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Use of banana pseudo-stem pulping as a biofilter to remove microplastics from wastewater

Artur Mendonca [*1], Angela Morais [1], Tiago Vieira [1], Marisa Faria [2,3], Manfred Kaufmann [2,3] and Nereida Cordeiro [2,3]

[1]*Escola B+S Bispo D. Manuel Ferreira Cabral, Portugal*
[2]*University of Madeira, Portugal*
[3]*University of Porto, Portugal*

Abstract

Currently, microplastics (MPs) are an issue of concern for marine ecosystems and biota due to their bioaccumulation and biomagnification with other pollutants. It has become urgent to develop sustainable and effective methods to remove them from the contaminated water. Cellulosic banana pulp and extracellular polymeric substances (EPS) – produced by microorganisms (cyanobacteria and bacteria) – are recognized as biodegradable, sustainable and low toxic materials, making them promise for applications in a wide range of fields - from biomedicine to bioremediation [1,2]. EPS are currently widely applied in industry as gums, bioflocculants, biosorbents and bioemulsifiers [3]. The present study intended to evaluate the feasibility of using cellulosic banana pulp per si – an agricultural residue – or nanomodified with EPS from cyanobacteria and bacteria for the removal of MPs from contaminated water. Banana pseudo-stem pulping was used as biofilter per si or nanomodified with (i) Cyanocohniella calida culture, (ii) C. calida EPS and (iii) bacterial cellulose pulp, through two processes: incorporation and immersion. A contaminated water solution with polystyrene MPs was used. The removal of MPs via biofilters was assessed by fluorescence microscopy, Neubauer chamber and flow cytometry. It was observed that the MPs were retained in the biofilter network. The efficiency limits of biofilters were also evaluated. Biofilters per si showed high efficiency (98.5%) in removing MPs from contaminated water. The retention capacity of microplastics increases with the increase amount of cellulose fibers. Nanomodified biofilter also exhibited a high removal efficiency (86.8%) when modified with 20% (m/v) C. calida EPS by immersion. The results show that the use of biofilters based on pulp of banana, given its durability and MPs holding capacity, could be an environmentally friendly alternative to commercial filters. This eco-technology proved to be an alternative for water decontamination.

Biography

Artur Mendonça has completed his high school´s degree in 2021 in Escola B+S Bispo D. Manuel Ferreira Cabral, Portugal. The financial support has been provided by the European Territorial Cooperation Programme PCT-MAC 2014-2020 through project REBECA-CCT (MAC/1.1.B/269), the Foundation for Science and Technology (BD/6615/2020) - Marisa Faria PhD grant.

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