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ABSTRACT BOOK

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Conversion of mixed plastic waste containing PET into biopolymer bacterial nanocellulose

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The rapid increase in global plastics production is also causing an accelerated environmental pollution. Recently, biotechnological solutions and enzymatic recycling of poly(ethylene terephthalate) (PET) waste stream have been put forward and commercialized1. Increasing recycling and upcycling rates is the most effective model approach to plastic circularity. However, mixed plastic waste is still quite a challenge for both recycling and upcycling technologies. This study is focused on the eco-conversion of plastic waste containing poly(ethylene terephthalate), PET, into biopolymer, bacterial nanocellulose. Polymer mix contained selection of commercial biodegradable plastics (poly(lactic acid), PLA, poly(ε-caprolactone), PCL, poly(hyoxyl butyrate), PHB) and PET. This mixture was hydrolysed under aqueous conditions and hydrolysate was used as carbon source for Komagataeibacter medellinensis ID13488 and bacterial nanocellulose (BNC) production. HPLC analysis confirmed the presence of monomers and dimers of polymer mix components indicating existence of potential substrates for BNC production. BNC production by K. medellinensis was investigated and optimized in ter of the amount of carbon source and growth conditions. Under the most efficient rate in ter of yield, BNC production was scaled up and the obtained biopolymer was characterized. The structure of produced BNC was confirmed by FTIR analysis, thermal properties by DSC/TG analysis, and the morphology of material by optical microscopy and SEM analysis. This research demonstrates how to put the mixed plastic waste stream into a circular loop through the biotechnological conversion into valuable biopolymer.

Keywords: plastic waste, PET, bacterial nanocellulose, upcycling, plastic sustainability

1Tournier, V., Topham, C.M., Gilles, A. et al. An engineered PET depolymerase to break down and recycle plastic bottles. Nature 580, 216–219 (2020). https://doi.org/10.1038/s41586-020-2149-4

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