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Laboratory-scale wetlands remove toxic veterinary drugs from wastewater

Constructed wetlands can effectively remove veterinary drugs from wastewater, preventing contamination of the environment, research suggests. A recent study has demonstrated that laboratory-scale constructed wetlands were able to remove between 94 and 98% of two commonly used antibiotics from pig farm wastewater.

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Veterinary drugs are used extensively in livestock rearing and are likely to contaminate wastewater from this industry. However, wastewater treatment plants are typically designed to remove infectious agents and nutrients, but are not always capable of removing pharmaceutical drugs. In such cases, waterways may become contaminated by treated effluent still containing drugs.

Natural and artificially constructed wetlands can be used to remove contaminants from wastewater either as an additional treatment for effluent, or as an alternative to treatment plants. Removal of drugs can occur through several different processes; breakdown by microorganisms, uptake by plants or trapping drugs in the substrate base as the wastewater flows though the wetland can all help to reduce contamination.

In this study, partly funded by the European Regional Development Fund[1], researchers used laboratory-scale constructed wetlands to study the removal of veterinary drugs from livestock wastewater. Plastic tanks were lined with a substrate base consisting of layers of gravel, lava rock, mixed sand and finally sediment from around the roots of reeds taken from a river in northwestern Portugal.

The containers were filled with enough wastewater, obtained from a treatment plant on a pig farm, to just cover the substrate layers and were wrapped in aluminium foil to exclude light at substrate level, mimicking conditions of full-scale constructed wetlands and preventing breakdown of drugs by light. Tanks contained either sterilised substrate, non-sterilised substrate, or non-sterilised substrate planted with common reeds, a species which has been previously shown to take up two commonly used veterinary antibiotics, enrofloxacin (ENR) and tetracycline (TET). The water in the tanks was changed every week for 12 weeks. The tanks received either wastewater straight from the treatment plant, or wastewater containing added ENR, or added TET, at concentrations found in the environment.

Levels of ENR and TET in the wastewater fell significantly (by at least 98% and 94% respectively) in all tanks each week. There was little difference in removal between planted and unplanted tanks. This suggests that the drugs were either removed by being trapped in the substrate, by microbial breakdown, or both. Drug removal also occurred in tanks containing only gravel and lava rock as substrate.

Since ENR removal in sterilised tanks was similar to ENR removal in non-sterilised unplanted tanks, ENR removal appears to have been primarily the result of trapping in the substrate rather than microbial breakdown. However, TET concentrations were higher in sterilised tanks compared with non-sterilised unplanted tanks suggesting that, in addition to becoming trapped by the substrate, TET was broken down by microorganisms in the non-sterilised tanks, thus improving decontamination.

Although it appears that plants in the planted systems did not make a direct contribution to drug removal, the planted microcosms presented fewer clogging problems than the unplanted systems, and plants may be useful in such systems for other reasons. The planted reeds showed no sign of being negatively affected by the presence of the added drugs compared with the wastewater treatment, and the plants appeared to cope well with the more general toxicity of the wastewater. In conclusion, the study demonstrated the potential for constructed wetlands to improve water quality, although additional testing would be appropriate.

1. http://ec.europa.eu/regional_policy/thefunds/regional/index_en.cfm