

Investigating the Presence of Trace Organic Contaminants in Hospital Wastewater and Their Treatment by Laccase

Komla Alokpa¹, Sabrina Saibi², Lounès Haroune², Hubert Cabana¹

¹Université de Sherbrooke Water Research Group, Department of Civil and Building Engineering/Université de Sherbrooke,

2500, boulevard de l'Université, Sherbrooke (Québec), J1K 2R1, Canada

²Pharmacology Institute of Sherbrooke – PIS Faculty of Medicine and Health Sciences /Université de Sherbrooke
3001, 12^e Avenue Nord, Sherbrooke (Québec), J1K 5N4, Canada

Komla.Alokpa@Usherbrooke.ca; Sabrina.Saibi@Usherbrooke.ca; Lounes.Haroune@Usherbrooke.ca;
Hubert.Cabana@Usherbrooke.ca

Extended Abstract

Hospital effluents can significantly contribute to the contaminant load in municipal wastewater. In many industrialized countries, hospital effluents are assimilated to municipal effluent and most of the contaminants they contain have no regulatory status. Eventually, these contaminants can reach waterbodies and threaten aquatic organisms and humans, even at low concentrations. Fungal laccases (EC 1.10.3.2) have shown promising potential for trace organic contaminant (TrOCs) removal from contaminated water. However, the use of free laccase in aqueous media can suffer from limitations such as washout with treated media, lack of stability, or the need of large amount of enzyme, resulting in an overall uneconomic process.

In this study, we first investigate the presence of TrOCs in hospital untreated effluents over a seven-month period. Secondly, laccase from *Trametes hirsuta* as free enzyme and covalently-bond to silica hollow microspheres were prepared and tested for their potential to remove TrOCs from hospital wastewater spiked with acetaminophen, ibuprofen, naproxen, carbamazepine, mefenamic acid, ketoprofen, and indomethacin at 10 ng/mL and 1 ng/mL. In parallel, elimination tests were performed on a laboratory-made effluent spiked with the same drug molecules at the same concentrations.

The occurrence of the TrOCs in the effluents was investigated using non-targeted UPLC-MS, whereas targeted UPLC-MS/MS was used to determine the extent of removal of the 7 molecules added to the effluents. A total of 108 compounds grouped in 36 categories and accounting for 216 cumulative occurrences were detected over a five-month period. The six most detected categories were: antipsychotics, antihypertensives, anxiolytics, antibiotics, antihistamines, analgesics, antibacterials.

Elimination test results showed that acetaminophen was completely removed by free laccase (1000 U/L) and immobilized laccase (200 U/L) after 24 h of treatment at 23° C, but free laccase contributed to fair removal of the rest of the monitored TrOCs. Carbamazepine, mefenamic acid, and indomethacin were best removed by both immobilized and deactivated immobilized laccase (60% to >90%), suggesting the role of other mechanisms of removal such as adsorption.