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COMPARATIVE STUDY OF SOME HEAVY METALS CONTENT IN WILD AND CULTURED CATFISH (*Clarias gariepinus*is) SOLD IN SAMARU- ZARIA, NIGERIA

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ABSTRACT

This study is to assess the level of some heavy metals in samples of wild and cultured catfish (*Clarias gariepinus*is) regularly consumed, therefore, the need to ascertain the safety of the consumption of this fish. Fresh samples of the wild and the cultured *Clarias* fish of different sizes were purchased from different locations in Samaru – Zaria, Nigeria. The fish samples were digested with a mixture of 20 cm^3 concentrated nitric acid and 5 cm^3perchloric acid (ratio 4:1). The concentrations of lead, copper, chromium, cadmium and Zinc were determined using atomic absorption spectrophotometer (AAS). The results obtained indicated that in both wild and cultured *Clarias gariepinus*is, the concentration of Zn > Cr > Cu > Pb > Cd. The concentrations of all the heavy metals determined in the various sizes of wild *Clarias gariepinus*is samples were higher than the corresponding cultured *Clarias* fish. In both wild and the cultured *Clarias* fish the concentrations of Cd, Pb and Cr were found to be in the order of: small size > medium size > large size, but for Cu and Zn there were variations in concentrations. In wild *Clarias* fish the concentrations of Cd, Pb and Cr were found to be higher than the permissive limits set by FAO/WHO, while in cultured fish only Cr concentration was higher than the permissive limit. Though the contents of heavy metals determined in this study have a great health implication on human, aquaculture and fisheries activities be encouraged.

Keywords: *Clarias gariepinus*is, Heavy metals, Human Health, Toxicity

INTRODUCTION

Fish is one of the economical foods that are rich in protein and also cheap to afford. Fish is an important source of omega-3 fatty acids which is never produced by the human body. These essential nutrients keep the heart and brain healthy by lowering blood pressure and reducing the risk of sudden death, heart attack, abnormal heart rhythms, and strokes. It is also important in vision and nerves development in infant, decreases the risk of depression, dementia, arthritis, diabetes and prevents inflammation (Anhwange *et al.,* 2012).

In Nigeria fish being consumed in every part of the country is readily available, relatively cheap and affordable in the market. Aquaculture and fisheries are major areas of agricultural activities and play a significant role to boost the country's economy by meeting the high fish demand. Fish can be polluted with heavy metal from the food it feeds on and water it lives in because, heavy metal pollution in rivers gives threat to public water supplies and also to consumer of fishery sources (Terra *et al*., 2008). Heavy metals accumulate in fresh water and elevate through food chain, and fishes are badly affected because they are top consumer in aquatic systems (Afshan *et al.,* 2014). The increase of heavy metals within fish is a threat to human health. and fishes are the most pivotal organisms in the aquatic food chain, which are very sensitive to metal contamination (Saha *et al.,* 2020). Different metals are accumulated in fish tissues at different concentrations. The metal concentration differs from fish to fish due to the affinity of metals to fish tissues, uptake rate, extraction and absorption rate (Abalaka *et al*., 2017). Therefore, there is need to assess the heavy metal levels, hence the safety of the consumption of this fish.

MATRIALS AND METHODS

Sample Collection and Pre-treatment

A total of 36 fresh fish samples each of the wild and the cultured *Clarias* fish were randomly collected where they were being sold at different locations (Figure 1) within Samaru - Zaria in Nigeria. The fresh fish samples were grouped into three according to their sizes (small, medium and large). The fresh Fish samples were washed with distilled water, cut into pieces and dried in an oven between 50ºC and 60ºC. The dried fish samples were ground using crucible mortar and pistil, sieved with 500 µm mesh and stored in sample bottles for further analysis.

Sample Digestion

The dried sieved fish samples were each weigh (1g) into a digestion tube and were digested with a mixture of 20 cm^3 concentrated nitric acid and 5 cm^3perchloric acid on a digesting block at 100 ºC for 30 min. The digest was cooled and filtered through Whatman No.1 filter paper, into a 100 cm^3 standard volumetric flask and made up to the mark with distilled water and stored in a sample bottle for AAS analysis (El-Moselhy *et al.,* 2014). The concentrations of lead, copper, chromium, cadmium and Zinc were determined. The Analysis was done in triplicate. The data collected were expressed as mean and standard deviation which were subjected to statistical analysis using Microsoft spreadsheet and statistical package for social science (SPSS) software version 20.0.

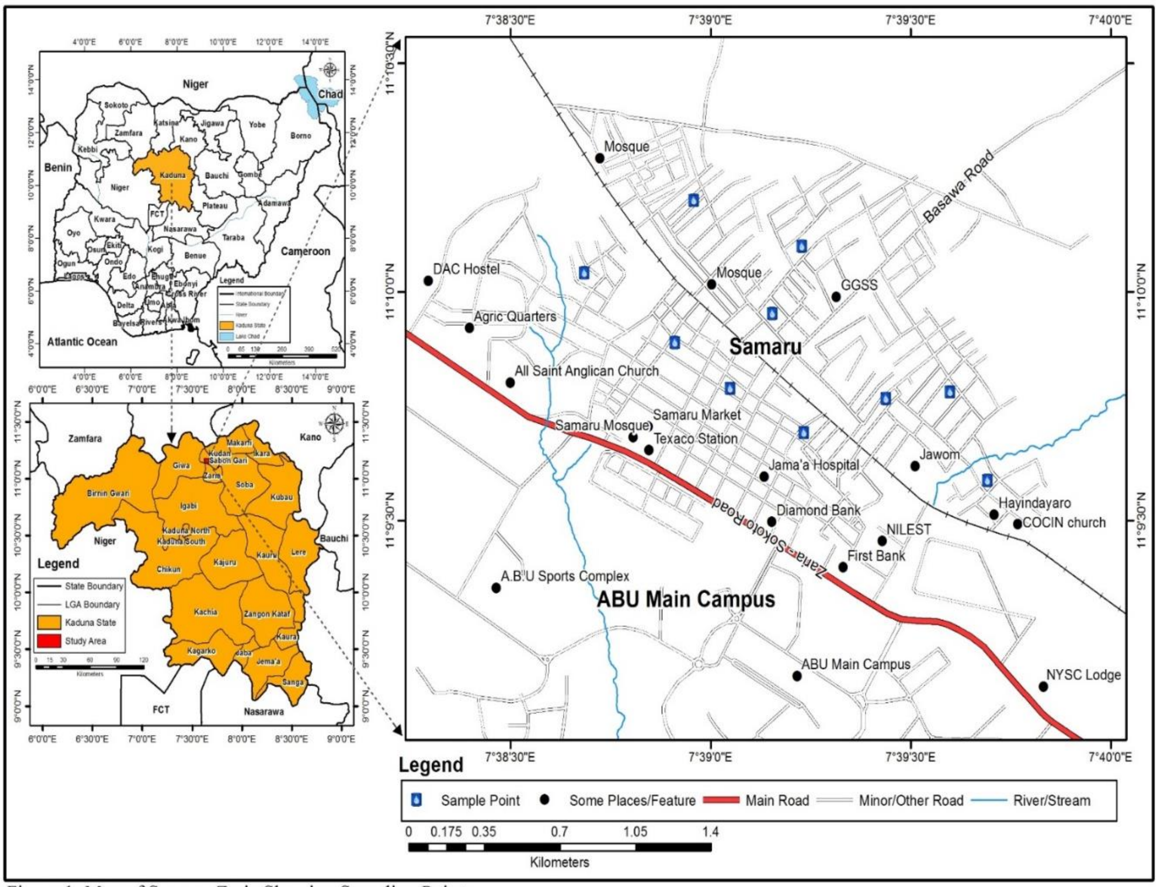

Figure 1: Map of Samaru-Zaria Showing Sampling Points

Source: Adapted and modified from the dministrative map of Kaduna State/Fieldwork, 2014

RESULT AND DISCUSSION

The results obtained for the concentrations of heavy metals determined in wild and cultured *Clarias gariepinus*is samples are presented in Tables 1 – 5. From the results it was observed that in both wild and cultured *Clarias gariepinus*is the concentration of Zn > Cr > Cu > Pb > Cd. The concentrations of all the heavy metals determined in the various sizes of wild *Clarias gariepinus*is samples were higher than the corresponding cultured *Clarias* fish. In both wild and the cultured *Clarias* fish the concentrations of Cd, Pb and Cr were found to be in the order of: small size > medium size > large size, for Cu and Zn there were variations.

The pollution of waterways with anthropogenic activities are the major cause of aquatic life metals pollution. The river systems may be contaminated with heavy metals released from domestic, industrial, mining and agricultural effluents. The overuse of fertilizers and pesticides that washed out through surface runoff degrade the quality of the water (Gu *et al*., 2015) and ultimately affecting the aquatic biota. Moreover, the river embracing daily a huge amount of domestic sewage and industrial waste which results in the disruption of the aquatic ecosystem. The concentrations of Cd in the wild fish studied were higher than in the cultured fish (Figure 1). All the values in the wild fish, 0.107mg/kg(small size), 0.090 mg/kg (medium size) and 0.077 mg/kg (large size) were found to be higher than the permissive limit while in the cultured fish 0.033 mg/kg (small size), 0.030mg/kg (medium size) and 0.023mg/kg (large size) were lower than the permissive limit of 0.05 mg/kg given by FAO/WHO (2011). In world ranking cadmium is seventh most toxic heavy metal as per Agency for Toxic Substances and Disease Registry (ATSDR) as it is well recognized of its adverse influence on the enzymatic systems of the cells, oxidative stress and also cause nutritional deficiency in plants (Irfan *et al.,* 2013). It binds to the cystein-rich protein (metallothionein) which forms the cysteinmetallothionein complex. This cysteinmetallothionein complex causes the hepatotoxicity in liver and it circulates to the kidney where it causes nephrotoxicity after its accumulation in renal tissue (Sabolic *et al*., 2010). The ability of cadmium to bind with the ligands of cystein, aspartate, histidine and glutamate can lead to deficiency of iron (Castagnetto *et al*., 2012). Kidneys are the most affected organ by toxicity of cadmium as it accumulates itself in the proximal tubular cells in higher concentrations and it may also cause bone mineralization (through bone damage or by renal dysfunction) (Showkat *et al*., 2019; Richter *et al*., 2017).

The concentrations of Chromium ranging from 4.300 – 4.910 mg/kg in the wild fish studied were higher than in the cultured fish (3.093 – 4.160 mg/kg) (Figure 2). All the values in both wild and cultured fish were found to be higher than the permissive limit of 0.05 mg/kg as given by FAO/WHO (2011). Chromium is used mainly in industries as electroplating, metallurgy, paint and pigment formations, tanning, wood preservation, production of chemical, pulp and paper. All these industrial activities contribute to chromium pollution which is having an adverse effect on the biological and ecological species (Ghani *et al*. 2011). Toxic level of chromium in the environment due to anthropogenic activities is a concern for the researchers, particularly hexavalent chromium, has been greatest concern (Economou *et al*. 2012). Exposure to higher amounts of chromium compounds in humans can lead to inhibition of enzyme erythrocyte glutathione reductase, this inhibition lowers the capacity to reduce methemoglobin to hemoglobin (Stephen *et al*. 2013). Chromium (VI) compounds are toxins and known human carcinogens, whereas inhaling high levels of chromium (III) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems (Ahsan *et al.*, 2018).

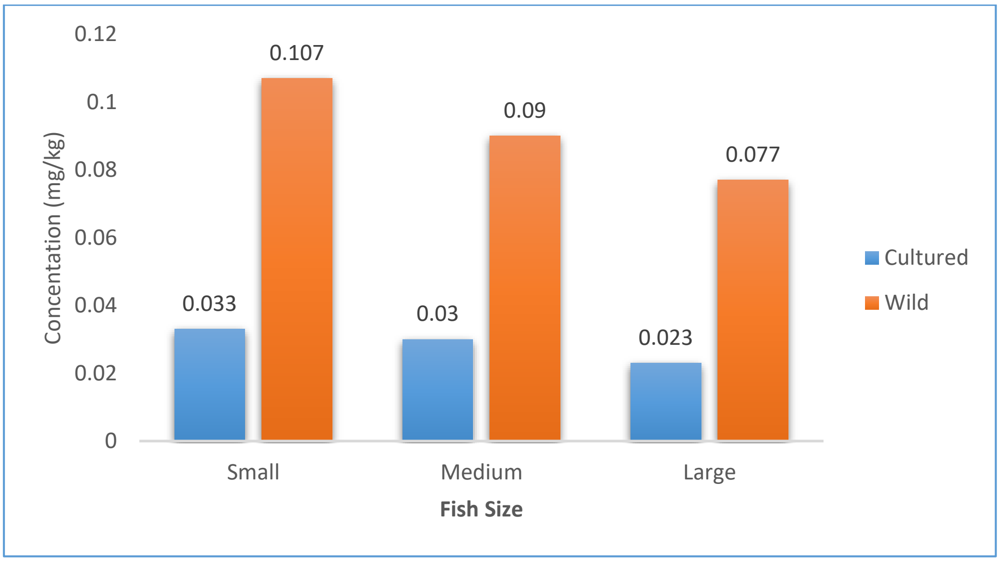

Figure 1: Mean Concentration of Cadmium in *Clarias* Fish Samples Purchased from Samaru - Zaria

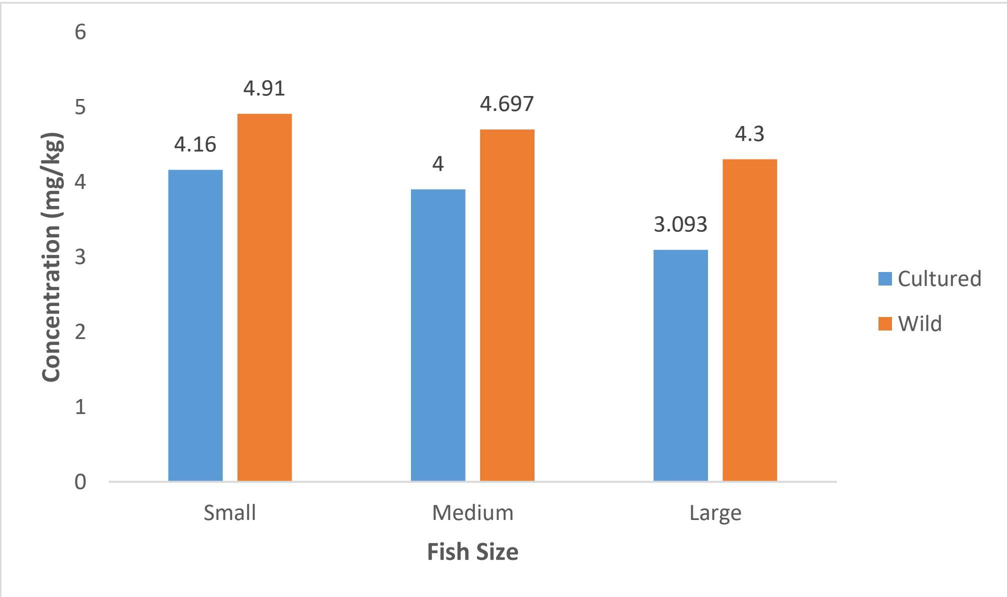

Figure 2: Mean Concentration of Chromium in *Clarias* Fish Samples Purchased from Samaru - Zaria

The WHO/FAO standard Copper concentration in fish is 20 mg/kg as reported by Ekweozor *et al*. (2017) therefore, in this study Copper concentrations ranged from 1.0 – 1.56 mg/kg for cultured fish and 2.167 – 3.993 mg/kg for wild fish (Figure 3), and all were below the permissible limit. The harmful of copper is largely attributed to its cupric (Cu^{2+}) form (Akpanyang, 2014). Copper is an essential element to living organism, but high amount of it causes problems to health such as anemia, acne, adrenal hyperactivity and insufficiency, allergies, hair loss, arthritis, autism, cancer (Sasanya, 2018). Copper causes liver (Wilson's disease) and kidney damage. Also causes delay in growth, development, bone formation, and decreased litter size and body weights in animals including humans (Mahurpawar, 2015). Copper play important role in the synthesis of hemoglobin in the living body as oxo-reduction enzymes and it also cause transitional poisoning when it is being used in preserving food or spray on fruit as insecticide (Draszawka, 2014). Copper is both essential cofactor and toxic element, involving a complex network of metal trafficking pathways such as protein trafficking and signaling of transcription living thing (Choudhary *et al.*, 2020). Copper is used in the regulation of water in the body (Arora *et al.*, 2017).

The WHO/FAO standard of Pb concentration in fish is 0.03 mg/kg as reported by Ekweozor *et al.*, (2017)) therefore, the values obtained in this study showed that lead in all the fish samples were above the permissible limit. In this study Wild fish had higher concentrations (0.42 – 0.52 mg/kg) than cultured fish (0.04 – 0.07 mg/kg) (Figure 4). Lead is a probable human carcinogen and can affect every organ and system in the body. Exposure to high lead levels can severely damage the brain, kidney and ultimately cause death (Ahsan *et al.*, 2018). Lead toxicity can be acute or chronic, the acute one can cause loss of hypertension, appetite, abdominal pain, headache, renal dysfunction, fatigue, arthritis, sleeplessness, hallucinations and vertigo, this acute exposure of lead mainly occurs in some place of work and in manufacturing industries where lead is used during manufacturing. The Chronic exposure of the lead can result in birth defects, mental retardation, psychosis, autism, hyperactivity, dyslexia, allergies, paralysis, weight loss, muscular weakness, kidney damage, brain damage may occur due to this chronic exposure of lead and even may cause death (Showkat *et al*., 2019).

The WHO/FAO standard of Zn concentration in fish is 40 mg/kg as reported by Ekweozor *et al.* (2017)) therefore, all the studied fish samples had much lower concentrations of Zn, 5.077 – 5.403 mg/kg (wild fish) and 4.370 – 4.803 mg/kg (cultured fish) (Figure 5) than the permissible limit. Zinc is an important essential mineral that people need to stay healthy; which the deficiency in humans is now known to be an important malnutrition problem world-wide. Zinc deficiency can lead to growth failure during growth periods, and epidermal, gastrointestinal, central nervous, immune, skeletal, and reproductive systems are the organs most affected clinically by zinc deficiency (Roohani *et al*., 2013).

CONCLUSION

This study is to assess the level of some heavy metals in samples of different sizes of wild and cultured catfish (*Clarias gariepinus*is) regularly consumed, therefore, the need to ascertain the safety of the consumption of this fish within Zaria Metropolis in Nigeria. The concentrations of all the heavy metals determined in the various sizes of wild *Clarias gariepinus*is samples were higher than the corresponding cultured *Clarias* fish. In both wild and the cultured *Clarias* fish the concentrations of Cd, Pb and Cr were found to be in the order of: small size > medium size > large size, but for Cu and Zn there were variations in concentrations. Though the contents of heavy metals determined in this study had a great health implication on human, aquaculture and fisheries activities be encouraged.

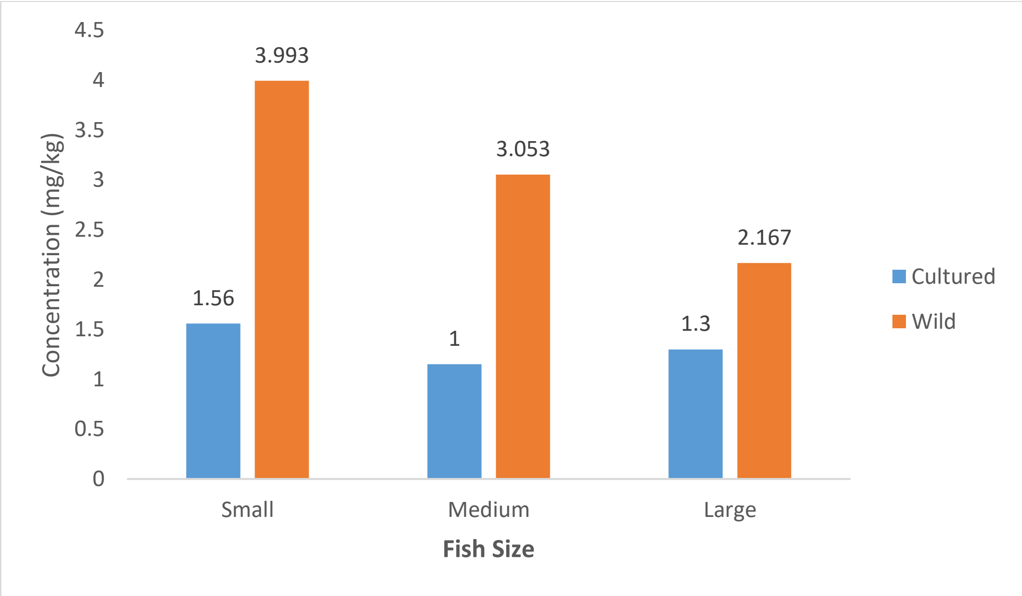

Figure 3: Mean Concentration of Copper in *Clarias* Fish Samples Purchased from Samaru - Zaria

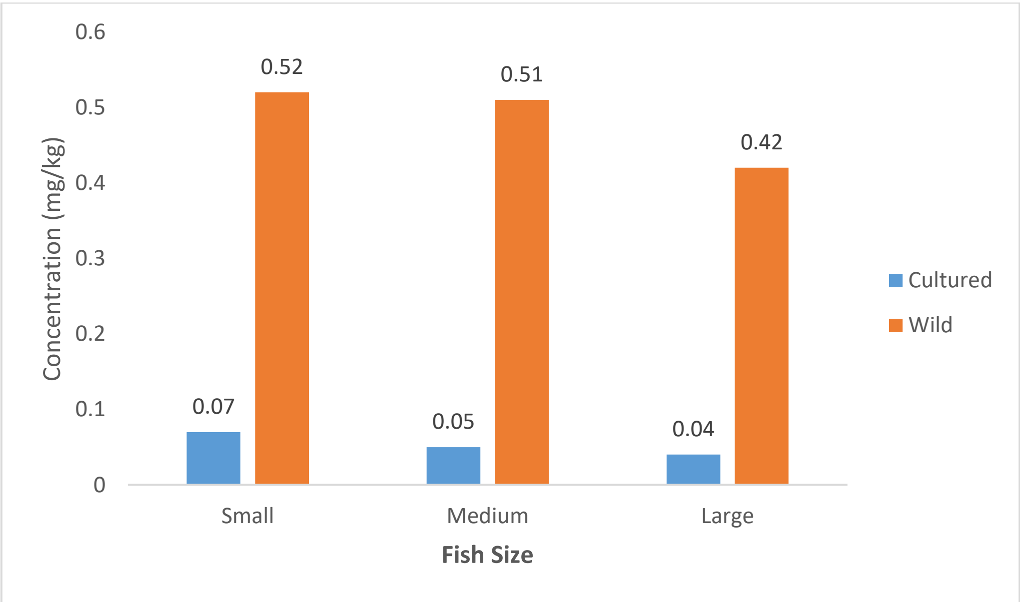

Figure 4: Mean Concentration of Lead in *Clarias* Fish Samples Purchased from Samaru - Zaria

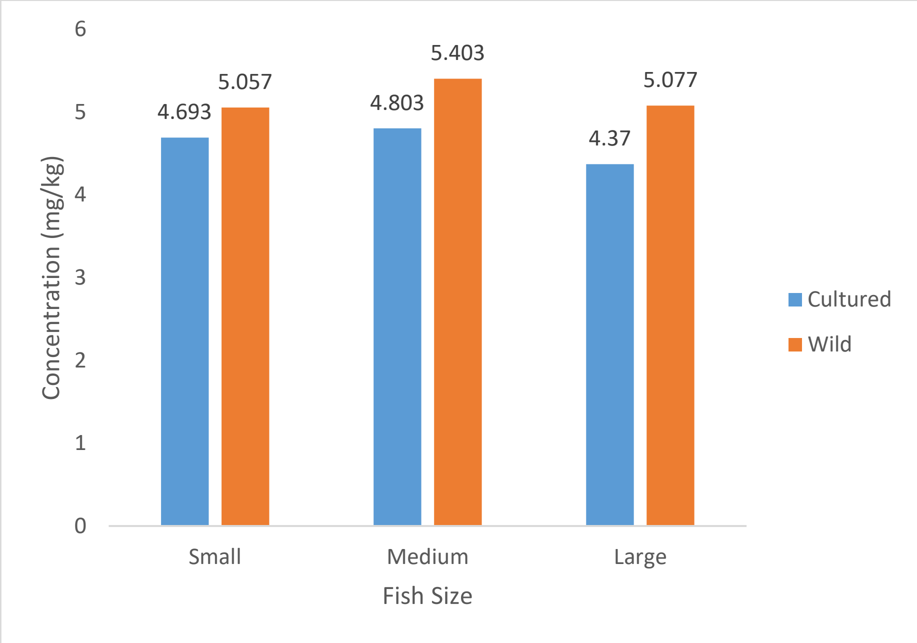

Figure 5: Mean Concentration of Zinc in *Clarias* Fish Samples Purchased from Samaru - Zaria

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