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Full Length Research Article

COMPARATIVE STUDY OF SOME HEAVY METAL CONCENTRATIONS (COPPER, CADMIUM, AND LEAD) IN THE LIVER AND KIDNEY OF CATFISH AND SILVER FISH FROM GASHUA, YOBE STATE

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ABSTRACT
A comparative study of some heavy metal concentrations (Copper, Cadmium, and Lead) in the liver and kidney of Catfish and Silver fish from Gashua, Yobe State was carried out. The results revealed high concentrations of these metals in the liver of both fish, with values of 1.20 mg/kg, 1.85 mg/kg, and 0.29 mg/kg for Catfish, and 3.07 mg/kg, 0.88 mg/kg, and 2.37 mg/kg for Silver fish, corresponding to Copper, Cadmium, and Lead, respectively. The concentrations recorded in the kidney were lower, with values of 0.01 mg/kg, 0.33 mg/kg, and 0.02 mg/kg for Catfish, and 0.02 mg/kg, 0.78 mg/kg, and 2.11 mg/kg for Silver fish. Based on the findings of this research, there is a clear indication that the liver of both fish species contains higher concentrations of heavy metals compared to the kidney. However, significant concentrations of heavy metals were also recorded in the kidneys, with some values exceeding the maximum permissible limits set by the World Health Organization and the Food and Agriculture Organization (WHO/FAO). Therefore, both the liver and kidney of Catfish and Silver fish from Gashua, Yobe State, are not safe for human consumption, and there is a need for continuous monitoring to protect the local population from diseases associated with heavy metal accumulation.

Keyword: Gashuwa, Kidney, Liver, Catfish, Silver fish

INTRODUCTION

The fish liver serves as a major organ for ~~the~~ storage and detoxification of heavy metals. After absorption from water or food, heavy metals are transported to the liver, where they are sequestered—often bound to proteins such as metallothioneins—for storage, or transformed for excretion. The high concentration of heavy metals in the liver makes it an important indicator of water pollution (Ayse 2003).

Heavy metal concentrations in fish liver vary widely depending on the species, location, and water quality. However, the liver generally serves as a major storage site for many metals, such as lead (Pb) and cadmium (Cd), with some studies identifying them as the most concentrated heavy metals in this organ. Copper concentrations are also typically high in the fish liver, although their distribution can vary; in some species, the highest levels are found in the gills (Sivakumar and Li 2018).

The kidney serves as a storage organ for heavy metals in fish, particularly for metals such as cadmium (Cd), iron (Fe), lead (Pb), and zinc (Zn), in addition to its primary role in excretion and osmoregulation. While the liver and gills are also major sites of heavy metal deposition, the kidney can accumulate significant amounts, serving as a potential indicator of pollution when metal uptake exceeds its ability to eliminate waste products (Sivakumar and Li, 2018).

MATERIALS AND METHODS

The apparatus used in this study was calibrated to check its accuracy before and during the experiment. Apparatus such as measuring cylinders, beakers, pipettes, and digestion flasks were thoroughly washed with detergent and tap water, followed by rinsing with deionized water.

All glassware was cleaned with 10% concentrated nitric acid (HNO_3) to remove any heavy metal residues from their surfaces and subsequently rinsed with distilled–deionized water.

Sample Collection and Transportation

Fresh tilapia (*Oreochromis niloticus*) and catfish *(Siluriformes)* were collected from three selected sites (Mashaya, Sabuwar Gada, and Tshohuwar Gada) located at Gashua town and immediately transported to the Yobe State University laboratory for analysis. The sampling locations included Sabuwar Gada, Mashaya, and Tsohuwar Gada. During transportation, the samples were preserved in polythene bags placed inside an icebox.

Sample Preparation and Digestion

The frozen fish samples were thawed, and only the liver and kidney were used for metal analysis. The organs were removed using a stainless-steel knife and dried in an oven (Model 30GC Lab Oven). A mortar and pestle were used to grind the dried samples,

Approximately 0.5 g of each sample was weighed and placed into a clean Teflon microwave digestion tube. To each sample, 6 ml of 65% HNO_3 and 3 ml of hydrogen peroxide (H_2O_2) in a 2:1 ratio were added and allowed to stand for 5 minutes. The digestion tubes were then sealed and placed into a microwave digester (Master 40, Serial No: 40G106M) for digestion. The digestion was carried out for 30 minutes at 180 °C. The digested samples were then diluted with deionized water to a total volume of 50 ml (Uba *et al.,* 2019).

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RESULTS AND DISCUSSION

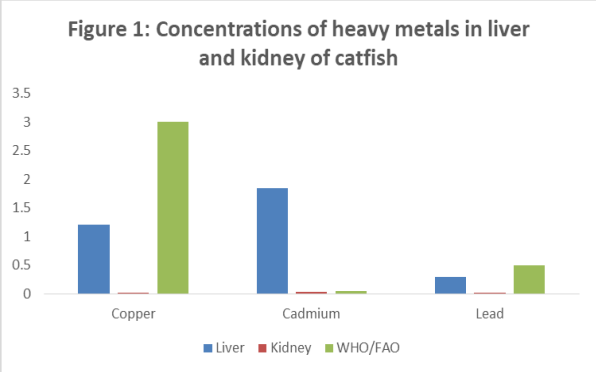

Figure 1: Concentration of Heavy Metals in Liver and Kidney of Catfish

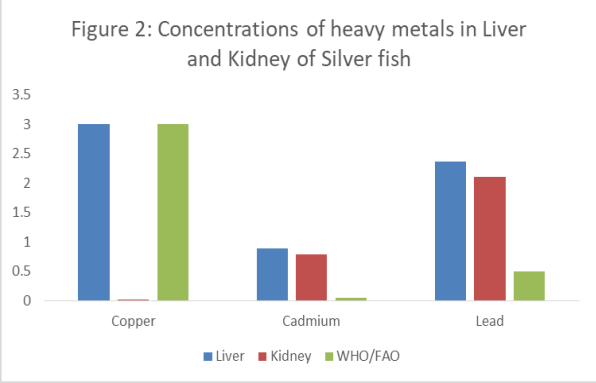

Figure 1: Concentration of Heavy Metals in Liver and Kidney of Silver fish

The concentrations of Copper, Cadmium, and Lead in the liver and kidney of catfish were analyzed. The results showed high concentrations in the liver, with values of 1.20 mg/kg, 185 mg/kg, and 0.29 mg/kg for Copper, Cadmium, and Lead, respectively. Low concentrations of 0.01mg/kg, 0.33 mg/kg, and 0.02 mg/kg were observed in the kidney. These findings provide evidence that the liver of catfish is a major site for heavy metal storage. This observation is consistent with Ayse's (2003) report, which noted that the fish liver serves as a primary organ for the storage and detoxification of heavy metals. Overall, catfish from Gashua were found to contain higher concentrations of heavy metals in the liver compared to the kidney, and this indicates accumulation is a strong indicator of water pollution (Ayse, 2003).

The liver of Silver fish from Gashua showed high concentrations of Copper, Cadmium, and Lead, with values of 3.07 mg/kg, 0.88 mg/kg, and 2.37 mg/kg, respectively. In comparison, the kidney contained 0.02 mg/kg, 0.78 mg/kg, and 2.11 mg/kg of Copper, Cadmium, and Lead, respectively. These values are lower than those found in the liver. A high concentration of toxic metals may be attributed to anthropogenic activities such as industrial discharge, mining, and agricultural runoff, as well as biological and environmental factors, including fish age, diet, pH, temperature, and water hardness (Mezbabul and Md Fazle, 2023).

A significant concentration of Cadmium and Lead was observed in the kidney of Silver fish, with values exceeding the maximum permissible limits set by the World Health Organization and the Food and Agriculture Organization (WHO/FAO, 2016). These findings are consistent with Sivakumar and Li (2018), who reported that the kidney serves as a storage organ for heavy metals in fish, particularly for metals such as Cadmium (Cd), lead (Pb), and Zinc (Zn).

Conclusion

The findings of this research revealed that the liver contains higher concentrations of Copper, Cadmium, and Lead compared to the kidney in both Catfish and Silver fish. Significant concentrations of these metals were also recorded in the kidneys of both species. Therefore, we recommend that the liver and kidney of Catfish and Silver fish from Gashua, Yobe State, be considered unsafe for human consumption. There is also a need for continuous monitoring of heavy metal levels to protect the local population from diseases associated with toxic metal accumulation.

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