodegradable alternatives like polylactic acid (PLA) are increasingly used, especially in packaging, yet their disposal presents challenges. The presence of PLA in polyethylene terephthalate (PET) recycling streams complicates mechanical recycling, highlighting the need for selective depolymerization and biological valorization. In this context, upcycling plastic waste into higher-value products offers a promising solution that reduces environmental impact and enhances material recovery efficiency. This study contributes to circular bioeconomy strategies by exploring the targeted hydrolysis of PLA and the microbial utilization of the resulting lactic acid, its monomer. In order to achieve this, post-consumer PLA waste was selectively hydrolyzed using water, separating it from PET. The resulting hydrolysate, primarily composed of lactic acid, was then explored for biological upcycling.

Currently, *Ralstonia eutropha* is the only bacterium known to produce polyhydroxyalkanoates (PHAs) directly from lactic acid [1], [2]. This study explores the potential of *Pseudomonas* spp. to convert PLA hydrolysates into PHAs, a class of biodegradable bioplastics with diverse material properties and promising applications as sustainable plastic alternatives. As a preliminary step, selected *Pseudomonas* strains were cultivated on pure lactic acid to assess their capacity for growth and PHA biosynthesis. Growth was monitored daily via optical density (OD_{600}) and dry biomass measurements, while high-performance liquid chromatography (HPLC-RI) was used to analyze lactic acid consumption. Results confirmed that *Pseudomonas* spp. can utilize lactic acid and initial indications of PHAs accumulation were observed. These findings provided the basis for the next phase of the study, which involved the evaluation of bacterial growth and PHA production on PLA hydrolysates.

References

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Key words

Pseudomonas putida, polyhydroxyalkanoates, lactic acid, PLA hydrolysates, plastic upcycling, circular economy