

Research Stays 2019

Understanding the enzymatic and cometabolic biotransformation of organic micropollutants under aerobic heterotrophic conditions

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Objectives

The presence of micropollutants (OMPs) in water is a problem of increasing concern due to their risks to the environment and human health. The current knowledge of OMPs biotransformation mechanisms is still very low. Therefore, the first objective of the research stay was to determine the transformation products of some OMPs found in wastewater treatment plants (WWTPs). The second objective was to evaluate the contribution of key enzymes during the biotransformation of selected OMPs.

Methodology

The determination of OMPs transformation products was performed through LCMS analysis from samples obtained in a continuous aerobic heterotrophic reactor. The data from the LCMS was analysed using the software Compound Discoverer 2.1.

The enzymatic tests determined the role of Acetyl-CoA Synthetase (ACS) and Isocitrate Dehydrogenase (ID) in OMPs biotransformation. The assays were done in batch mode, where OMPs removal was monitored in the presence and absence of the enzymes.

Results

The results showed the formation of transformation products for diclofenac, ibuprofen, celestolide, galaxolide, ethinyl estradiol, nonylphenol, bisphenol-A, sulfamethoxazole, fluoxetine, trimethoprim and diazepam. The transformation reactions involved oxidation, hydroxylation, demethylation and hydrogenation, among others.

The assays performed with ACS and ID showed that they are not involved in the biotransformation of the selected micropollutants. Findings suggest that enzymes without a broad specificity do not participate in OMPs biotransformation. It was also observed that the presence of OMPs can inhibit the activity of the enzymes (Fig. 1).

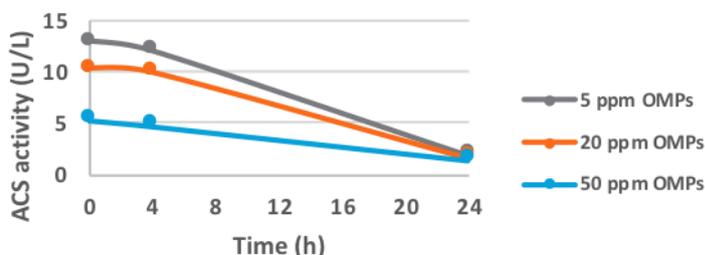


Fig. 1: Acetyl-CoA Synthetase activity with time in the presence of different OMPs concentration

Highlights

Micropollutants biotransformation leads to the formation of multiple transformation products through a wide variety of chemical reactions. Moreover, it seems that these reactions occur due to the action of broadly specific enzymes.

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