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Bioaccumulation of Cadmium in Selected Tissues of *Hoplobatrachus rugulosus* Wiegmann

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Bioaccumulation of cadmium in selected tissues of *Hoplobatrachus rugulosus* Wiegmann was analyzed using atomic absorption spectrophotometer. Frogs was sacrificed for the determination of the extent of bioaccumulation in the stomach, liver, kidney and muscles. Digestions of samples were done at Chemistry Section of the Department of Science and Technology (DOST). The heavy metal concentrations were determined with a Fast Sequential Atomic absorption spectrophotometer (AA280FS Series). Furthermore, results of this study showed that stomach showed the highest cadmium level with 466mg/100g, followed by liver with 388.12 mg/100g, muscle with 226.46mg/100g and the least is in urogenital (kidneys) with 57.89mg/100g. It should be noted that the *Hoplobatrachus rugulosus* used in this study was directly collected from the places where garbage with suspected cadmium content materials is present to determine the real long term effects of cadmium. This study showed that the contamination of cadmium into the environment and could bio-accumulate to amphibians and other animals living in the area and threaten their survival. The results obtained indicated that the heavy metal is toxic and could be lethal as it bio-concentrates along the food chain. Different effects of cadmium were discussed in this study but this needs to be further ascertained with regards to the effect of heavy metals on the entire population of the anuran amphibians.

Keywords: Bioaccumulation of cadmium, *Hoplobatrachus rugulosus*, stomach, liver, kidney, muscles

Introduction

One of the global environmental problems today occurring all over the world is the contamination of soil, water and atmosphere thru harmful discharge of substances. Heavy metal contamination in the different components of the environment can cause biological effects because of its pervasive and persistent characteristics (Singh and Chandel, 2006). This environmental contamination has been considered as the main cause of the

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decline of agricultural animals such as amphibians (Sparling *et. al*., 2001). It should be noted that agricultural land is one of the natural habitats of amphibians where they can be exposed to various chemicals (Khan and Law, 2005). Bioaccumulative contaminants are rapidly absorbed by living aquatic organisms and transferred to their tissues at a concentration range from thousand to million times in ambient environment (Ogeleka, 2007). The total accumulation of toxic chemical substances by an organism directly absorbed from the environment is termed as bioaccumulation (APHA 1998). These absorbed levels of bioaccumulative contaminants may cause dysfunction in an organism and has possible adverse effects to humans. According to Britton (1998), the accumulation of chemical compound by a living organism is faster than broken down or excreted. The assessment of environmental hazard is very important by evaluation on the bioaccumulation of chemicals in animal tissues (Heng *et al*., 2004; Beek, 1991). In this study, common field frogs found in rice paddy and agricultural areas, known to be a human commensal were used as a sentinel species of environmental health effects from the agricultural activity, since stable population of field frogs were found in the agriculture areas making it exposed to long period of time and therefore accumulation of xenobiotics. Amphibians are considered as suitable sentinel species in evaluating environmental contamination because they are sensitive, fragile and disturbance-susceptible indicators of ecosystem function (Pechmann *et al.*, 1991; Hager, 1998; Welsch and Ollivier, 1998; Lawler *et al.*, 2003). These animals are qualified to inform humans regarding the health of their environment (Kremen, 1992; Dufrêne and Legendre, 1997; Carignan and Willard, 2002). This study therefore been planned to determine the amount of heavy metal residues in different tissues of frog.

Materials and Methods

Distribution of Hoplobatrachus rugulosus:

Hoplobatrachus rugulosus Wiegmann was collected in agricultural rice field in close proximity to a dump site. General observations in the collection area were conducted. Frogs were randomly collected in aquatic habitats such as rice paddies, ditches and pools in plantations near the dump site. They were collected using hand nets to prevent injury to animals during capture since they are active animals. The location (latitude/longitude) and elevation of the surveyed (15o44’22.53”N 120o55’39.16E 78m) area were recorded using Global Positioning System (GPS).

Preparation of Tissue Sample for Atomic Absorption Spectrometry (ASS)

Frogs was sacrificed for the determination of the extent of bioaccumulation in the stomach, liver, kidney and muscles (Fig.1). Digestion of samples was according to Chemistry Section of the Department of Science and Technology (DOST). To each sample tissue, (0.1g), 10ml of 10% perchloric acid: conc. HNO3 (3:2 v/v) was added and heat was applied (60 ℃) until a clear solution was formed. The sample was digested using an Advanced Microwave Digestion System (ETHOS 1 Series) (Fig.2). The volumes were made up to 50ml using distilled water. The samples were then stored in plastic bottles before analysis with atomic absorption spectrophotometer to determine the amount of heavy metal bio-accumulated. The heavy metal concentrations were determined with a Fast Sequential Atomic absorption spectrophotometer (AA280FS Series) The source of radiation was a hollow cathode lamp which contained a cathode constructed of the same material as that being analysed. After analysis using the AAS, the actual concentration of heavy metal in the tissue was determined.

Figure 1. Organs of ***Hoplobatrachus rugulosus.***

Results and Discussion

Microclimate of the Study area

The Province of Nueva Ecija has evenly distributed rainfall throughout the year, the northeast has no pronounced seasons while the west and center are dry from November to April and wet May to October. The three mountain ranges naturally protect the province from monsoon rains and typhoons that occur from July to October. Average annual rainfall is 76.1 inches.

Study Area Description.

The collection area is a rice field and mango plantation in close proximity to dump site. The soil types are clay, loam, clay loam, sandy loam and some are wet with water. All types of wastes of the community are located here ranging from biodegradable to non bio-degradable. Bio-degradable includes fresh and dried leaves, papers and many others. Non bio-degradable includes plastics, can, metals, electronics, batteries, etc. Soil degradation was observed in the area. Meaning, the soil is not good in terms of its quality resulting to long-term decline in soil productivity and its environment-moderating capacity (Bloom, 2000). Chemical contamination is the biggest threat in this type of ecosystem. Plastics, batteries with cadmium, toxins in wastes and other chemicals leak into the ground where they remain. Modern chemicals and materials either do not biodegrade or break down, or if they do, then break down into smaller chemical particles. These particles poison the ground itself. Plants growing in the area, herbivores that depend on these plants and even humans are all affected by these chemicals. This can lead to the loss of some plant species and animal life as well as create long-term health problems such as cancer in humans.

Bioaccumulation

This study showed that the release of cadmium into the environment could threaten amphibian survival. Cadmium can get into your blood stream by eating and drinking cadmium-contaminated food or water and by breathing cadmium contaminated air. Bioaccumulation of cadmium in liver, stomach, urogenital and muscle is shown in Figure 2.

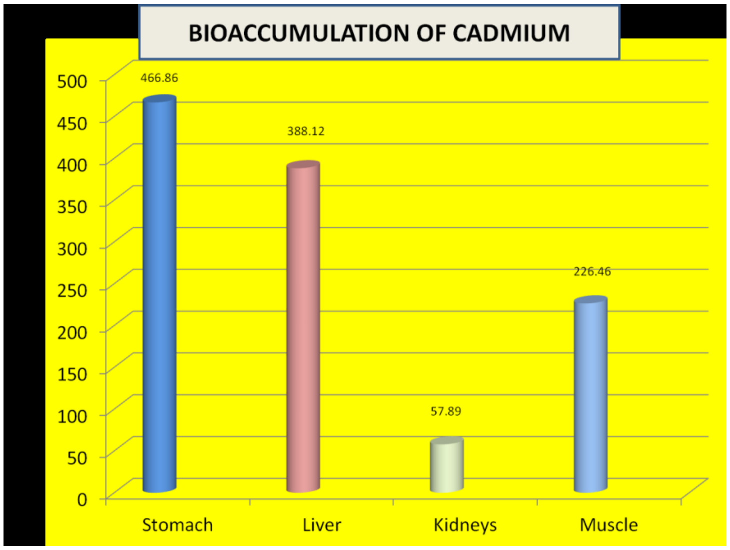

Fig. 2 Bioaccumulation of cadmium in liver, stomach, urogenital and muscle

Stomach showed the highest cadmium level with 466mg/100g, followed by liver with 388.12 mg/100g, muscle with 226.46mg/100g and the least is in urogenital (kidneys) with 57.89mg/100g. It should be noted that the *Hoplobatrachus rugulosus* used in this study was directly collected within the area proximal to the dump site with suspected cadmium contamination. Some of the components of the dump site with cadmium are: Nickel cadmium slow charger, Nickel cadmium battery for motor cycle, e-cigarette battery charger, cordless phone battery, rechargeable battery. Usage of phosphate fertilizers can also be a source of cadmium contamination. The results of this study indicated that cadmium accumulation gradually increases during the exposure period (Ezemonye *et al.*, 2012). Compared to other studies, the bioaccumulation of cadmium in the different organs showed absolutely high. This may be due to direct exposure of frogs from water contaminated with cadmium. It should be noted that frogs are capable of absorbing water from moisture at soil surface or on wet vegetation or rocks. Heavy metals cannot be shattered through biological degradation. When exposed to higher concentrations, organs of aquatic animals may accumulate heavy metals (Ezemonye *et al.*, 2012). Bioaccumulation of bio-toxic chemical like cadmium in different body organs such as lungs, liver, kidneys, reproductive organs and even in the bones were observed by Egwurugwu *et al.*, 2007. Cadmium may cause nephrotoxicity, teratogenicity, carcinoeginicity, endocrine disruption (Serafim and Bebianno, 2007) and deterioration of cell membranes (Cui, *et al.*, 2004).

Conclusion

This study showed the release of cadmium in the dump site from metals, electronics, batteries, and others into the environment resulting to the contamination of the different components of the ecosystem. Living components of the area like plants and animals particularly *Hoplobatrachus rugulosus* were threatened due to bioaccumulation of cadmium in their different tissues.

This research work recommends further in depth studies to be conducted such as including all living organisms and different ecological parameters should be tested. Morphological study from tadpole to matured stage should also be evaluated.

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