Centre for Global Eco-Innovation

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Anti-dotal studies

The occurrence, fate and remediation of veterinary antibiotics in surface waters

Bowland ANALYTICAL SUPPORT

Bowland Analytical Support offers services to laboratories in the environmental, pharmaceutical and chemical industries. The company can provide repair, maintenance, and validation activities on Agilent GC, GCMS and LC hardware by a factory trained engineer, who is also an experienced analytical chemist. Additionally, they provide training services to smaller laboratories.

Over the last decade the potential impacts of pharmaceuticals in the environment have attracted increasing interest from the scientific community and the media. The 2015 Longitude Prize, addressing the increased resistance to antibiotics was recently voted as the greatest scientific challenge of our age by the British public. The main issue is that the occurrence of pharmaceuticals is closely related to the emergence and development of antibiotic-resistant bacteria. There is a growing need to efficiently monitor these chemicals, using robust and quick screening methods in order to fully comprehend the extent of their influence in freshwater systems.

Evangelia Tzelepi, a graduate Researcher as part of the Centre for Global Eco-Innovation has been working in collaboration with Bowland Analytical, and the Lancaster Environment Centre. Together they have established an

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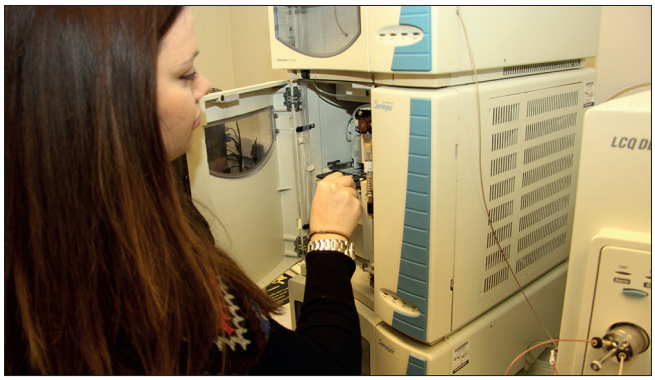

effective, easy to implement and economically viable way of monitoring widely used antibiotics in surface waters.

The research method involved monitoring the occurrence of widely used veterinary antibiotics in the area surrounding three high impact farms in a river catchment, using online Solid Phase Extraction coupled to a Liquid Chromatography/ Mass Spectrometry system. Conventional Solid Phase Extraction methods require at least 500ml of surface water and multiple steps until one sample is ready for analysis through a Liquid Chromatography/Mass Spectrometry system. However, this revolutionary new method utilises a regenerating online Solid Phase Extraction cartridge for sample pre-treatment, with a required sample volume of 1.5ml.

The sample is filtered and then loaded into the Liquid Chromatography/Mass Spectrometry system. Because of the high volume injection the detection limits for this method are in the order of low *parts-per-trillion* and in some cases *sub-parts-per-trillion* levels with the total analysis time of 30 minutes. Due to the low sampling volume required, multiple sampling locations

"Animal waste is a significant source of antibiotics in the environment"

are examined across the river and streams to determine how these pharmaceuticals enter the aquatic environment.

Depending on the amount of samples that someone wants to analyse with this method you save time, which eliminates the cost of analysis, you minimize the use of materials and solvents and also the transport cost. Compared to the offline sample preparation you can save up to 4g

A wide variety of different classes of antibiotics were included in the testing methods outlined here, including:

* Tetracyclines
* b-lactams (penicillins, cephalosporins)
* Sulphonamides
* Lincosamides
* Macrolides
* Fluoroquinolones
* Aminoglycosides

of plastic and 0.2g of polymeric sorbent and up to 500ml of organic solvent for each sample.

Animal waste is a significant source of antibiotics in the environment. Farms are capable of producing vast amounts of waste in relatively small areas. Improper processing, use or storage of animal waste can pollute rivers and ground water supplies. Furthermore, these pollutants can also contribute to significant air quality problems, including dust, smog, greenhouse gases, and odours. There are knowledge gaps regarding the fate of these chemicals and how they breakdown under different environmental conditions, perhaps giving rise to recalcitrant degradation by-products.

In addition to the ongoing fate studies, the team is trying to establish a novel, low-technology method, based on culturing key aquatic microorganisms using primarily farm waste, which may serve as a plausible route for enhanced removal of dissolved antibiotics and other pharmaceuticals.

Evangelia Tzelepi I Graduate researcher