European Commission

Science for Environment Policy

Combinations of veterinary antibiotics may harm algae

Combinations of antibiotics used in veterinary medicine could harm the growth of algal communities when they pass into water bodies from treated livestock, according to recent European research. Algae play vital roles in ecosystems by cycling nutrients and producing energy from photosynthesis; veterinary use of antibiotics should, therefore, be monitored in the environment, including for any biological impacts on algal species, the study recommends.

Antibiotics used in agriculture can enter soils and waterways either directly when excreted from pasture animals or when manures and slurries from housed animals are added to agricultural fields as fertiliser. As antibiotics target bacteria, non-target algal species such as cyanobacteria — bacteria which obtain their energy from photosynthesis — may be particularly affected by antibiotics in the environment. Potential impacts include prevention of, or a reduction in, the algae's growth.

Water bodies within certain agricultural landscapes are likely to be exposed to a mixture of antibiotics from veterinary use. Assessing the combined effects of these products is therefore important when assessing the environmental risks from antibiotics.

The EU's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation outlines a tiered approach for assessing the risks from mixtures of chemicals to the natural environment, which can also be used to assess antibiotic mixtures. Tier 1 uses a conservative approach for assessing chemical mixtures. The risk from chemicals to the environment, termed risk quotient (RQ), is assessed based on predicted environmental concentrations (PECs) and predicted no-effect concentrations (PNECs). In this study the researchers use a similar approach to that under REACH, in order to assess the risks posed by antibiotic mixtures to algal species.

The study used experimental ecotoxicity studies combined with exposure models[1] to assess the risk from mixtures of three veterinary antibiotics to algae and cyanobacteria in European water bodies. The antibiotics studied — tylosin, lincomycin and trimethoprim — are commonly used and have all been detected in water bodies.

They initially estimated concentrations of the antibiotics in representative water bodies within agricultural land in Europe using scenarios recommended by the EU's Forum for Pesticide Fate Models and their Use (FOCUS). Different scenarios for soil drainage, run-off and water-body type (i.e. ditches, ponds or streams) were all considered to derive the PECs.

They then used data from their own laboratory experiments with algae and cyanobacteria alongside published data to determine PNECs for each of the antibiotics. The researchers calculated an RQ for each antibiotic individually based on the PECs and the PNECs. They also used a mixture modelling approach, validated using targeted laboratory studies on defined mixtures of the antibiotics, to calculate RQs for mixtures of the antibiotics. If the RQ was lower than 1, the risk was considered acceptable[2].

Continued on next page.

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1. EMEA, Revised guideline on environmental impact assessment for veterinary medicinal products: http://www.ema.europa.eu/docs/en_GB/document_library/Scientific_guideline/2009/10/WC500004389.pdf

2. Ibid.

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Combinations of veterinary antibiotics may harm algae *(continued)*

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The study found that trimethoprim posed an acceptable risk level (RQ of 0.033) to algal species. Tylosin (maximum RQ value 367) and lincomycin (maximum RQ value 18.68) were found to pose an unacceptable risk to the aquatic environment. For tylosin, unacceptable risk was found for all exposure scenarios, with the RQ values (based on maximum application rate) ranging from 5.33 to 367. For lincomycin, unacceptable risk was calculated for scenarios that represented ditches and streams within agricultural land found in western, central and southern Europe (with the RQ values of 1.24, 6.71 and 18.68, respectively). For the mixtures of antibiotics, the RQ value exceeded 1 for most scenarios modelled. The RQ values for the mixtures ranged from 0.066 to 385.

The researchers say that the method used here could be applied to other antibiotics and active ingredients used in veterinary medicine, as well as other situations of antibiotic exposure, such as emissions from wastewater treatment plants. As the models indicated an unacceptable risk level for the mixture of three antibiotics (mainly due to tylosin and lincomycin), the researchers recommend targeted monitoring of these antibiotics within European water bodies. Monitoring should collect data which could contribute to a full risk assessment of antibiotics, including data on any effects on algae.