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Assessment of Metalloids in *Tilapia Guineensis* and *Sarotherodon Melanotheron* Found in Bodo River

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Abstract: **The amounts of silicon, arsenic, tellurium and germanium in the flesh of *Tilapia guineensis* and *Sarotherondon melanotheron* found in Bodo River were studied using X-ray fluorescence (XRF). The amount of tellurium found in the two fish species ranged between 7.7-12.4mg/kg, silicon 1,485-1,570mg/kg, arsenic 1.8-2.1mg/kg and germanium less than 0.5mg/kg. The results show that the consumption of *Tilapia guineensis* or *Sarotherodon melanotheron* from Bodo River is not likely to lead to tellurium toxicity. On the otherhand, silicon toxicity is possible through the consumption of any of both fish species. Arsenic remains a serious problem since there is no safe limit. Since germanium naturally present in food does not appear to cause harm but its compounds are do further analysis of the compounds of germanium present in these fish species need to be investigated.**

Keywords: **Metalloid, silicon, arsenic, tellurium, germanium *Tilapia guineensis, Sarotherodon melanotheron,* Bodo River.**

1. INTRODUCTION

A metalloid is an element whose properties are between those of metals and nonmetals or has a combination of both. This includes elements like silicon, germanium, arsenic and tellurium. Metalloids are generally brittle and fairly conduct electricity. Metalloids and the compounds they form are used as alloys, biological agents, catalysts, flame retardants and semiconductors among others. Metalloids have toxic, dietary and medicinal properties (Rezanka and Sigler, (2008); Sekhon, (2012) which makes studying their presence and amounts in foods important. Tolerable limits of human consumption of some metalloids have been established by various health agencies including the European Food and Safety Authority (EFSA, 2004), FAO/WHO, (2010), WHO, (2010), and Health Council of the Netherlands, (2002). However, apart from arsenic, few researches if any, gives an idea of other metalloids in fish species found in heavily polluted places like Bodo River in the Niger Delta.

Although fish is a major source of protein (Rasheed, 2001), it is also a major source of heavy metals in food (Siverperumal *et al.,* 2007). Furthermore, fish species are used as bio-indicators of heavy metals (Svobodova *et al.,* 2004) because heavy metal concentration depicts both the present and the past pollution load of an environment (Ravera *et al.,* 2003). Due to several years of oil exploration and exploitation in Ogoni land there has been several reports stating how badly damaged the entire environment is. In recent times, the Federal Government of Nigeria invited the United Nations Environment Programme (UNEP) to independently study Ogoni Environment and make recommendations. The summary of that report is presented in UNEP Job number DEP/1337/GE. The summary of the report is that Ogoni environment is heavily polluted and needs cleaning.

In trace amounts many elements are useful to the human body but in large amounts they cannot be excreted and thus, bio-accumulate in the body interfering with enzyme activities thus, hindering many body functions (Ongwuegbu and Ijioma, 2003). On the otherhand, no amount of some particular element is considered safe. Generally, it is importance to constantly study the amount of elements in fishes found in various water bodies especially, in polluted areas. Fishes accumulate some dangerous elements from the surrounding water to an amount hundreds or even thousands of times higher than the surrounding water (Osman *et al.,* 2007).

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2. MATERIALS AND METHOD

2.1 Study Area:

Bodo community is a part of Ogoni land in Gokana Local Government area of Rivers State. Ogoni land has had several incidents of oil spill and oil well fires leading to serious environmental pollution. According to Kpobari *et al.*, (2013) Ogoni land covers 1,000km^2 in the South-East of the Niger Delta basin (See figure 1) with a population of 832,000 consisting mainly of Ogoni people.

Figure 1: Map of Ogoni land.

Figure 2: Bodo River (Numuu tekuru)

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2.2 Collection of test samples:

The fresh samples of *Tilapia guineensis* and *Sarotherdon melanotheron* were collected from Bodo River (See figures 3 and 4). This river is popularly known by the dwellers as "Numuu tekuru"(See figure 2). Identity of the fish species was confirmed at the Nigerian Institute for Oceanography and Marine Research fish farm, Buguma. Some table size of each fish species were collected, cleaned, wrapped in aluminium foil and put into ice. The entire content was put in a black polyethylene bag and carried in a cooler for analyses.

Figure 3: ***Tilapia guineensis***

Figure 4: ***Sarotherodon melanotheron***

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2.3 Reagents:

Analytical grade reagents of high purity were used in the analyses of samples.

2.4 Determination of elements:

The amount of silicon, arsenic, tellurium and germanium were determined using X-ray fluorescence spectrometer in accordance with USEPA 6200. Fish samples were oven dried at 110°C for twenty hours. With the unwanted material like bones of fish etc removed, the fleshy part of the sample was reduced to less than 2µm diameter by crushing. Crushed samples were further pulverized (i.e. crushed until it becomes powder). They were then processed into pressed pellets, transferred to clean prolene foil and then into a sample vial, labelled, arranged in the sample tray and finally transferred to the sample compartment of the X-ray fluorescence equipment (SpectroX-LabPro) and then screened for their elemental composition. The concentration of each element was obtained via a previously stored calibration with certified reference materials. Results were calculated automatically as the necessary sample details were computed in the software.

3. RESULTS

3.1 Results:

Table 1: Amount (mg/kg) of tellurium, silicon, arsenic and germanium in *Tilapia guineensis* and *Sarotherodon melanotheron* found in Bodo River

Fish Specie	Tellurium (mg/kg)	Silicon (mg/kg)	Arsenic (mg/kg)	Germanium (mg/kg)
Tilapia guineensis	12.4	1,485	2.1	0.5
Sarotherodon melanotheron	7.7	1,570	1.8	0.5

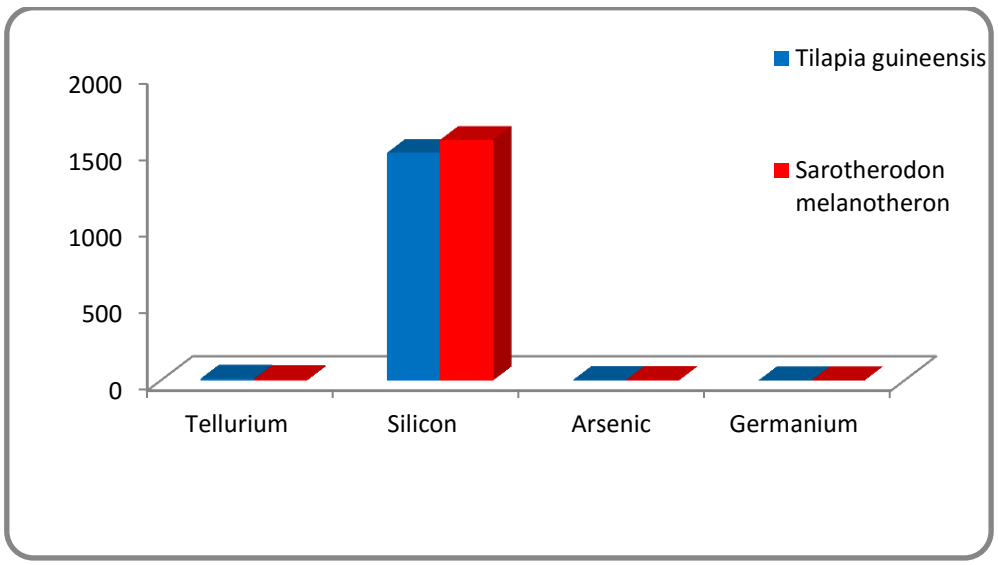

Figure 5: Amount (mg/kg) of tellurium, silicon, arsenic and germanium in Tilapia guineensis and Sarotherodon melanotheron in Bodo River

3.2 Discussion:

3.2.1 Tellurium:

According to the Health Council of the Netherlands (2002), exposure to tellurium and its compounds can lead to symptoms like garlic odour of the breath, dryness of mouth, sweating etc. The garlic odour can remain for months. The garlic odour is known to be associated with dimethyl telluride ($(CH_3)_2Te$), a gas produced as a result of tellurium toxicity or exposure. Keall *et al.*, (1946) reported that tellurium accumulates in the liver, spleen and kidney. The Health Council

of the Netherlands (2002) and Cantone *et al.*, (1993) stated that the estimated daily intake for tellurium is 0.6mg. M ller *et al.*, (1989) stated that a woman who ate a piece of meat containing 0.8-1.0mg/kg of tellurium suffered tellurium toxicity but was given 200mg of ascorbic acid per day as treatment to avoid permanent health impairments. This suggests that consumption of 0.8-1.0mg/kg of tellurium can be toxic.

From table 1, the amount of tellurium found in 1kg of both fish species ranges between 7.7-12.4mg. The recommendation of 0.6mg/day means that an adult of 65kg should stay within 39mg of tellurium per day. These amounts are equivalent to 3.1kg/day and 5.1kg/day of *Tilapia guineensis* and *Sarotherodon melanotheron* respectively. However, since an individual cannot consume this amount of fish species per day it is not likely that people will suffer from tellurium toxicity through the consumption of *Tilapia guineensis* or *Sarotherodon melanotheron* from Bodo River.

3.2.2 Silicon:

The European Food and Safety Authority (EFSA, 2004) stated that silicon is not an essential mineral for humans. Nielson (1996) stated that although the specific role of silicon in humans is not clearly understood, it is predominantly found in bones and joints. EFSA (2004) has recommended 20-50mg of silicon per day as safe limits. EFSA (2004) further explained that this amount corresponds to 0.3-0.8mg of silicon per kilogram body weight per day. This safe limit means that an adult of 65kg should consume between 19.5-52mg of silicon per day.

From table 1, the above range is equivalent to 13.1-35.0g/day and 12.4-33.1g/day of *Tilapia guineensis* and *Sarotherodon melanotheron* respectively. Since an average weight of a table size of any of these two fish species is about 67g people consuming these two fish species from Bodo River can easily exceed the recommended limit of silicon per day. Therefore, moderation in the consumption of *Tilapia guineensis* and *Sarotherodon melanotheron* from Bodo River is required to avoid silicon toxic effects.

3.2.3 Arsenic:

Although the amount of arsenic in both fish species ranged between 1.8-2.1mg/kg, the highest amount of arsenic observed in this research work was in *Tilapia guineensis* (See table 1). According to FAO/WHO (2010) and WHO (2010), there is no known tolerable limit for arsenic in food. However, WHO (2010) recommends staying within drinking water limit of 10µg/l per day. This result suggests that both fish species may not be safe for consumption in terms of arsenic.

3.2.4 Germanium:

According to Halford (2003) germanium is not essential to the health of plants and animals. US Geological Survey (2008) states that it has little or no health impact since the amount found in the environment is usually very small and are not likely to be ingested. However, Brown (2008) states that reactive intermediate compounds of germanium are poisonous. According to Emsley (2001), some compounds of germanium have low toxicity to mammals but toxic to certain bacteria. Generally, available literature suggests that germanium naturally present in food does not appear toxic but the problem of severe toxicity is with the germanium products or compounds formed.

4. CONCLUSION

It is not likely that the consumption of *Tilapia guineensis* or *Sarotherodon melanotheron* from Bodo River will lead to tellurium toxicity. On the otherhand, silicon toxicity is possible through the consumption of any or both fish species. Arsenic remains a serious problem since there is no safe limit. Thus, the amount of any or both fish species consumed per day is to be moderated or avoided entirely. Germanium naturally present in food does not appear to cause harm but its compounds do. Thus, further analysis of the compounds of germanium present in these fish species need to be investigated.

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