Removal of Ciprofloxacin and Tetracycline by Vetiver Grass from Nutrient Amended Secondary Wastewater Matrix

Saumik Panja, Dibyendu Sarkar, Rupali Datta, and Abhishek RoyChowdhury

Antibiotics have played a major role in improving human health and have been widely used since the 1940s. After ingestion, only a minor fraction of antibiotic compounds is retained in the physiological system; the rest is excreted. These excreted antibiotics enter the environment through animal husbandry, municipal and hospital sewage, increasing the risk of developing antimicrobial resistance in microorganisms. Prolonged residence time of these emerging contaminants in the environment has instigated the search for environment-friendly and innovative remediation techniques. In this study, we investigated the potential of vetiver (*Chrysopogon zizanioides*), a fast-growing, high biomass perennial grass to remove two extensively used antibiotics (ciprofloxacin and tetracycline) from secondary wastewater effluent with high nitrogen (N) and phosphorus (P) concentrations. Our previous studies demonstrated the efficiency of vetiver in removing the above antibiotics both from nutrient media and secondary wastewater effluent. Although sunlight-mediated photodegradation of ciprofloxacin (CIP) and tetracycline (TTC) has been reported in some studies, due to certain physico-chemical properties of wastewater, such as the abundance of organic matter and complex matrix chemistry, photodegradation may not occur. In recent years, vetiver system (VS) has been implemented in several parts of the world as a sustainable, green remediation technology due to its ability to uptake and hyperaccumulate many chemical pollutants from both soil and water. Major objectives of this study were to: i) evaluate the potential of vetiver grass to selectively phytoextract nutrients (N, P) and antibiotics (ciprofloxacin and tetracycline), and ii) determine the combined effects of nutrients and antibiotics on plant physiological system. Vetiver plants were grown hydroponically in wastewater matrix spiked with nutrients and antibiotics. Periodic samples were collected to determine removal kinetics of nutrients and antibiotics for two months. Significant ($p<0.0001$) removal (>90%) of antibiotics (CIP & TTC) was observed in all experiments. Antibiotic removal declined with increasing concentrations of nutrients.

Saumik Panja, Stevens Institute of Technology, 1 Castle Point Terrace, Hoboken, NJ, United States, 07030, Tel: 973-508-5185, spanja1@stevens.edu

Dibyendu Sarkar, Stevens Institute of Technology, 1 Castle Point Terrace, Hoboken, NJ, United States, 07030, dsarkar@stevens.edu

Rupali Datta, Michigan Technological University, 1400 Townsend Drive, Houghton, MI, United States, 49931, rupdatta@mtu.edu

Abhishek RoyChowdhury, Stevens Institute of Technology, 1 Castle Point on Hudson, Hoboken, NJ, United States, 07030, aroychow@stevens.edu

Presenting Author: Saumik Panja