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BIOREMEDIATION OF EMERGING POLLUTANTS FROM SEWAGE SLUDGE BY FUNGAL BIOAUGMENTATION

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Abstract

Current wastewater treatment processes are not able to completely remove many organic pollutants. The increasing use of the sludge derived from wastewater treatment plants (WWTP) in agricultural lands therefore becomes a source for micropollutants to enter the environment.

An eco-friendly biotechnological treatment which employs the white-rot fungus *Trametes versicolor* was assessed to remove several groups of pharmaceuticals at pre-existent concentrations from sewage sludge.

First, two different strategies were applied in sterile conditions to demonstrate the colonization and degrading ability of the fungus: solid-phase systems with dehydrated sludge and a lignocellulosic substrate, and slurry bioreactors with sludge from the outlet of an anaerobic digester, all from the same WWTP. Fungal colonization and activity were monitored with ergosterol content, laccase activity and a degradation test (ND24). The solid phase biopile treatment resulted in the complete removal of seven out of 14 detected pharmaceuticals, and between 42-80% for the remaining compounds. Meanwhile, the bioslurry reactor produced a complete elimination of eight out of 24 pharmaceutical agents detected, and 26-92% for the others. However, for the same compounds, in most of the cases the solid-phase treatment showed higher removal efficiency, plus better results in terms of reducing the toxicity of the sludge after the treatment.

Next step consisted in applying *T. versicolor* in non-sterile sludge, which was assessed in solid-phase biopiles, considering the better fungal performance on these systems. Success in the fungal bioaugmentation was monitored by community analyses, which compared the bioaugmented (TVB) and non-bioaugmented (NB) systems. DGGE profiles revealed some inhibition caused by the fungus over bacterial community and also the predominance of *T. versicolor* in the TVB-systems up to 21-d (half-treatment), to later disappear by the end of the process and being replaced by other fungi. Results permitted to find the relationship of the fungal survival with the degradation of pharmaceuticals on time. Results include the identification of the most abundant bacterial/fungal taxons present in the sludge biopiles. After 42-d of treatment, removals over 50% for eight out of the nine therapeutic agents detected were obtained; only carbamazepine could not be removed at all, contrary to sterile conditions. Overall results suggest that mycoremediation is a potential strategy for the degradation of emerging pollutants from sludge.

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