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ORIGINAL PAPER

Quest to Assess Potentially Nephrotoxic Heavy Metal Contaminants in Edible Wild and Commercial Inland Fish Species and Associated Reservoir Sediments; a Study in a CKDu Prevailed Area, Sri Lanka

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Abstract
Inland fish is one of the main protein sources of the regular diets of remote communities in Sri Lanka where the incidences of chronic kidney disease of unknown etiology (CKDu) have significantly increased. Nevertheless, the nephrotoxic heavy metals accumulated in the reservoir sediments may affect the bio-community, especially in fish through the food chains. To study the problem, concentrations of heavy metals (Cd, Pb, As, Cr, Cu, Zn, and Mn) in two common edible wild and commercial inland fish species and associated reservoir sediments were investigated in selected CKDu endemic and non-endemic areas in Sri Lanka. The concentrations of heavy metals were 1000 times higher in sediments than in dorsal fish muscles. Based on SQGs, Sediment-bound As, Cu, Zn, and Cd contents which exceeded the Effect range-low and median levels, implicated the harmful biological impacts to the living organisms inhabiting the Ulhitiya reservoir in the CKDu hotspot, including fish. Significant strong correlations in Cd, Pb, and Zn between the reservoir sediments and dorsal muscles of *E. suratensis* and *O. niloticus* confirmed that presume. Calculated Hazard Indices (HIs) were higher in *E. suratensis* (wild species) than *O. niloticus* (commercial species) irrespective of the location, and nephrotoxic heavy metals, including Pb, Cd, and As in fish muscles, contributed about 80% to the HI. Whether the estimated Target hazard quotients (THQs) for fish consumption were very much less than the threshold of 1, a relative possibility to the occurrence of chronic kidney failure of CKDu can exist due to exposure to the nephrotoxic heavy metals such as Pb, Cd, and As via fish consumption in the selected CKDu prevalence area. While a pollution event into an inland reservoir is often transitory, the pollutants' effects may be long-lived due to their tendency to be absorbed in the sediments and then released into the food chain. Even though detected heavy metal contents have complied with acceptable limits for human consumption, long-term consumption as the main animal protein source can directly impact the prevalence of CKDu among the residents in Girandurukotte GND, Badulla, Sri Lanka.

Keywords Inland fish · Reservoir sediments · Nephrotoxic heavy metals · Ckdu · Human risk assessment

Introduction

Humans' destructive influence on the aquatic systems is one form of sub-lethal pollutions, which generates adverse effects on aquatic life with chronic environmental stress conditions. In aquatic ecosystems, heavy metals have received considerable attention as a risk factor due to their toxicity and accumulation in biota. They act as metabolic poisons to living organisms. Heavy metal toxicity is primarily occurred due to their subsequent inhibition of enzyme systems (e.g., sulfhydryl (SH) enzyme systems) and oxidative stress, which can devastate the inherent antioxidant defenses of cells resulted in the production of reactive oxygen species (Sunahara et al. 2002; Ercal et al. 2001). In the typical scenario, some beneficial heavy metals, indeed dietary essential, such as Copper (Cu), Zinc (Zn), Manganese (Mn) may become toxic when occurrence in excess by exhibiting toxic effects on aquatic organisms (Kris-Etherton et al. 2002; Ribeiro et al. 2005). Several heavy metals are recognized, which are clearly associated with renal damages, and Cadmium (Cd), Lead (Pb), Arsenic (As), and Chromium (Cr) are among the environmentally relevant most hazardous heavy metals (Barakat 2011) and can be categorized as biologically non-essential

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