

TITLE: Occurrence of antibiotics and bacterial resistance in wastewater and sea water from the Antarctic

AUTHOR: ['Félix Hernández', 'Nancy Calisto-Ulloa', 'Claudio Gómez-Fuentes', 'Mauricio Rojas Gómez', 'Javier Ferrer', 'Gerardo González-Rocha', 'Helia Bello-Toledo', 'Ana María Botero-Coy', 'Clara Boix', 'María Ibáñez', 'Mónica Montory']

ABSTRACT:

The potential presence of introduced antibiotics in the aquatic environment is a hot topic of concern, particularly in the Antarctic, a highly vulnerable area protected under the Madrid protocol. The increasing presence of human population, especially during summer, might lead to the appearance of pharmaceuticals in wastewater. The previous discovery of *Escherichia coli* strains resistant to antibiotics in sea water and wastewater collected in King George Island motivated our investigation on antibiotics occurrence in these samples. The application of a multi-residue LCMS/MS method for 20 antibiotics, revealed the presence of 8 compounds in treated wastewater, mainly the quinolones ciprofloxacin and norfloxacin (92% and 54% of the samples analyzed, average concentrations 0.89 µg/L and 0.75 µg/L, respectively) and the macrolides azithromycin and clarithromycin (15% positive samples, and average concentrations near 0.4 µg/L), and erythromycin (38% positive samples, average concentration 0.003 µg/L). Metronidazole and clindamycin were found in one sample, at 0.17 and 0.1 µg/L, respectively; and trimethoprim in two samples, at 0.001 µg/L. Analysis of sea water collected near the outfall of the wastewater discharges also showed the sporadic presence of 3 antibiotics (ciprofloxacin, clindamycin, trimethoprim) at low ng/L level, illustrating the impact of pharmaceuticals consumption and the poor removal of these compounds in conventional WWTPs. The most widespread antibiotic in sea water was ciprofloxacin, which was found in 15 out of 34 sea water samples analyzed, at concentrations ranging from 4 to 218 ng/L. Bacteria resistance was observed for some antibiotics identified in the samples (e.g. trimethoprim and nalidixic acid, a first generation quinolone). However, resistance to some groups of antibiotics could not be correlated to their presence in the water samples due to analytical limitations (penicillins, tetracyclines). On the contrary, for some groups of antibiotics detected in samples (macrolides), the antibacterial activity against *E. Coli* was not investigated because these antibiotics do not include this bacterial species in their spectrum of activity. Our preliminary data demonstrate that antibiotics occurrence in the Antarctic aquatic environment is an issue that needs to be properly addressed. Periodical monitoring of water samples and the implementation of additional treatments in the WWTPs are recommended as a first step to prevent potential problems related to the presence of antibiotics and other emerging contaminants in the near future in Antarctica.

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