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DETERMINATION OF ZINC AND LEAD IN SURROUNDING WATER AND GILLS OF *Tilapia zilli* FROM ´FARFAZAI´ POND IN KANO CITY, NIGERIA

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ABSTRACT

This study highlighted the issue of heavy metal (ions) in 'Farfazai' pond in Kano city, Nigeria. Samples were collected on weekly basis from the study sites for nine (9) months (July 2015-March 2016). Laboratory analyses were carried out to determine the concentration of Zinc (Zn) and Lead (Pb) ions in pond water and gill samples of Tilapia zilli. These were achieved using water and fish sampling procedures as well as heavy metal determination using Atomic Absorption Spectrophotometer (AAS). The results revealed that the pond water contained 4.35mg/l of Zinc and 2.61 mg/l of Lead ions while the gill of Tilapia zilli contained 9.11mg/l of Zinc and 3.39 mg/l of Lead ions respectively. An analysis of variance at P<0.05 revealed a significant difference between the Pond water and gills of sampled Tilapia zilli. It is therefore concluded that the gills of Tilapia zilli contained higher concentrations of Lead and Zinc ions than what was obtained in the pond water samples. The pond should be regularly monitored to ensure that the level of heavy metals and other pollutants do not go beyond limits that could cause unbearable health consequences. There is also the need to manage and preserve the pond as it serve as ecological "laboratory" for scientific research.
Keywords: Heavy metals, Pond, Concentration, Pollutants, Public health, Implication.

INTRODUCTION

Contamination of water bodies with heavy metals occur world wide as a result of increasing urbanization, extensive agricultural activities and industrial expansion- a consequence of which many rivers, streams and ponds have been polluted (Neethu and Puttaih, 2014). Heavy metals constitute an important group of the environmentally hazardous substances (Ibrahim *et al*. 2000). Their toxicity has been reported to affect human health as they are not known to be easily disintegrated and decomposed for a very long period of time. This may be a reason why heavy metal contamination in water bodies is of primary concern (Omolara *et al*., 2014). Although some heavy metals such as iron and manganese are required for metabolic activities, others like zinc, lead, mercury, nickel and cobalt exhibit toxicity effects in living organisms (Göbel *et al*. 2007).

Occurrence of toxic metals in ponds, ditch, and river water affect the lives of local people that depend upon the water body for their daily survival. Consumption of aquatic food enriched with toxic metals may cause serious health hazards through magnification of food chain (Gytautas *et al*., 2017).

Ponds in and around the city of Kano are a major place where fishes are grown. Apart from serving as a means of protein, low saturated fat and sufficient omega fatty acids in their protein- deficient diet, it is also a way of obtaining livelihood to the population of urban Kano. The ponds are more of amenity as they are used for different purposes apart from fishing such as car washing activities, irrigation, fire control, swimming, animals´ consumption, block making, picnicking and a site for dumping solid wastes. Annual rainfall, discharges from settlements´ domestic waste water and urban runoffs are the major sources of water in the pond. Such pond waters containing various pollutants including heavy metals from anthropogenic sources have received considerable attention due to their toxic effects, as they enter food chain, bioaccumulate and biomagnify causing physiological and morphological alterations (Basyigit and Tekiz-Ozon, 2013). These may have carcinogenic, cytotoxic, and mutagenic effects in humans and other animals (Neethu and Puttaiah, 2014). Various studies have been documented worldwide on the contamination of different fish species by heavy metals (Bhupander *et al*., 2011).

The activities associated with the pond and the consumption of fishes from its water necessitates the need to assess the concentration of zinc and lead in both the pond water and gills of *Tilapia zilli* which predisposes the population of urban Kano to both short and long term health risks.

MATERIALS AND METHODS

Sampling site

The study site was ´Farfazai´ Pond along Bayero University, road in Gwale Local Government Area Kano, Nigeria within Latitude 11˚58' 57.3' N and Longitude 8˚30' 31.1'E. The site reflects the diverse ecological as well as human interactions prevailing in the area.

Plate 1: A View of Farfazai Pond Showing Human Interaction in the Study Area

Sampling Procedure

Three samples were collected per week in a 250ml sampling bottle, preserved with 2 ml concentrated HNO_3 to prevent precipitation of metals and stored at 4º C.

Digestion of Heavy Metals in Water and Gill Sample

Water Sample was filtered with acid-washed 125mm Whatman filter paper and subjected to Nitric acid digestion using microwave assisted technique and transferred into a 500cm^3 beaker and heated to dryness. The residue was dissolved in 50ml 0.1 M nitric acid and made up to 100ml in a 200cm^3 volumetric flask.

Fish samples of *Tilapia zilli* were collected from the site. The gills and rakers were removed and washed thoroughly with distilled water and air dried for 2 days, it was oven dried in hot air oven at 70 º C for 24 h. The dried samples were grounded and sieved through muslin cloth. The gill samples (0.5 g) were digested in HNO_3. Blank sample was prepared using distilled water in the same manner the samples were treated. Heavy metals analyses were performed using a Perkin Elmer model 306 Atomic Absorption Spectrophotometer as described by (APHA, 2005).

Statistical Analysis: An Analysis of variance (ANOVA) using the software SPSS version 13.0 was used to obtain a significant difference between the various parameters.

RESULTS

The result in Figure1 represents the mean concentration of Lead ions in both the pond water and gills of *Tilapia zilli*. There is a significant difference in the mean concentration ($P<0.05$) of Lead ions in pond water samples. The values ranged from 0.17mg/l to 2.61mg/l from the month of July 2015 to March 2016. The highest concentration of lead ions (2.61mg/l) was observed in July 2015, but decreased to 0.17mg/l in March 2016. Highest value of 4.74mg/l of Lead in the gill samples was also observed in July; the same month in which highest concentration of 3.39mg/l was observed in the pond water samples.

The result in Figure 2 showed the mean concentration of Zinc ions in both the pond water and gills of *Tilapia zilli*. Significant difference ($P<0.05$) was observed in mean concentration of Zinc in the pond water sample. The mean concentration of 2.94mg/l was observed in July 2015 which decreased to 0.36mg/l in October 2015 but rose up to the highest value of 4.35mg/l in March 2016.

It can be seen that a similar trend of mean concentration of Zinc ions was observed in gills of *Tilapia zilli*. The values decreased from 3.95mg/l in July 2015 to 2.09mg/l in October 2015. However, the values rose up to 9.11mg/l in March 2016. Although the mean concentration of Zinc in the pond water is high, the values in gills of *Tilapia zilli* were higher across the months.

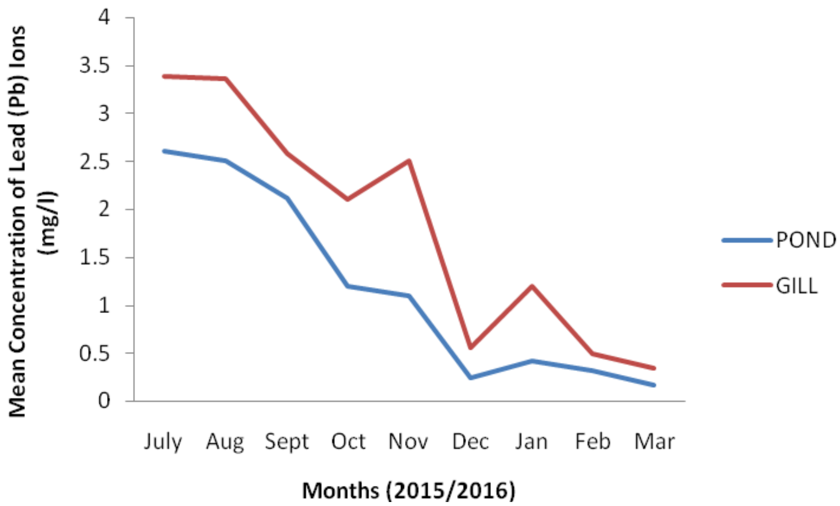

Figure 1: Mean Concentration of Lead Ions in Pond Water and Gill of *Tilapia zilli* (2015/2016)

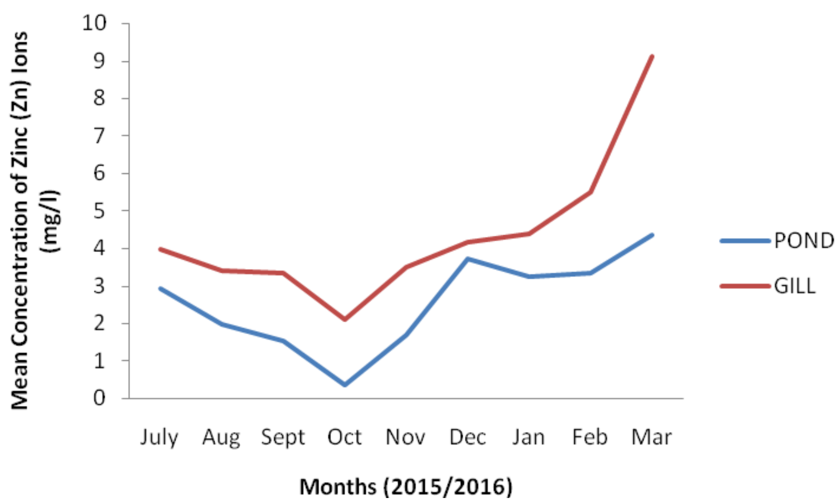

Figure 2: Mean Concentration of Zinc Ions in Pond Water and Gill of *Tilapia zilli* (2015/2016)

DISCUSSION

The pond water contained variable levels of Lead and Zinc ions. The high concentration of Lead could be due to urban run offs, gasoline, lubricating oils from car washing and other anthropogenic activities (McPherson *et al.*, 2002). It can be observed that mean values of lead were high in months coinciding with the rainy season (July 2015 to October 2015) which tend to wash substances in to the pond water thereby raising the mean concentration of Lead values. However, the high mean concentration values of Lead ions as seen in the gills of *Tilapia zilli* sample could be as a result of bioaccumulation of the Lead ions. According to Noverita *et al*. (2013); Nwabuike, (2016), most metal contaminants in the aquatic environment tend to accumulate in non-lipid rich tissues such as the gills and subsequently biomagnify in humans. Illnesses linked to continues consumption of either high or low levels of Lead in food or water include disruption of biosynthesis of heamoglobin leading to anaemia (Shivakumar *et al*., 2014).

It may also include a rise in blood pressure, kidney damage, miscarriages, subtle abortions and disruption of nervous system (Nnaji *et al.* 2007). Bhupander *et al.* (2011) maintained that excessive Lead intake in either food or water may cause brain damage, declined fertility in males, diminished learning abilities and behavioral disruptions in children. The amount of Lead in both the pond water and gills of fish samples were above limit of 0.05mg/l set by WHO (2011).

The highest mean concentration of Zinc in the pond water sampled coincided with the dry season. The fluctuation of weather conditions tends to evaporate the water and concentrate the substances thereby raising the mean value of Zinc in the pond water. It could also be that the water is contained within ultra mafic volcanic or metamorphic rock as Kano region is under lined by the old igneous rock formation referred to as the basement complex (Bala *et al.*, 2011). Another likely source of zinc metal could be from chemical breakdown of metallic items such as buckets and Zinc roofing sheets often dumped as waste in to the waste water (Censi *et al.*, 2006). When considering the heavy metals concentrations in fish species, the most important aspect is their bioaccumulation (Anser *et al.* 2016) of substances especially heavy metal ions and their subsequent toxicity to humans exposed to consuming such fishes (Buzier, 2011). Similar observation was reported by Awasthi (2000).

The values obtained were above the WHO, (2011) permissible levels of Zinc of 5.0 mg/l in and the FEPA (2003) <1.00mg/l of lead in waste water and fishes which reflects the aquatic condition of the study area.

CONCLUSION

The results of this study revealed that the Farfazai pond in Kano city and the fish (*Tilapia zilli*) found in the pond water contains variable concentrations of Lead and Zinc ions which are above the WHO (2011) and FEPA (2003) limit for heavy metals found in both pond water and gills of sampled *Tilapia zilli*. Consuming fishes from the Pond pose serious public health implications to population living in the area.

Recommendations

i. Level of concentration of heavy metals in the ponds should be monitored regularly by relevant agencies to ensure that the pollution does not go beyond limits that could cause widespread public health consequences.

ii. There is a need for the public to be enlightened on the dangers of eating fishes raised in the pond.

iii. Waste management agencies should critically evaluate existing strategies of waste disposal.

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