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Ecotoxicological effects of 3,4-dichloroaniline on *Daphnia magna*: implications for aquatic ecosystem health and management

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Abstract

Background: Aromatic amines are extensively employed in dye, pharmaceutical, pesticide, and polymer manufacturing. These compounds exert environmental impacts, affecting aquatic ecosystems and biodiversity [1]. 3,4-dichloroaniline (3,4-DCA) is a candidate for inclusion in the 4th Watch List of Water Framework Directive due to its presence in aquatic ecosystems and known ecotoxicological effects [2, 3]. **Objective:** This study aimed to assess the individual and sub-individual chronic effects of 3,4-DCA on *Daphnia magna*, considering environmental concentrations [0.07 µg/L to 6 µg/L in wastewater treatment plant influents, superficial water (Germany), and effluents (USA), river waters (Portugal and USA) and groundwaters (Portugal) [3]] and previous studies (subchronic exposure). **Methods:** Chronic exposure (21 days) was conducted with *D. magna* exposed to a range of ecologically relevant concentrations of 3,4-DCA (≤ 6 µg/L). Different biological responses were evaluated: 1) individual - growth and reproduction; and 2) sub-individual - antioxidant defense and detoxification, energetic metabolism, neurotransmission, and genotoxicity. **Results:** Significant effects were observed in *D. magna* following 3,4-DCA exposure. Somatic growth rate increased (≥ 2 µg/L), catalase activity decreased (0.222 µg/L) followed by an increase (6 µg/L), and genetic damage index increased above 0.294 µg/L. The rise in somatic growth may signal resource allocation changes, affecting fitness and reproduction. Catalase activity fluctuation and the absence of significant results in other antioxidant defenses and lipid peroxidation suggest that this enzyme was able to neutralize oxidative stress and damage. Genotoxicity suggests future impacts on population and genetic diversity. **Conclusions:** This study provides crucial insights into the chronic ecotoxicological effects of 3,4-DCA on *D. magna*, under ecologically relevant concentrations. It underscores the importance of considering diverse biological endpoints in ecotoxicological assessments. These findings play a pivotal role in assessing the ecological risks associated with aromatic amines, enabling the identification of measures to safeguard global environmental integrity and human health.

Keywords: ecotoxicology; aromatic amine; aquatic ecosystem; growth; biomarkers

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