METAL COMPOSITION OF *CLARIAS GARIEPINUS* CONSUMED IN MAKURDI AND ITS ENVIRONS

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Abtract

A study was conducted to determine the concentrations of nine heavy Metals (Cadmium, lead. Copper, Chromium, Iron, Zinc, Selenium, Nickel and Aluminum) in gills, muscles and skin of \Clarias gariepinus within three different locations (Kuatansule, Wadata and UAM fish) with the use of standard flame atomic absorption spectrophotometry techniques. Iron was found high concentration in all the sites with the gills having the highest concentration while lead. Cadmium, Selenium, Nickel and Aluminum were not detectable. Significant differences in metal concentrations were observed between locations with UAM fish farm having the highest metal concentration. It is concluded that concentration, of heavy metals found in selected organs of Clarias gariepinus were within tolerable limits as recommended by FAO.

KEY WORDS: Metal, *Clarias gariepinus*

Introduction

All metals are natural constituents of the environment and are found in varying levels in the ground and surface waters (Martin and Coughtrey, 1982). According to Forstner and Wittmann (1981), heavy metals in trace amounts are normal constituents of fresh water organisms. Some heavy metals are essential, required for the normal metabolism of aquatic organisms, while others are non essential and play no significant biological roles. The essential elements such as Zinc are required to maintain a certain homeostatic status in fish. On the contrary, the non-essential elements, such as lead, have no biological function or requirement and their concentrations in fish are generally low (Thompson, 1990)

Apart from the natural occurrence of heavy metal, they may enter and contaminate the environment from five general sources namely geological weathering, industrial processing of metals and ores, the use of metals and their compounds, leaching of metals from municipal and soil waste dumps especially mine dumps, animal and human excretions (Forstner and Prosi, 1979).

According to Rainbow (1985), the chemical characteristics of metals are responsible for the fact that all metals ultimately become toxic at some elevated concentration. Abnormally high concentrations can cause the inability of organisms to excrete, sequester, or otherwise detoxify themselves, especially in the case of non-essential metals (Thorp *et al.* 1979). Organisms can accumulate metals to levels above those which are required for normal physiological functioning. The measurement of metal concentrations in these organisms provides the basis for the use of bioaccumulative indicators of the degree of metal pollution in the various aquatic ecosystems.

Freshwater fishes are often subjected to pollution especially near industrial or urban areas. Along with other pollutants, heavy metals are known to exert a wide range of effects, from metabolic and physiological to behavioral and ecological, on fishes (Forstner and Wittmann, 1981). The observed effects include disturbances in osmoregulation (Lewis and Lewis, 1971) respiration (Hughes, 1981), tissue damage, especially in the gills (Tort *et al*, 1984), reduced energetic sources (Heath, 1984) and poor growth performance (Steele, 1983).

The persistence of heavy metals in water is compounded by the fact that generally they are water soluble, non-degradable, vigorous oxidizing agents and strongly bonded to many biochemical substances especially polypeptides and proteins.

Clarias gariepinus is widely distributed, not only in African countries and has excellent meat quality, which is marketed fresh, frozen, eaten boiled, fried and baked hence its choice for this study.

Materials and Methods

Fresh samples of *Clarias gariepinus* and water were collected from University of Agriculture, Makurdi fish farm, Kuatansule, and Wadata all in Makurdi, Nigeria. The dorsal muscles, gills and skin of the fish were removed after the fish were dissected using clean stainless steel tools. All glasswares were acid washed in1 M Hcl for 24hrs and rinsed in distilled water prior to use.

Site A: The University of Agriculture Makurdi (UAM) fish farm is located at the southern part of the University and about 200m from River Benue (its water source). The fish farm is fed with water from the University's sedimentation tank where pipes have been laid to convey water to the treatment plant.

Site B: Kuatansule is located at the northern part of Benue State. The major economic activity of the people here is agriculture including artisanal fishing. This site lies about 50km ahead of site C.

Site C: Wadata is the heart of Makurdi town, the site is influenced by a lot of riparian activities. Upstream of this site are Nigerian Bottling Company and More brewery that employs that empty their waste products into the river (Fig. 1).

Determination of Heavy Metals

A total of 20g of each dried sample was weighed into separate porcelain crucibles and ashed at 950°C for 2 hours in a furnace (Galenkamp muffle furnace size 2) and cooled. Out of the ashed samples, 2g of each weighed into 250-ml separatebeakers and digested using Aguaregia, after which 75ml of distilled water was added to each sample and boiled for some minutes. Each sample was then filtered into 100 ml volumetric flask and allowed to cool. The volume was then made up to the 100 ml mark. Each sample was then read using an Atomic Absorption Spectrophotometer with the standard and castlock lamps of each element. Determination of heavy metals was repeated three times and results obtained were subjected to statistical analysis using ANOVA.

Results

Table 1 gives the mean values of the metal concentrations in gill, muscle and skin of *Clarias gariepinus*. The order of the metal concentrations is generally Iron> manganese> copper. The largest mean value for opper was 4.20ppm found in the skin of the fish from Kuatansule while the smallest mean was 0.001ppm found in the water from UAM fish farm. The non-essential elements such as cadmium, Lead and some others were not detectable. The concentrations of heavy metals were lowest in muscle among the fish samples. Copper concentration was highest (4.20ppm) in the skin of *C. gariepinus* from Kuatansule, followed by fish gills from UAM fish farm (4.00ppm).

Statistical analysis revealed that there was a significant difference at 95% level (P>0.05) in copper concentration in the gill and muscle if fish from UAM farm, Kuatansule and Wadata. Iron concentration was found to be highest (913.38mg/kg) in fish gills from Kuatansule followed by fish skin from UAM fish farm (93.43mg/kg). The least Iron concentration was found in the fish muscle from Kuatansule (33.58 mg/kg).

There was high significant difference between Iron concentration in fish gills, muscle and skin from all the three sites. Manganese concentration followed the same pattern as copper and Iron. The to highest concentration being (77.55 mg/kg) in fish gills from UAM fish farm followed by gills from Kuatansule (25.21 mg/kg), fish skin (9.91 mg/kg) from Kuatansule. The least concentration is 2.07 mg/kg in fish muscle from Wadata. Fish muscle had much lower concentration of manganese compared to the gills and skin.

Statistical analyses also showed significant difference between fish gills from UAM fish farm Kuatansule and Wadata sampling sites.

Discussion

Copper concentration was found to be high in the fish from the UAM site, though it is not up to the general limit of 20 mg/kg for most foods including fish (MAFF, 1981). Although harmful in large doses, copper is essential for haemoglobin formation, this accumulation may not be uncommon to the fact that heavy metals accumulate in the body of the organism over time. The water that feeds the fish farm is from the UAM sedimentation tank where pipes have been laid to convey water to the farm. These pipes are made of metals, which erode, gradually into the water, consequently bioaccumulation in fish and water sediment. Similar pattern of concentration was observed in Iron and Manganese, which may also be components of eroding pipes.

The significant difference found in accumulation ability of fish gills, muscles and skin may be due to the fact that these accumulations may have taken place over years since the fish sampled were matured adults and metals are non degradable hence bioaccumulative.

The significant difference in metals: Cu, Fe and Mn accumulation in fish gills, muscles and skin may not be unconnected with the fact that various body organs have different absorption and retention ability when exposed to the metals.

Fish gills which showed the highest concentration of Iron, Manganese and Copper may be due to the fact that the gills play a major role in respiration and osmoregulation whereby water is constantly passing through the gills more than the muscles and the skin, which are not permeable to water.

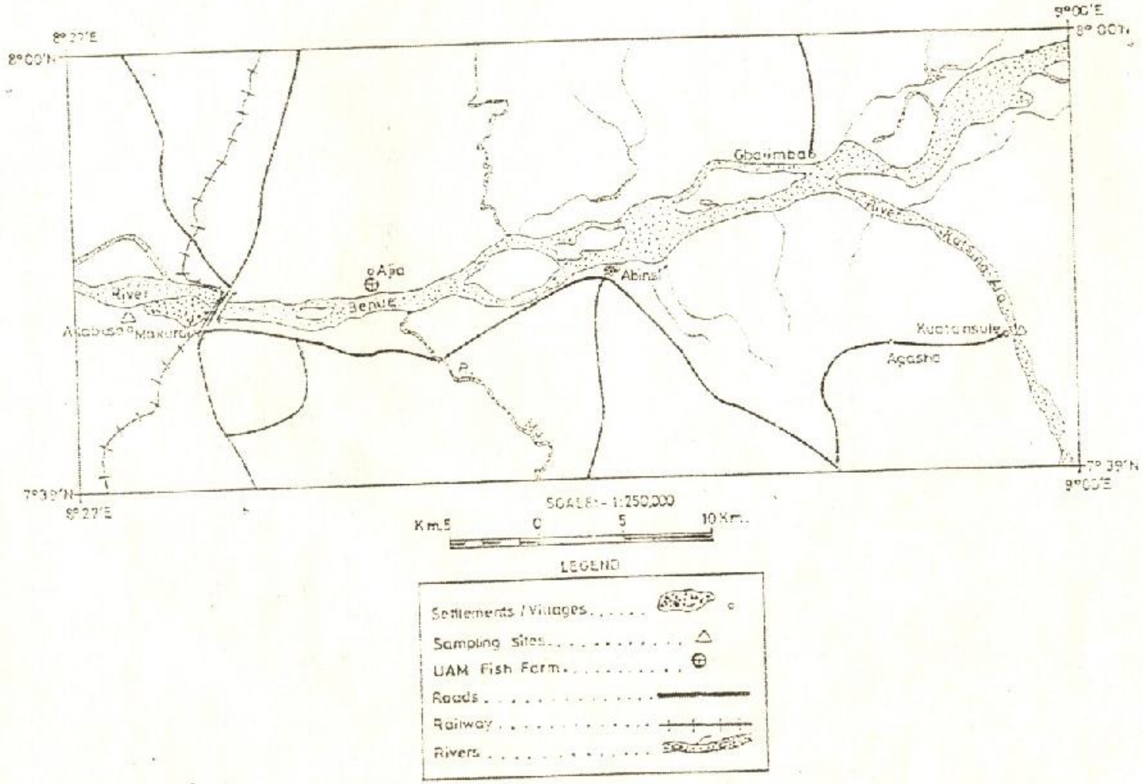

Figure 1: Map of parts of River Benue showing sampling sites and UAM Fish Farm.

Result from this experiment indicates that fish muscles generally have the lowest metal concentration Chen and cheu (2000), Chiee and Meng (2003) made the same observation. Chiee and Meng (2003) also made a similar observation when they investigated Zn, Cu, Cd, and Hg concentrations in the oyster of Chi Ku, Tai Shi and Tapeng Bay southwestern Taiwan.

Generally, inorganic elements are required for normal life processes of fish. Their main functions include the formation of skeletal structure, electron transfer, regulation of acid-base equilibrium and osmoregulation. Minerals are also important components of hormones and enzymes, and they activate enzymes. The electrolytes, Na, K, Mg, Ca, and Hco play a major role in the osmotic and ionic regulation of extra and intracellular fluids in fish.

Conclusion and Recommendations.

The results show that consuming fish from the river Benue and UAM fish farm is not harmful to the general public, as Fe, Cu and Mn were the micro essential elements, which were important in maintaining regular physical functions in humans. These elements all play an important role in the human metabolism process. Only by consuming excessive amounts would they become hazardous. The amounts observed with samples from the different sites were far below the acceptable intake set by the USA and WHO/FAO (Codex Alimentaries commission, 1984). Therefore under regular consuming habits, the intake of Fe, Cu and Mn from the sampling stations achieved the basic nutritional requirement for normal physical functions and are not harmful to human health. Although Cd is a toxic element that would deposit in human body and is danger to human health the concentration in fish in this study was not detectable hence consuming fish from these sites is safe.

However, since muscle and skin were the major consuming portions and that massive internal organ were rarely consumed, there should not be any health threat to the public resulting from the consumption of this fish. From the investigation carried out, the following recommendations are made: (1) There is need to carry out this heavy metal determination from time to time so as to ensure safety in fish consumption in the study areas at all time; (2) This research should be extended to other elements like Mercury and Zinc, which are also of concern to man and his environment. (3) Check should be placed on the various sources of heavy metal contamination in the water bodies; and (4) Other fish species consumed in Makurdi and its environs should be sampled in subsequent researches of this nature.

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