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Diatomite and Dietary Sodium Chloride Decrease Cu^{2+} Accumulation and Induction of Metallothionein Expression on Tilapia Juvenile (*Oreochromis mossambicus*) Upon Exposure to Waterborne Copper

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ABSTRACT

This study aims to estimate the effectiveness of dietary NaCl in fish and aquatic water filtered with diatomite, to determine whether both treatments could practically be applied to aquaculture to reduce Cu^{2+} accumulation in fish. The experimental designs were included one blank (B) group of fish which was without any treatment, and four Cu^{2+} exposure groups (3.15 μM Cu^{2+} exposure for 72 h): C group of fish was treated with Cu^{2+} exposure; *Na* group of fish was treated with Cu^{2+} exposure after dietary NaCl for 6 weeks; *Si* group of fish was treated with Cu^{2+}, but the exposure water was filtered by diatomite; *Na+Si* group of fish was treated with Cu^{2+} exposure after dietary NaCl for 6 weeks, and the exposure water was filtrated by diatomite. Results showed that both diatomite and dietary NaCl treatments induced significantly increased metallothionein expression and reduced Cu^{2+} contents in fish, but did not interfere with the growth, or whole-body water or Na^+ homeostasis of juvenile tilapia. In treatment groups, Cu^{2+} levels decreased in the water and in the whole fish body after 6.26 μM $CuSO_4$ exposure. According to the data, we suggested that both diatomite filtration and dietary NaCl have a potential to decrease Cu^{2+} accumulation and to induce metallothionein expression on fish.

Key words*: copper, diatomite, tilapia, metallothionein, dietary sodium.*

1. INTRODUCTION

Copper sulfate is commonly applied in concentrations of 3.1-9.4 μM to aquaculture ponds to eradicate filamentous algae, and also effectively reduces phytoplankton, including *Microcystis* as well as other blue-green algae. On the other hand, fish fed diets supplemented with Cu^{2+} at levels of 3-9 mg/kg experienced significantly higher growth rates (Shao et al., 2012). However, too much Cu^{2+} can induce toxicity in aquatic ecosystems and impact organisms, as it is a cumulative non-biodegradable pollutant. It is evident that sublethal Cu^{2+} concentrations accumulate in the tissue of tilapia larvae, impacting their physiological mechanisms (Wu et al., 2003). Considerable evidence has been presented to show that Cu^{2+} toxicity also disrupts Na^+ and K^+ homeostasis, Na^+-K^+- ATPase activity (Wu et al., 2008), and growth in both juvenile and adult fish (McGeer et al., 2000). Therefore, methods of decreasing Cu^{2+} accumulation in fish have important safety implications for aquaculture. Our previous studies show that Cu^{2+} and Na^+ content are strongly correlated in tilapia. Combined with external Na^+, Cu^{2+} exposure can induce higher metallothionein (MT) expression and increase Cu^{2+} resistance (Wu et al., 2007). The metal toxicology of tilapia is better understood than for other aquaculture species, and it presents a significant commercial value.

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