

QUANTIFICATION AND RISK ASSESSMENT OF POLYCHLORINATED
BIPHENYLS (PCBs) AND TRACE METALS IN WATER, SEDIMENT AND FISH
(*Clarias gariepinus*) FROM ENIONG RIVER, NIGERIA

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ABSTRACT

Levels of 28 PCB congeners and six trace metals (Cd, Cu, Fe, Mn, Pb and Zn,) in water, sediment and fish (*Clarias gariepinus*) samples from Eniong River, Nigeria were quantified for a period of twelve months from April 2019 to March 2020 using Unicam 939/935 Atomic Absorption Spectrophotometer (AAS) and Agilent 6890 single phase Gas chromatography – Mass Spectrometer (GC-MS). The results of physicochemical parameters showed significant differences in concentrations of the physicochemical parameters between wet and dry seasons. The results of $\Sigma 28$ PCB concentrations in water, sediment and fish ranged from $2.78 - 33.50 \text{ ngL}^{-1}$, $7.03 - 135.2 \text{ ngg}^{-1}$, and $12.87 - 9280 \text{ ngg}^{-1}$ respectively. These concentrations were below the permissible limits set by National Oceanic and Atmospheric Administration (NOAA), Canadian Sediment Quality Guidelines (CSQG) and United State Food and Drug Administration (USFDA). The results of trace metals revealed that iron ($0.01 \pm 0.02 \text{ mg/l}$) and ($8.53 \pm 1.98 \text{ mg/kg}$) were higher in water and sediment samples compared to other metals, while zinc ($0.83 \pm 0.53 \text{ mg/kg}$) was highest in fish compared to other trace metals. The levels of trace metals in water, sediment and fish were below the acceptable limit by World Health Organisation (WHO), United State Environmental Protection Agency (USEPA) and International Sediment Quality Guidelines (ISQG). Analysis of the fish pollution status using biota-sediment accumulation factor (BSAF) revealed that Cd (0.607) had the highest BASF while Pb (0.035) recorded the lowest. The distribution coefficient ($\log(k_d)$) indicated that Mn (3.33) and Cd (1.69) were the most and least stable metals in water, respectively. A range of pollution indices; contamination factor (0.000016 - 0.813), pollution load index (0.0057 - 0.052), enrichment factor (1.0 - 5611) and index of geoaccumulation (-15.586 to -0.883) used to ascertain sediment quality revealed minimal contamination. Non-carcinogenic risk of trace metals was generally low for adults and children as the computed hazard quotients (HQs) and hazard indexes (HIs) were less than unity. Similarly, non-carcinogenic hazard quotient (HQ) of dioxin-like and non dioxin – like congeners due to exposure to PCBs through fish consumption were within acceptable limits. Incremental lifetime cancer risk (ILCR) for dioxin-like PCBs value recorded for consumption of fish did not exceed USEPA minimum risk level of 10^{-6} . Toxic equivalent quotient (TEQ) value for 12 dioxin-like PCBs (DL-PCBs) was $1.74 \text{ E-}07$ indicating low adverse effects of PCBs to the inhabitants of the community.