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Antibiotic fate in the process environment: informing on waste management options to mitigate veterinary antibiotics as drivers of antimicrobial resistance

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The University of Nottingham owns a high throughput dairy farm with around 200 milking cows, from which the pressed liquid waste ends up in a 3000 m3 slurry tank. The health of a dairy herd is supported by the administration of antibiotics so the farm setting works as an antimicrobial resistance (AMR) reservoir and as a route of entry into the environment. The persistence of antibiotics in dairy settings occur through mediums such as slurry and subsequently via spreading to soil and crops. These routes can act as a channel for the transference of pollutants and the development and spread of AMR within the food chain through uptake by plants and migration to other sources via water run-off, possibly affecting the therapeutic potential against human and animal pathogens and posing a high risk to public health. The main objective of this study is to measure the distribution and fate of select antibiotics currently in use within the farm environment, informing on process options with the aim to mitigate development and spread of AMR. Therefore, this study intends to understand the response of antibiotics to different process/environmental factors (eg. temperature, mixing) in order to transfer outcomes to improving the waste management in the farming environments. Fate experiments were performed testing biodegradation degradation in wastewater slurry under different conditions. This work demonstrates that 6 veterinary antibiotics showed persistence in wastewater slurry after 24 hours in an experiment emulating the real conditions of the slurry tank. Cephalosporins were the antibiotic group showing both highest degradation as well as abiotic removal after 24 hours (Fig.1). Understanding antibiotic fate in the real environment enables us to design and adapt engineering processes accordingly, as well as the approach of new ways of managing waste in agricultural environments, mainly as regards the reuse practices including food security.

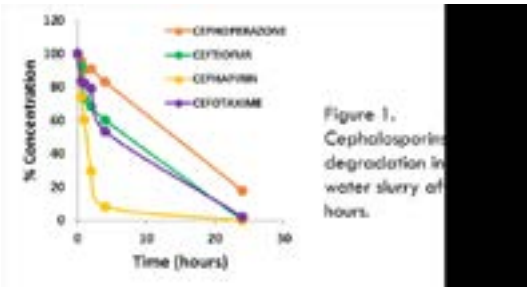

Figure 1. Cephalosporin degradation in water slurry at hours.

Recent Publications:

1. Villar-Navarro, E, Baena-Nogueras, RM, Paniw, M, Perales, JA, Lara-Martín, PA (2018). Removal of pharmaceuticals in urban wastewater: high rate algae ponds (HRAP) as an alternative to conventional technologies. Water Research, 139: 19-29.
2. Biel-Maeso, M, Baena-Nogueras, RM, Corada-Fernández, C, Lara-Martín, PA (2018). Occurrence, distribution and environmental risk of pharmaceutically active compounds (PhACs) in the Gulf of Cadiz (SW Spain). Science of the Total Environment, 612: 649-659.
3. Baena-Nogueras, RM, González-Mazo, E, Lara-Martín, PA (2017). Photolysis of antibiotics under simulated sunlight irradiation: kinetics and identification of photoproducts by high resolution mass spectrometry. Environmental Science and Technology 51: 3148-3156.
4. Baena-Nogueras, RM, González-Mazo, E, Lara-Martín, PA (2017). Degradation kinetics of pharmaceuticals and personal care products in surface waters: photolysis vs biodegradation. Science of the Total Environment, 590-591: 643-654.

5. Baena-Nogueras, RM, Pintado-Herrera, Marina G, González-Mazo, E, Lara-Martín, PA (2016). Determination of pharmaceuticals in coastal systems using solid phase extraction (SPE) followed by ultra performance liquid chromatography – tandem mass spectrometry (UPLC-MS/MS). Current Analytical Chemistry 12: 1-19.

Biography

Rosa Maria Baena Nogueras obtained a degree in Environmental Sciences at the University of Granada in 2009, followed by MSc in Environment, Health and Safety, a MEd in Biology and Geology at the University of Granada and a MSc in Integrated Water Resources Management at the University of Cadiz. Meanwhile she performed a research fellowship focused on the determination, reactivity, and fate of surfactants in marine environments and led to a Ph.D. in Marine and Environmental Sciences focuses on the determination and environmental behavior of pharmaceuticals and personal care products in aquatic systems at the University of Cadiz. She joined the University of Nottingham in 2016 as a postdoctoral research fellow to continue her research developing methods and fate of antibiotics in dairy environments within a strong multidisciplinary research programme on AMR (Antimicrobial Resistance) in agricultural settings..

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