J. Chem. Soc. Nigeria, Vol. 36, No.2, pp90-94[2011]

HEAVY METAL CONCENTRATIONS IN SOME FRESHWATER FISHES OF NIGER STATE, NIGERIA

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Accepted:05/04/11

Abstract
Concentrations of the heavy metals Lead, Copper, Zinc, Cadmium and Nickel were determined in the flesh, intestine and gills of nine most common freshwater fishes found in Niger State of Nigeria. Samples of fishes were collected from Minna central fish market over a period of five days. Generally fish species accumulate metals in the order Zinc>Copper>Lead>Nickel>Cadmium, except in Clarotes laticapae and Tilapia niloticus where the order is Copper>Zinc>Lead>Nickel>Cadmium. Metal accumulation in fish samples was greater in the internal organs than in the flesh, except for Copper. For Lead and Cadmium the order was gills>intestine>flesh. For Zinc and Nickel the order was intestine>gills>flesh while for Copper the order was intestine>flesh>gills. Levels of the metals in fish samples were generally below the WHO and FAO maximum permissive limits (µg/g) of Lead (1.5), Copper (120), Zinc (150), Cadmium (0.5) and Nickel (0.4) *and hence pose no consumption risk.*

Keywords: heavy metals, accumulation, fish species, Minna, Niger State

Introduction

The toxicity of heavy metals has been, for many years, a global challenge. Historical cases of catastrophic and endemic exposures of heavy metals abound in literature. Minamata disease [1], the Pink disease [2], the Bradford sweet poisoning [3,4], the *itai-itai* disease [5], Iraq mercury poisoning [6] and Alexander Litvinenko poisoning [7], are all associated with heavy metal poisoning. During the last two centuries, heavy metals released by human activities have superimposed new patterns of metal distribution on those occurring naturally [8].

The concentrations of heavy metals in continental waters are controlled by atmospheric precipitations and the weathering processes on soils and bedrocks [9]. Because these pathways and processes have been significantly altered by human activities, the flux and distribution of heavy metals in a large fraction of all fresh water resources has increased [10]. In aquatic ecosystem, heavy metals have received considerable attention due to their toxicity and accumulation in biota and fish [11]. In fish, the toxic effects of heavy metals may influence physiological functions, individual growth rates, reproduction and mortality. Heavy metals may enter fish bodies in three possible ways, through the body surface, gills or the digestive tract [12].In order to evaluate the concentration and effect of heavy metals in the environment, analysis of biological organisms such as fish had been a valuable source of information [13]. The present study assesses the levels of the heavy metals. Pb, Cu, Zn, Cd and Ni accumulation in some fish species from Niger State of Nigeria in order to ascertain their safety for human consumption.

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Materials and Methods

Sample Collection and Treatment:
Nine major species of freshwater fishes obtained from rivers in Niger State of Nigeria were chosen for this study. These are *Mormyrops deliciosis*, *Claris garilpinus*, *Protopterus annectans*, *Clarotes laticapae*, *Bagrus docmac*, *Mormyrus rumenius*, *Pellonula atzelium*, *Heterotus niloticus* and *Tilapia niloticus*. Fish samples were collected from the market over a period of five days, in July 2008, and kept in a deep freezer prior to digestion and analysis. For each fish species, the flesh, the gills and the intestine were removed, weighed and analysed separately on wet basis.

Procedure The FAO method [13, 14], involving the digestion of the sample in an open beaker on a hot plate was used. 2.0g of fresh weigh of samples were placed in a beaker (in triplicates) and 15cm^3 of freshly prepared 1:1 mixture of nitric acid and hydrogen peroxide added. The beaker was covered with a watch glass and set aside for about an hour in order to allow the initial reactions to subside. The beaker and its contents were heated on a hot plate, with the temperature of the hot plate not exceeding 160°C. Boiling was continued for about 2hours and subsequently reducing the volume to between 2 and

5cm³. The contents of the beaker were transferred into a 25cm³ volumetric flask and diluted to mark with de-ionized water, kept ready for instrumental analysis. The digests were analyzed using the Buck Model 210VGP Flame Atomic Absorption Spectrophotometer. The instrument was calibrated with analytical grade standard metal solutions. Blanks were also determined to ascertain the contribution of reagents to metal levels. Instrument calibration and blank determination were carried out at intervals of ten samples.

Results and Discussions

Table 1 shows the mean concentration of metals in the flesh, intestine and gills of the various fish species while Table 2 shows the mean concentration of metals in whole fish. Generally, fish species accumulate metals in the order Zn>Cu>Pb>Ni>Cd except in *Clarotes laticapae* and *Tilapia niloticus* where the order are Cu>Zn>Pb>Ni>Cd (Table 2). There were variations in the levels of accumulation of heavy metals by fish organs (Table 1). For Pb and Cd the order of accumulation of metals in fish species was gills>intestine>flesh. For Zn and Ni the order is intestine>gills>flesh while for Cu, the order was intestine>flesh>gills. Metal accumulation is greater in internal organs than in the flesh, with the exception of Cu. The results of this study are in agreement with earlier works reported [11, 15]. In a study by Javed [11] on heavy metals contamination of some freshwater fishes, it was reported that fish organs accumulated Zn, Ni and Mn in the order liver>kidney>gills>muscle while for Pb the order is gills>liver>kidney>muscle [12]. El-Shahawi and Al-Yousaf [15] reported that, in fish, the levels of Ni, Co, Pb and Cr were found to follow the order liver>skin. The absorption of metals is to a large extent a function of their chemical forms and properties [11]. Pulmonary intake causes the most rapid absorption and distribution through the body via the circulatory stem. Absorption through the intestinal tract is influenced by pH, rate of movement through the tract and presence of other materials. The form of metal can determine which organ is affected most [14].

The range of heavy metal concentrations found in the fish samples were Pb: 0.03 – 0.88; Cu: 3.75 – 13.99; Zn: 7.59 – 13.88; Cd: 0.02 – 0.09; Ni: 0.01 – 0.20 (Table 3). These concentrations are generally below established maximum permissive concentrations of WHO (Pb: 1.5; Cu: 120; Zn: 150; Cd: 0.2; Ni: 0.4) [16] and FAO (Pb: 0.5; Zn: 30; Cd: 0.5; Ni: 0.4) [17].

Conclusion

The results obtained in this study show that the concentrations of metals in fish samples were generally below the WHO and FAO maximum permissive level and hence pose no consumption risk. However continuous monitoring is recommended.

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