

Toxic heavy metal/metalloid contamination and health risk assessment in *Etroplus* spp.; A study in Negombo Estuary, Sri Lanka

M. A. U. Dias¹, K. A. D. D. Sakunthala², W. A. P. J. Premaratne^{1,2}, W. P. R. T. Perera^{2,3},
J. A. Liyanage^{1,2*}

¹College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka

²CKDu Information and Research Centre & Department of Chemistry, Faculty of Science, University of Kelaniya, Sri Lanka.

³Department of Indigenous Medical Resources, Faculty of Indigenous Health Sciences and Technology, Gampaha Wickramarachchi University of Indigenous Medicine, Sri Lanka.

*janitha@kln.ac.lk

Fish is a rich source of protein, fat-soluble vitamins, and essential minerals that are important for human health. However, fish can also accumulate toxic metals from their environment, which may pose potential health risks to consumers. This study investigates toxic heavy metal/metalloid bioaccumulation and associated human health risks in *Etroplus suratensis* (Koraliya) in the Negombo Estuary, a region impacted by fishing activities and rapid industrialization, providing the first Inductively Coupled Plasma Mass Spectrometry (ICP-MS) based update of heavy metal data in over two decades. Adult specimens of *E. suratensis* (n=18) were collected directly from the fishermen, with an average weight of 208.39 g and average length of 20.3 cm. The samples were analyzed for Pb, Cd, Cr, and As in muscle, gill, and gut tissues via ICP-MS after microwave-assisted acid digestion. Bioaccumulation levels varied significantly by tissue type in the order of gut > gill > muscle. One-way ANOVA revealed that only arsenic accumulation lacked uniformity across tissues, with significant variation specifically in the gut tissue ($p < 0.05$). Chromium levels were elevated across all analyzed tissues, with average muscle concentrations

(2.29 ± 0.22 mg/kg) exceeding the permissible limits established by WHO/FAO. Arsenic concentrations were highest in the gut, reaching 1.03 ± 0.68 mg/kg. The Target Hazard Quotient (THQ) for Cr (2.54) and As (2.17) both exceeded the safety threshold of 1. Total THQ of 5.45 suggests fish consumption poses health risks, exceeding daily safety intake levels by more than fivefold. Furthermore, the total carcinogenic risk was 5.30×10^{-3} , significantly surpassing the US EPA's maximum threshold of 1×10^{-4} , primarily driven by Cr and As levels in muscle tissue. These findings suggest that long-term consumption of *E. suratensis* from this environment poses substantial health risks. Immediate biomonitoring and stricter industrial waste regulation are essential to minimize heavy metal entry into the food chain.

Keywords:

Etroplus suratensis, Health risk assessment, Negombo estuary, Toxic elements