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TOWARDS THE PHYCOREMEDIATION OF PLASTIC DEBRIS: IDENTIFICATION OF GREEN MICROALGAE ACCESSION AND CATABOLIC ENCODING GENES

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A huge amount of plastic material has been released annually into landfills and it has been estimated that in 2050 about 12000 million metric tons will be found as waste. The most common type of plastic produced are polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), and polyethylene terephthalate (PET). These polymers are slowly degraded in a range of 10 to about 600 years and usually by UV irradiation and weathering plastic debris (PD) are formed mainly as microplastics (MPs, < 5 mm) and nanoplastics (NPs, < 100 nm). The ubiquitous presence of plastic debris in soil and aquatic ecosystems leads to toxicity effects on living organisms including humans and it is considered a key geological indicator of Anthropocene. Several physical- or chemical-based methods are available to remove or degrade plastic materials, but eco-friendly approaches are required. The most preferred method is biodegradation, mainly based on enzymes secreted by microorganisms such as bacteria and fungi that depolymerize plastic to monomers, simple organic compounds. Metagenomic approaches have discovered several plastic degrading enzymes that belong to hydrolases, which split ester bonds such as esterase or act on carbon-nitrogen bonds such as amidase, and oxidases such as alkane hydroxylase, monooxygenase and laccases.

In this context, the use of microalgae to remediate waste, phycoremediation, is one of the most promising and advanced technologies

for municipal, industrial and agricultural wastewater treatments. Only few studies have reported the ability of microalgae to degrade plastic through the production of exopolysaccharides that allow the cells to attach on plastic surface and then to produce specific catabolic enzymes. However, the exposure of microalgae to plastic debris could cause oxidative stress-response leading to cell apoptosis.

Therefore, the aim of this work within a PhD’s project is to phycoremediate plastic and convert microalgae biomass into eco-friendly biopolymers. For these purposes, we have evaluated the toxicity effects of plastic debris at different concentrations on microalgae vitality and then identified accessions able to grow under these conditions. The inhibition growth assay performed on 37 microalgae accessions has identified 6 species able to grow in plastic enriched liquid medium. In addition, we have evaluated the ability of microalgae to produce laccase in the liquid medium and performed an in silico analysis of laccase gene in green alga model *Chlamydomonas reinhardtii*. The activity of this enzyme was detected in all accessions assayed and genetic mining analysis showed three genes encoding laccase in this microalgae database.