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”Closing the Loop: Optimizing Agricultural Waste Fermentation for Next-Gen Bioplastics”

Increased environmental load of fossil fuel-derived plastics has propelled interest in renewable bioplastics, of which polylactic acid (PLA) is notable due to its biodegradability, biocompatibility, and varied uses. The core of PLA manufacture is lactic acid, an organic acid of natural origin commonly manufactured via microbial fermentation of biomass feedstocks. Chirality (L- and D- isomers) and purity are key factors, as they dictate the properties of the polymer, including crystallinity, strength, and degradation rate. Aside from the production of lactic acid, the key step is its polymerization—direct condensation or ring-opening polymerization of lactide—to produce PLA of controlled molecular weight and activity. Characterization by thermal, mechanical, and spectroscopic means follows, determining relationships between polymer structure and function. Short-chain PLAs are appropriate for
biomedical applications such as drug delivery and sutures, whereas high-molecular-weight PLAs are applied in packaging, textiles, and structural applications. This review highlights post-fermentation strategies, polymerization routes, and customized applications, highlighting PLA’s significance in promoting circular bioeconomy solutions.

Keywords: Agricultural waste, hydrolysis, cellulose, condensation, Poly lactic acid.

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