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Sensitivity of four freshwater animal species to copper and cadmium under tropical temperature exposure

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Copper and cadmium are two common pollutants in Sri Lankan freshwater ecosystems. Water quality criteria for these metals focusing on the protection of freshwater species in Sri Lanka are yet unavailable. Formulating water quality criteria based on tropical species sensitivity distribution analysis would require credible ecotoxicity data (especially at early life/young stages) under tropical temperature exposure for a range of freshwater species belonging to different trophic levels. Thus, objective of the present study was to generate freshwater ecotoxicity data for copper and cadmium for tropical temperature exposures using four freshwater native/model test organisms: two crustaceans, *Daphnia magna* and *Moina macrocopa*, the fish *Poecilia reticulata* and the tadpoles of *Duttaphrynus melanostictus* representing primary and secondary consumers. Based on the range finding tests, the animals were exposed separately to a series of concentrations of Cu²⁺ (*D. magna* 50-300; *M. macrocopa* 1-150; fish 25-300; tadpole 10-300) or Cd²⁺ (*D. magna* 10-200; *M. macrocopa* 1-150; fish 25-300; tadpole 100-500) in µg/L along with the controls (in triplicate/quadruplicate exposure medium, n=10 animals per replicate) at 28°C - 30°C under static-renewal conditions (hardness ≤ 66 mg/L as CaCO₃) following standard OECD toxicity testing protocols. The sensitivity of the crustaceans (neonates) for different concentrations of Cu²⁺ and Cd²⁺ exposure was assessed based on percentage neonates immobilized whereas the sensitivity of *P. reticulata* (fry 5-10 mm total length) and *D. melanostictus* (Gosner stage 25 tadpoles) was evaluated based on percent mortality. Concentrations of copper and cadmium in the exposure media were determined using atomic absorption spectrophotometry. Ecotoxicity thresholds were estimated based on concentration-toxicity response relationships using USEPA software, 'Toxicity Relationship Analysis Program'. Estimated 48 hour median effective concentration (EC₅₀) of copper for immobilization of the crustaceans, *D. magna* and *M. macrocopa* were 117 and 15 µg/L respectively whereas corresponding values for cadmium were 45 and 12 µg/L. Estimated 96 hour median lethal concentration (LC₅₀) values of copper for the fish, *P. reticulata* and the tadpole, *D. melanostictus* were 63 and 72 µg/L respectively. Corresponding LC₅₀ values for cadmium were 76 and 431 µg/L. The most sensitive species for copper and cadmium was the crustacean, *M. macrocopa*. The highest tolerance for cadmium was shown by the amphibian, *D. melanostictus* tadpole whereas *D. magna* showed the highest tolerance to copper. Additional ecotoxicity data for copper and cadmium focusing on more tropical freshwater species are needed for derivation of water quality criteria for tropical freshwater life protection.

Keywords: Cadmium, copper, freshwater species sensitivity, toxicity, tropical temperature