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RESEARCH ARTICLE

Reprotoxicity of the Antifoulant Chlorothalonil in Ascidians: An Ecological Risk Assessment

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Abstract

Chlorothalonil is a widely used biocide in antifouling paint formulation that replaces tin-based compounds after their definitive ban. Although chlorothalonil inputs into the marine environment have significantly increased in recent years, little is known about its effect on marine animals and in particular on their reproductive processes. In this line, the aim of the present study was to investigate the effects of chlorothalonil exposure on the gamete physiology, fertilization rate and transmissible damage to offspring in the marine invertebrate *Ciona intestinalis* (ascidians). To identify a possible mechanism of action of chlorothalonil, electrophysiological techniques were used to study the impact on oocyte membrane excitability and on the electrical events occurring at fertilization. The pre-exposure of spermatozoa and oocytes to chlorothalonil did not affect the fertilization rate but caused damage to the offspring by inducing larval malformation. The highest toxicity was observed when fertilization was performed in chlorothalonil solutions with the lowest EC_{50} value. In particular, it was observed that low chlorothalonil concentrations interfered with embryo development and led to abnormal larvae, whereas high concentrations arrested embryo formation. In mature oocytes, a decrease in the amplitudes of the sodium and fertilization currents was observed, suggesting an involvement of plasma membrane ion currents in the teratogenic mechanism of chlorothalonil action. The risk estimation confirmed that the predicted no-effect concentration (PNEC) exceeded the predicted effect concentration (PEC), thus indicating that chlorothalonil may pose a risk to aquatic species.

Introduction

The widespread use of antifouling paints containing the biocide tributyltin (TBT) to prevent the settlement and growth of organisms on submerged structures has caused several adverse effects, such as reproductive disorders in different marine species [1]. Therefore, in the last decade, new environmentally friendly organic booster biocides have been developed as TBT alternatives.