Rhodococcus sp. ED55 – a bacterial strain with potential for application in wastewater treatment for effective removal of endocrine disruptors

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Abstract

The occurrence of Endocrine disrupting chemicals (EDCs) in domestic and industrial wastewater is topic of concern. It is commonly accepted that the major source of EDCs to the environment is wastewater treatment plants (WWTPs') effluents, due to the inefficiency of WWTPs to remove this kind of pollutants. This represents a treat to the ecosystems and human health and impairs the reuse of treated effluents. It is imperative to find solutions for the complete removal of these pollutants during wastewater treatment. The objective of the present work was to develop a green and sustainable biotechnological approach to improve the wastewater treatment process and detoxification of effluents. A bacterial strain – *Rhodococcus* sp. ED55 was isolated from the sediments of a discharge point of a WWTP in Coloane, Macau, for its ability to degrade EDCs. The bacterium was able to biodegrade 17β–estradiol (E2), 17α–ethinylestradiol (EE2), bisphenol-A (BPA) and bisphenol-S (BPS) at different extents. Strain ED55 was able to completely degrade the supplied amount of E2 in few hours, both in synthetic medium and in real wastewater from a municipal WWTP (Parada, Maia – Portugal). Bioaugmentation with *Rhodococcus* sp. ED 55 significantly improved the natural attenuation of the compound in municipal wastewater in batch assays. The detection and identification of 17 metabolites was achieved by means of UPLC/ESI/HRMS, which allowed the proposal of a metabolic degradation pathway of E2. The acute test with luminescent marine bacterium *Aliivibrio fischeri* revealed elimination of the toxicity of the treated effluent and the standardized yeast estrogenic (S-YES) assay with the recombinant strain of *Saccharomyces cerevisiae* revealed decrease of estrogenic activity of samples. *Rhodococcus* sp. ED55 was applied in a strategy of an aerobic granular sludge (AGS) sequencing batch reactor adapted to salinity, which was operated for treating a synthetic saline wastewater containing E2, EE2 and

BPA. E2 was no longer detected in the bulk liquid after 10 min of aerobic reaction throughout reactor operation, suggesting that this compound was quickly removed by biodegradation. EE2 adsorption/desorption to the aerobic granules was observed. Removal of BPA significantly increased after bioaugmentation with *Rhodococcus* sp. ED55, showing that biodegradation was the governing removal mechanism. *Rhodococcus* sp. ED55 can potentially be applied in bioaugmentation strategies for ameliorating treatment of wastewater contaminated with EDCs.

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