**Removal of pharmaceuticals from artificial and real wastewater matrices using *Trametes versicolor* in fed-batch and trickle-bed bioreactors**

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**Highlights**

* The performance of two bioreactor configurations was studied.
* Pharmaceuticals were treated in bioreactors containing *Trametes versicolor*.
* Removals over 95% were achieved for 11 drugs in a fed-batch bioreactor over 14 days.

**1. Introduction**

The presence of pharmaceuticals in the environment has been a raising concern over the past years. There is lack of information about their effect on ecosystems, making their impact on the environment and public health difficult to predict [1]. Current wastewater treatment plants (WWTP) are not designed to remove these pollutants; consequently, many of them reach surface waters unaltered [2]. In the search for alternatives to minimize their chronicle impact, the use of white-rot fungi as a biological treatment for the removal or transformation of pharmaceuticals has been studied and has been proven to be an environmentally friendly and effective alternative [3]. Specifically, studies using bioaugmentation with *Trametes versicolor* have obtained better pharmaceutical removal values compared to conventional activated sludge (CAS) treatment [4][5]. This work aims to explore the fungal treatment of real wastewater matrices and synthetic wastewater spiked with different pharmaceuticals including psychiatric drugs, anti-inflammatory drugs and antibiotics, in two different bioreactor configurations, a fed-batch stirred tank bioreactor and a trickle bed bioreactor. The fed-batch bioreactor uses molasses, obtained as a secondary product in the production of sugar, as a nutrient source for the employed microorganism. While the trickle-bed bioreactor was designed to be an easy and economically competitive alternative to be used as tertiary treatment in WWTP.

**2. Methods**

Artificial wastewater was prepared with 16 commercial drugs (1 mg/L each), while real wastewater was obtained from a secondary treatment plant. Two bioreactors containing polluted water, inoculated with *T. versicolor* pellets, were operated in fed-batch mode with intermittent additions of molasses solution as carbon and nitrogen source. Results were verified by triplicate assays in Erlenmeyers, operated under the same conditions. Moreover, three trickle-bed bioreactors were built using a lignin-rich substrate mixed with an artificial substrate for support, inoculated with *T. versicolor*. In both bioreactor configurations, heat-killed and abiotic control assays were performed in order to determine abiotic losses and sorption to the fungal biomass, as well as ecotoxicological assays with *Daphnia magna* and *Lactuca sativa*. Removal of pharmaceuticals was quantified by LC-MS/MS analysis.

**3. Results and discussion**

Removals over 95% were achieved for 11 pharmaceuticals during the treatment of synthetic wastewater in the stirred tank bioreactor; in general, individual removal values were above 50% for this system (see Figure 1). The highest removals were found for ceftiofur, lincomycin, acetaminophen and ketoprofen, while the lowest corresponded to azithromycin. Acetaminophen showed the highest removal rate.

**Figure 1.** Removal of pharmaceuticals from artificial wastewater in a fed-batch bioreactor with *Trametes versicolor*.

We will further discuss the results obtained for the trickle-bed reactors. Results will include pharmaceutical removal in synthetic and real wastewater matrices, as well as EC50 values.

**4. Conclusions**

The fungal bioreactors studied with *Trametes versicolor* can be used as methods to overcome the lack of specialized treatment given in WWTP. Given the results, a fed-batch stirred tank bioreactor could be used as a removal system for punctual discharge of pharmaceuticals. While on the other hand, the trickle bed bioreactor could be used as a tertiary treatment in farms to treat animal residues, hospital or municipal wastewater, among others.

**References**

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