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Impacts of mercury exposure on life history traits of *Tigriopus japonicus*: Multigeneration effects and recovery from pollution

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Here, through a multigenerational life-cycle test, *Tigriopus japonicus* were exposed to different mercuric chloride treatments in seawater (nominal concentrations of 0, 0.5, 1, 10, and 50 μg/L) for five successive generations (F0–F4), and subsequently all the treatments were recovered in clean environments for one generation (F5). Six life history traits (survival, developmental time for nauplius phase, developmental time to maturation, fecundity, number of clutches, and number of nauplii/clutch) were examined for each generation. Mercury (Hg) accumulation was also analyzed for the adult copepods in the F1, F3, and F5. The results indicated that Hg accumulated in a dose-dependent manner for the F1, F3, and F5 generations. Moreover, higher Hg contents were observed in F3 than F1 at the same exposure levels. Among the six life history traits, only fecundity and number of nauplii/clutch showed a greater sensitivity to Hg toxicity, and the inhibitory effects worsened from F0 to F3, which was explained by a trend for higher metal accumulation with increasing generations. In the recovery generation (F5), none of the traits differed from the control, highlighting that Hg might not induce any epigenetic or parental effects in the following generations. Thus, we hypothesized that although cumulative effects might have been involved in Hg multigenerational toxicity, physiological acclimation, that is, phenotypic plasticity could explain Hg tolerance obtained by marine copepods. Impacts on important life history traits could disturb the population dynamics of some important marine copepods, hence having unexpected ecological consequences in the marine ecosystem. Yet, the Hg harmful impacts rapidly fade away as the Hg is cleared from the environment.

1. Introduction

Mercury (Hg) is one of the most hazardous and persistent environmental pollutants in the aquatic environments (Jiang et al., 2006). Hg pollution is considered as one of the primary environmental problems in China, which contributes approximately 28% of the global Hg emissions to the atmosphere. This is a result of anthropogenic activities including mining, industrialization and rapid urbanization (Pacyna et al., 2006). Atmospheric Hg is deposited through various pathways and finally aggregates into aquatic environments. In China, the average annual input of Hg into coastal environments by major rivers was about 58 tons between 2009 and 2013 (NBO, 2015). Additionally, Hg released from point sources and long-range air transport has further contaminated the marine and coastal environments in China, hence causing Hg contamination to be a serious problem in this area. Wang et al. (2009) have reported maximum levels of total Hg (T-Hg) for water and sediment in Jinzhou Bay to be 2.59 μg/L and 64 μg/g, respectively, which are three orders of magnitude higher than the background concentration. In such a highly contaminated environment, the organisms may have been exposed to the high Hg levels throughout many generations. The potent toxicity of Hg compounds is often associated with the high affinity of Hg for sulfur, causing an efficient binding to cysteine residues in proteins and enzymes, thereby perturbing their functions and subsequently displaying multiple toxicity (e.g., hepatotoxicity and neurotoxicity) in organisms (Castoldi et al., 2001; Ung et al., 2010). Therefore, data on multiple biological traits such as growth, development and reproduction are really desired in aquatic organisms when challenged with multigenerational exposure to Hg. Such information is most valuable for marine ecotoxicological studies where degenerative or adaptive responses in progeny may be the most critical impacts.

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