TITLE: UNRAVELING POLYETHYLENE METABOLISM: HOW CAN BACTERIA FEED ON PLASTICS?

AUTHORS: PEIXOTO, J. & KRÜGER, R. H.

INSTITUITION: DEPARTAMENTO DE BIOLOGIA CELULAR, BLOCO K TÉRREO, CAMPUS DARCY RIBEIRO, UNIVERSIDADE DE BRASÍLIA, CEP 70910-900, BRASÍLIA – DF, BRASIL

ABSTRACT:

Polyethylene (PE) is the most utilized synthetic polymer with a global production that exceeds 150 million tons/year. As a consequence of its physicochemical properties, PE-based materials are extremely recalcitrant and inert requires over 100 years to decompose under natural conditions. In an attempt to address this important global issue, we have isolated from the Brazilian Cerrado soil nine novel bacterial strains of *Comamonas*, *Delftia* and *Stenotrophomonas* capable of degrading unpretreated PE of very high molecular weight (191.000). These bacterial strains showed metabolic activity and cellular viability after a 90-day incubation with PE as the sole carbon and energy source, indicating that they can thrive for long periods under such conditions. Changes in PE chemical composition, crystallinity, viscoelasticity, molecular weight and topography induced by these microbes were assessed by different spectroscopic and microscopic approaches. Intriguingly, the biodegraded PE chemical fingerprint, together with genomic and transcriptomic analysis, indicated not only the reported participation of extracellular oxidoreductases in the oxidative fragmentation of this polymer, but also the involvement of yet undescribed biochemical strategies to cope with this process. One such strategy is the oxidation of the polymer, triggered by the biotic production of nitric oxide. Furthermore, we have identified over 15 extracellular oxidases that potentially participate in the biodegradation process. To the best of our knowledge, this is the first study characterizing the metabolism of high molecular weight PE at a cellular level following an integrated experimental, genomic and transcriptomic approach. The detailed study of PE metabolism increases the understanding of the molecular mechanisms underlying its biodegradation, which is critical for the development of sustainable strategies to address the plastic disposal issue and the recovery of harmed natural environments in order to preserve both human and wild lives.

Keywords: biodegradation, polyethylene, *Comamonas*, *Delftia*, *Stenotrophomonas*