Title: Biodegradation of polyethylene by bacterial isolates from Brazilian Cerrado's soil: a potential contribution to minimize hazards to natural environments

Authors: Peixoto, J. [1], Kruger, R. [1]

Institution: [1] Department of Cellular Biology, Biology Institute, University of Brasília, Brazil (Campus Universitário Darcy Ribeiro, Asa Norte, Brasília, DF - 70910-900)

Abstract:

Polyethylene (PE) is strikingly the most produced and utilized synthetic polymer, with a global production of over 299 million tons/year. It has been considered an inert non-biodegradable plastic due to its physico-chemical features, such as high molecular weight, hydrophobicity and chemical composition. Indeed, it takes more than 100 years for it to decompose in natural environments. However, we believe that the microbial potential to degrade such recalcitrant polymers is much wider than the already uncovered. In this context, our work attempts to provide a proper and sustainable management of accumulated plastics and their dramatic consequences to the environment. Due to its outstanding microbial richness and diversity, we collected plastic debris disposed at the Brazilian Cerrado's soil in order to isolate their colonizing microorganisms. We screened and isolated PE-degrading strains and then performed analysis of cellular viability and adhesion to PE films after long cultivations of up to 3 months with PE as the sole carbon source. Thus, we found that 9 bacterial strains comprised into 3 different genera – *Delftia*, *Stenotrophomonas* and *Comamonas* – are capable of utilizing this polymer as the sole carbon source. In fact, PE's dry weight measurements after two-months cultivation period confirmed the successful weight loss. Chemical, structural and topographic changes on biotically treated PE films were carried out using ATR-FTIR spectroscopy, scanning electron microscopy and atomic force microscopy. Therefore, we showed that the isolated strains were remarkably effective on performing biodegrading processes, since there were evident alterations on PE's phisico-chemical properties. In contrast to the few other PE-degrading microorganisms previously described on the literature, these isolates were never related to PE's biodegradation and, interestingly, they do no require any prior treatments to the film, which is an extremely novel phenotype. These findings reinforce the concept that, despite PE's molecular stability, microbial degradation is a powerful tool for decontamination processes and its viability is connected to microbial diversity's exploration. Our perspective is to study the metabolism of PE using genomic and transcriptomic approaches to understand the molecular mechanisms behind this process and, ultimately, to propose a replacement strategy to the harmful conventional waste managements: a promising and sustainable biodegrading system.

Keywords: biodegradation, bioremediation, polyethylene, plastics, Cerrado.

Financial Support: CNPq