Trace metal contamination in the giant mud crab Scylla olivacea and sediments from the Pakistani coast: is it safe to eat these crabs?

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The Pakistani coast holds significant economic potential through its rich marine resources, including a thriving mud crab fishery. However, trace metal contamination from industrial effluents, sewage, agricultural runoff, port activities, ship breaking industry, mining, and untreated waste dumping, along with natural sources like rock weathering, an active tectonic boundary, and mud volcanic eruption poses serious environmental threats. Coastal sediments act as reservoirs for these pollutants, facilitating their spread and endangering marine ecosystems, marine life, and human health. Hence, effective and continuous monitoring is essential to mitigate this problem and ensure the safety of mud crab (*Scylla olivacea*) consumption. To meet this objective, a total of 50 mud crab claws were acquired from five sites, and 24 sediment samples were obtained from eight sites at the Pakistani coast. Burrowing and feeding habits of mud crabs make them suitable candidates for environmental monitoring studies. Concentrations of trace metals were analysed using Inductively Coupled Plasma Mass Spectrometry (ICPMS). In sediments, trace metal concentrations were in the following order: Al(27067.45ug/g) > Fe(24106.66ug/g) > Mn (538.53ug/g)> Zn(120.01ug/g) > Cr(62.34ug/g) > V(59.48ug/g) > Ni(44.78ug/g) > Cu(28.30ug/g) > As(14.48ug/g) > Pb(13.80ug/g) > Co(12.69ug/g) > Cd(0.22ug/g) > Hg(0.11ug/g). The concentration in mud crab tissue showed the following ranking: Zn(225.92ug/g) > Al(105.46ug/g) > Fe(103.66ug/g) > Cu(71.21ug/g) > As(27.81ug/g) > Mn(13.99ug/g) > Cr(0.79ug/g) > Ni(0.47ug/g) > Pb(0.24ug/g) > V(0.23ug/g) > Co(0.18ug/g) > Hg(0.18ug/g)> Cd(0.05ug/g)[MK1] . Pearson correlation coefficients reveal strong positive correlations among metals like Fe, Cu, and Zn, indicating common pollution sources. The Metal Pollution Index [.H2] (MPI) was highest in Sandspit (75) and Keti Bandar (60), surpassing the threshold of 50. The Ecological Risk Index (ERI) highlights elevated risks in Kalmat, Sandspit, and Gwadar, with values exceeding 60. The Biota Sediment Accumulation Factor indicates significant bioaccumulation, with Zn (10.5ug/g) and As (5.5ug/g) in Ibrahim Hyderi and Sonmiani crossing the threshold of 1, signaling ecological concerns. Total Hazard Index (THI) values were below 1 for all metals but were closer to 1 for Hg (0.7) and Cu (0.7). THI value >1 indicates potential hazard to health from metal ingestion through consumption of mud crabs. While the measured levels of Cd, Hg, and Pb in mud crabs remained within safe limits for human consumption, potential risks associated with Cd, Hg, and Pb cannot be ignored if average per capita shellfish consumption increases.

Keywords
Heavy Metal Analysis, Marine Bioindicators, Environmental Risk Assessment, Aquatic Toxicology, Seafood Safety