Genetic engineering as a tool for enhanced PHA biosynthesis from inexpensive substrates

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Abstract

Large-scale production of polyhydroxyalkanoates (PHAs) is mainly limited by the high cost of the raw materials used as substrates. However, huge amounts of cheap residues such as whey, molasses, waste glycerol and lipids, starchy and lignocellulosic substrates are available and could be potentially used for industrial PHAs production. Unfortunately, wild-type strains for the direct and efficient conversion of low-cost waste streams into PHAs are not available in nature, and therefore the engineering of strains became the key factor.

There are two possible approaches: (i) the engineering of highly efficient PHAs producing microorganisms for their utilization of waste streams, or (ii) the engineering of bacteria naturally able to utilize complex and inexpensive carbon sources, but unable to produce PHAs.

This paper tries to summarize the recent relevant results dealing with PHAs production from a large selection of organic by-products by means of engineered microbes developed using the two above mentioned approaches. The most relevant and recent genomic tools for the genetic modification are also initially described, with emphasis on hosts, genes, plasmids, promoters and gene copy number.

Keywords: polyhydroxyalkanoates (PHA); bacteria; genetic engineering; cheap and organic by-products,