Production of Polyhydroxyalanoates Using Sustainable Carbon Sources | Biological Engineering

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Full Abstract

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Polyhydroxyalkanoates (PHAs) are promising bioplastic polymers with the potential to replace petroleum-derived plastics in diverse applications. Production costs for PHAs are still very high, however, largely due to the cost of carbon feedstocks for the bacteria that produce the polymers and the cost of extracting the polymers after production. Waste streams that could be diverted to PHA production as inexpensive carbon sources include food wastes and methanol. Secretion-based recovery of PHA granules was studied in the methylotrophic bacteria Methylobacterium to decrease the cost of downstream processing of PHAs, while using methanol as the sole carbon source. The hemolysin type I secretion pathway from Escherichia coli was transformed into a novel isolate of Methylobacterium. A synthetic biology approach was used to create a phasin fusion protein that binds to the surface of PHA granules and the hemolysin secretion signal peptide. This genetic construct was used in conjunction with the secretion system with the intent of inducing the cell to secrete PHA into the extracellular media. As currently constituted, however, the secretion system made no significant difference in the amount of PHA produced and secreted by the Methylobacterium isolate. The information gathered in this work can be further optimized and applied to other methylotrophic bacteria to reduce costs in PHA manufacturing systems.