Fate and effects of cytostatic pharmaceuticals in the environment and the identification of biomarkers for and improved risk assessment on environmental exposure

Results in Brief

The environmental dangers of anticancer drugs

Recent research from the EU has shown that anticancer drugs and by-products in wastewater negatively impact on reproduction and survival of many freshwater organisms.

Cytostatic drugs (a class of pharmaceutical commonly used to treat cancer) have been very successful, but may be negatively affecting the environment. These drugs stop the growth and division of cells; released into the environment, they can affect the ecosystem through altered fertility and increased genetic defects.

Scientists studied the effects of cytostatic drugs in freshwater organisms and in vitro cell lines through the EU-funded project CYTOTREAT (Fate and effects of cytostatic pharmaceuticals in the environment and the identification of biomarkers for and improved risk assessment on environmental exposure). They examined how four cytostatic compounds (5-fluorouracyl, imatinib, etoposide and cisplatin) affected the genetics and reproduction
of various freshwater organisms.

The team developed an automated cytostatic compound detection method capable of detecting 43 different cytostatic pharmaceuticals (and derivatives) in water, 13 of which were unknown.

Researchers carried out eco-toxicological studies of the acute and chronic effects of four cytostatics on algae, bacteria, crustaceans and zebrafish. Crustaceans were the most heavily affected group, showing growth inhibition and DNA damage at low concentrations. Algae and bacteria were less sensitive, while zebrafish were the least affected. Researchers also found that the combined effects of the anticancer drugs were no different from the individual effects.

The team also looked at toxicity of the various compounds in human and zebrafish cells in the laboratory, to model the long-term side-effects of these drugs. Zebrafish cells were chosen as a reliable model system to study acute but not long-term cytotoxic effects.

CYTOTHREAT is filling an important gap in knowledge regarding the effects of cytostatic drugs on aquatic organisms and on human beings. Determining the concentration and distribution of these hazardous compounds in water resources will have a major impact on water quality management programmes. Taken together, project outcomes are expected to play a major role in helping to safeguard the public from toxic pharmaceuticals and their by-products.

Keywords

Anticancer drugs, wastewater, reproduction, freshwater organisms, cytostatic, genetic defects
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