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Advancing Sustainable Biopolymer Production through Cell Free Biomanufacturing

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In the quest for sustainable biopolymers, Polyhydroxyalkanoates (PHAs) stand out for their inherent biodegradability. However, their industrial production faces challenges, including high production costs and complex downstream processes. To surmount these obstacles, our approach involves leveraging cell-free systems to streamline PHA synthesis and polymerization. Our ongoing work focuses on deciphering the metabolic pathways of cnambio1 and designing a chain elongation pathway using acetyl CoA compounds derived from the sugar pathway. The sugar feedstock is sourced from valorized Corn Stover using a novel consolidated bioprocessing (CBP) system, eliminating the need for pretreatments. We are also exploring innovative purification methods tailored to the unique characteristics of cell-free-produced PHAs, ensuring the isolation of pure and homogeneous biopolymer products. By accelerating the shift towards a sustainable biopolymer industry, our efforts contribute to global initiatives aimed at curbing the projected accumulation of 12 billion metric tons of plastic waste in landfills by 2050. Through strategic manipulation of synthetic multi-enzyme pathways, our work paves the way for the establishment of "Bio-Precursor Industries" worldwide, marking a significant step towards a more environmentally conscious future.
Keywords: Bio-Precursor industries; Cell-free biomanufacturing; Consolidated bioprocessing (CBP) Polyhydroxyalkanoates (PHAs)

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