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Acute toxicity screening of 4-chloroaniline in freshwater standard species

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Abstract

Background: Aromatic amines are commonly used in the production of pigments, dyes, pharmaceuticals, pesticides, and laboratory chemicals [1]. Due to inappropriate discard and the ineffectiveness of wastewater treatment plants in removing these compounds, they are frequently detected in aquatic ecosystems [2], leading to 4-chloroaniline being considered a candidate for the 4th Watch List under the Water Framework Directive [3], to determine the risk it poses to the aquatic environment. **Objective:** To evaluate the biological effects (individual and sub-individual responses) of standard species from different trophic levels, after exposure to 4-chloroaniline. **Methods:** A toxicity screening was performed regarding the ecotoxicological effects on *Allivibrio fischeri* (bioluminescence inhibition), *Raphidocelis subcapitata* (growth inhibition), *Lemna minor* (growth inhibition and biomarker assessment) and *Daphnia magna* (immobilization/mortality, reproductive effects and biomarker assessment). **Results:** The 4-chloroaniline exposure showed an *A. fischeri* effect concentration of EC_{50}(30 min) = 1.99 mg/L. Preliminary results demonstrate that *R. subcapitata* should be the most sensitive organism. *L. minor* presented an EC_{50}(7 d) = 82.84 mg/L. *L. minor* sub-individual results showed a significant decrease (≥ 93.75 mg/L) in the photosynthetic pigments content; a significant increase in catalase and glutathione *S*-transferases activities; and a significant decrease in lipid peroxidation. *D. magna* showed an EC_{50}(48 h) = 0.102 mg/L and, after a subchronic exposure (10 days), a significant decrease in N1 fecundity was recorded above 13.89 µg/L. Catalase and Glutathione *S*-transferases activities were only significantly increased at 13.89 mg/L. **Conclusions:** Results showed that 4-chloroaniline has an ecotoxicologically relevant effect in aquatic organisms, with an impact on several biochemical pathways, ultimately affecting individuals (survival, growth and reproduction responses). To better understand the effects of exposure to 4-chloroaniline in non-target organisms, more studies (e.g., chronic assays) should be conducted to produce data to help policy decisions related to monitoring and regulating these compounds in surface waters.

Keywords: ecotoxicology; aromatic amines; aquatic organisms; individual and sub-individual responses; biomarkers

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