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Environmental concentrations of antibiotics are potentially damaging to aquatic life

Combinations of antibiotics have been found in high enough concentrations to pose a serious threat to aquatic ecosystems, in a recent Spanish study. Antibiotics can have toxic effects on the bacteria and algae that form the basis of aquatic ecosystems.

Antibiotics are in widespread use, not only for human medical conditions, but also for increasing growth rates in livestock, in the feed of farmed fish and to prevent bacterial crop damage. As a result, contamination of natural environments is common in Europe, and antibiotics have been found in groundwater, drinking water and soils. Although much of current concern regarding antibiotics is focused on bacterial resistance and the consequences for human health, the presence of antibiotics in the environment can also have damaging effects on ecosystems.

In this study, researchers examined the effects of antibiotics on a cyanobacterium and a green alga, key organisms which supply the nutrients needed for aquatic ecosystems. Five different types of antibiotics (amoxicillin, erythromycin, levofloxacin, norfloxacin and tetracycline) were chosen because they had been previously detected in aquatic environments.

In natural environments, it is likely that organisms will be exposed to mixtures of different antibiotics arising from different sources, it is therefore important that the combined effects of such compounds are studied. Researchers tested the toxicity of these antibiotics, both in isolation and in different combinations, up to all five at once. To assess toxicity, concentrations similar to those that had been measured in the environment were added to solutions containing the cyanobacterium or the alga.

The results suggest that erythromycin in particular was highly toxic to both cyanobacteria and algae, to such an extent that researchers warn that it could be classified as 'very toxic to aquatic life' under the EU regulation on classification, labelling and packaging of substances and mixtures[1]. In general, the toxicity of all antibiotics was higher for the cyanobacterium than for the alga. This was to be expected, since antibiotics are designed to target bacteria. However, erythromycin and tetracycline were both highly toxic to the alga, demonstrating that antibiotics can be toxic even to non-target organisms, such as plants.

In order to assess the effects of interactions between antibiotics the researchers used a 'Combination Index'. This showed that, in most cases, the toxic effects of antibiotics were increased when they were in combination with other antibiotics. The researchers stress that this result shows that even if compounds are in low concentrations in the environment, they may still have a toxic effect on ecosystems when mixed with other substances.

Finally, researchers calculated 'risk quotients': the ratio of observed concentration in the environment to no-effect concentration (i.e. the level at which the compound is expected to have no harmful impact). A ratio of greater than 1 was found for erythromycin and tetracycline individually in surface waters in relation to the cyanobacterium and the alga, respectively, and for a mixture of the two antibiotics in wastewater effluent in relation to both organisms. The results demonstrate that antibiotics, and in particular certain combinations, may pose a potential ecological risk for aquatic ecosystems.

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