Current advances on plastic recycling using diverse microbial regimes

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ABSTRACT

In less than a century of manufacturing, plastics have become essential to modern society, driven by their incredible versatility coupled to low production costs. It is, however, now widely recognized that plastics pose a dire global pollution threat, especially in marine ecosystems, because of the ultralong lifetimes of most synthetic plastics in the environment. Degradation of plastic polymers can proceed by either abiotic or biotic pathways. In response to the accumulation of plastics in the biosphere, it is becoming increasingly recognized that microbes are adapting and evolving enzymes and catabolic pathways to partially degrade man-made plastics as carbon and energy sources. These evolutionary footholds offer promising starting points for industrial biotechnology and synthetic biology to help address the looming environmental threat posed by man-made synthetic plastics. Leading plastic packaging producers' are moving towards a goal of 100% recycled, biodegradable or re-useable plastics in their products by 2025. This shift towards a sustainable economy has occurred in the recent decade, such that, between 2010 and 2017, bio-based poly-ethylene (Bio-PE), bio-based poly-ethylene terephthalate (Bio-PET), poly-lactic acid (PLA) and poly-hydroxy-alkanoates (PHAs) have seen production capacity growth of approximately 22%, 10 000%, 300%and 41% respectively. Replacement of petroleum-based plastics with bio-based alternatives is a more sustainable pathway to plastic production due to their lower associated carbon emissions from petroleum extraction and refinement. Among these, poly-hydroxy-alkanoates (PHAs) have been hailed as the solution to replace conventional, oil-based plastics. Given their biodegradable nature and mechanical properties, their use can be envisioned in a wide range of applications reducing the environmental footprint. Based on this current scenario, current study will be focusing on extensive literature survey on plastic waste recycling using natural and genetically modified microbial communities.

Keywords: Synthetic plastics, poly-ethylene, poly-ethylene terephthalate, poly-lactic acid, poly-hydroxy alkanoates, biodegradability.

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