Lethal and sub lethal effects of the biocide chlorhexidine on aquatic organisms

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Abstract

Chlorhexidine is among the most used biocides in Europe, however its toxicity to aquatic organisms is scarcely known. The main objective of this study was to assess the lethal and sub lethal effects of chlorhexidine digluconate (ChD) on four aquatic model organisms: the bacteria Vibrio fischeri, the algae Pseudokirchneriella subcapitata, the crustacean Daphnia magna and the embryos of the fish Danio rerio. ChD was very toxic to algae and crustaceans, with a 72 h-EC50 of 62.2 µg/l and a 48 h-EC50 of 45.0 µg/l, respectively. Toxicity to fish embryos and the bacteria was lower, with a 96 h-EC50 of 804.0 µg/l and a 15 min-EC50 of 1,694.0 µg/l, respectively. Concerning sub lethal effects on D. magna (feeding inhibition) a 6 h-EC50 of 503.7 µg/l was obtained. In fish, ChD caused developmental abnormalities, namely alterations in the amniotic fluid (48 h-EC20 of 753.6 µg/l) and early hatching. Moreover, enzymatic biomarkers on fish embryos showed an induction of cholinesterase activity in all ChD tested concentrations (80-900 µg/l). The catalase activity was also induced at the highest concentration tested (900 µg/l) whereas no changes were observed for glutathione-S-transferase and lactate dehydrogenase activities. The toxicity of ChD to the algae and crustacean raises concerns about its potential effects in aquatic food webs, since these organisms are in the base of trophic chains, and highlights the need for further studies on ChD toxicity to aquatic organisms.

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