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Toxicity evaluation of new antifouling compounds using suspension-cultured fish cells

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Abstract

A simple, rapid toxicity test was developed using the suspension-cultured fish cell line CHSE-sp derived from chinook salmon *Oncorhynchus tshawytscha* embryos in order to assess the toxicity of new marine antifouling compounds. The compounds tested were copper pyrithione, Diuron, Irgarol 1051, KH101, Sea-Nine 211, and zinc pyrithione, all of which have been nominated in Japan as possible replacements for organotin compounds. The in vitro acute toxicity (24-h EC_{50}) of the six compounds to these fish cells was evaluated using the dye Alamar Blue™ to determine cell viability, and then correlated with the results of in vivo chronic toxicities (28-day LC_{50}) to juvenile rainbow trout *Oncorhynchus mykiss*. The suspension-cultured fish cells were found to be suitable for the screening of such chemicals before performing an in vivo test. The toxicities of the test compounds obtained from both tests, shown in decreasing order, were as follows: copper pyrithione > zinc pyrithione > KH101 ⩾ Sea-Nine 211 > Diuron > Irgarol 1051. The herbicides Diuron and Irgarol 1051 showed the least toxicity, while the pyrithiones had the greatest toxicity.

Keywords: Antifouling compound; Fish; Rainbow trout; Suspension-cultured cells

1. Introduction

New antifouling compounds are needed as possible replacements for organotin compounds, which have been regulated internationally since the late 1980s and early 1990s. Information in the open literature on the practical usage of antifouling compounds is limited, except for the case of Britain (Voulvoulis et al., 1999). A preliminary assessment of antifouling compounds alternative to organotins by the Shipbuilding Research Association of Japan reported that 17 compounds had been proposed as safe and effective antifouling compounds (Yonehara, 2000). To our knowledge, information on the chemical compositions, production and usage statistics of antifouling compounds used in Japan is not publicly available. We previously investigated Irgarol 1051, a new antifouling compound that has been mainly detected in European coastal waters. Residue analyses of Irgarol 1051 in Japanese coastal waters have already indicated wide usage in antifouling paints (Liu et al., 1999; Okamura et al., 2000a). Ecotoxicity studies showed that both Irgarol 1051 and its major degradation product could possibly damage primary producer communities in aquatic ecosystems at environmentally relevant concentrations (Okamura et al., 2000a,b). Irgarol 1051 does not exhibit high toxicity to fish and

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