



Evaluation of heavy metals and their potential risk to human health from seafood in Escravos Estuary, Southern Nigeria

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ABSTRACT

In this study, we investigated the levels of heavy metals in sediment, shrimps, silver catfish and their potential bioaccumulation, trophic transfer and the associated risk to human health from the Escravos estuary in southern Nigeria. The values of heavy metals in shrimps and silver catfish were disproportionately higher than the allowable limits for seafood, with values in the gills and the rest of the fish higher than those of the muscle, liver and gonads. Furthermore, the increased BSAF for Cd, Cr and Cu in the study, underscore the uptake of metals from sediments into shellfish. High EDI and HR values from silver catfish for adults and children indicate immediate health risks, with the values for children considerably high, emphasizing the urgent need for regulatory measures and continuous monitoring of seafood from the estuary to protect the health of coastal population within the subregion.

1. Introduction

Heavy metals are naturally occurring elements that have a relatively high atomic weight and a density at least five times greater than that of water (Chinedu and Chukwuemeka, 2018). In Nigeria, oil and gas production, mining of ore deposits, use of agrochemicals, and the manufacture of fast consumer goods are among the several industrial activities capable of influencing the dispersion and distribution of heavy metals and metalloids into the environment (Ihedioha et al., 2017). Once in the environment, metals are partitioned among the various compartments in soil, water, and biota in relation to their state or reactive potentials (Yahya et al., 2016). Heavy metals that enter the aquatic environment may accumulate in the sediments, resulting in the concentrations of these elements in sediments several times higher than those in the water column (Zhao et al., 2018; Liu et al., 2021). Thus, sediments are generally considered as sinks for heavy metals in aquatic ecosystems (Qiu et al., 2011; Ekperusi and Asiwa, 2024). On the other hand, trace elements found in sediments may enter the food chain through uptake and trophic transfer, posing health risks to aquatic organisms and humans (Gao et al., 2015; Yang et al., 2021). The pink shrimp, *Penaeus notialis* (Pérez Farfante, 1967) is a benthic decapod characterized by a

soft body, long antennae and legs, with thin and semi-transparent exoskeleton. Shrimp belong to the largest class of crustaceans, Malacostraca, which includes crabs, lobsters, krill and woodlice. *P. notialis* is native to the West African region and constitutes a major fishery product for artisanal and trawl fishing. While the cultivation technology for pink shrimp is not yet fully developed, juvenile and adult pink shrimps are commonly found in estuaries across the Niger Delta region (Ebonwu et al., 2007). Shrimp is a crucial seafood commodity, traded globally with an annual market value exceeding US \$20 billion, accounting for 19 % of international trade (Islam et al., 2003). The silver catfish, *Chrysichthys nigrodigitatus* (Lacepède, 1803) is an important demersal fish species in tropical ecosystems (Ikongbeh et al., 2015). It is abundant and a regular fish found in catches of artisanal and commercial fishers across coastal communities. Silver catfish feed on shrimps and other crustaceans as a source of food.

Many coastal and marine organisms, shrimps, and fish accumulate elevated levels of metals from the surrounding water and sediment (Arulkumar et al., 2017; Adimalla and Wang, 2018).

They act as bioindicators for monitoring aquatic pollution, due to their relatively large size, lifespan, trophic level and use for human consumption (Zhou et al., 2008). Trace metals taken up by sediment-

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