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Cd and Pb Concentration in Muscle and Liver Tissues of Flathead (*Platycephalus indicus*) in the Northeastern Persian Gulf

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Abstract

This study was conducted to determine Pb (Pb) and Cd (Cd) concentrations in the liver and muscle of *Platycephalus indicus* (flathead) in Minab, Qeshm Island and Khamir Port in the Northeastern Persian Gulf. Moreover, the influences of season (winter and summer) and target tissue (liver and muscle) on the Pb and Cd concentrations in flathead were investigated and compared with FAO/WHO standards for human consumptions. Sampling was done in three stations (Minab, Qeshm Island and Khamir Port) and within two seasons (winter and summer). Thirty samples were prepared per season per station. The concentration of metals (Pb and Cd) was measured using Atomic Absorption Spectrometry (AAS). The results showed that metal levels differred significantly ($P<0.05$) between stations, seasons and organs. The concentrations of Pb and Cd in the muscle of flathead fish were below the FAO/ WHO standard values indicating flathed fishes in Minab, Qeshm Island and Khamir port were safe for human consumptions.

Keywords: *Platycephalus indicus (flathead), Cd, Pb, Persian Gulf, Minab, Qeshm Island, Khamir Port.*

1. Introduction

The Persian Gulf as a semi-enclosed, shallow body of water with mean depth of 36m is located in the midst of the arid landmasses of Iran, Saudi Arabia, Kuwait, Oman, Qatar and the United Arab Emirates (UAE). The turnover of all the water in the Persian Gulf is 3–5 years (Fuhrer et al., 1996; Laimanso et al., 1999; Hayes, 2001; Al- Saleh & Shinwari, 2002; Agah et al., 2009; Ganjavi et al., 2010; Saei- Dehkordi et al., 2010). Further natural stress originates from several factors, including normal seepage of underwater oil fields that account for approximately 10% of chronic spillage. Consequently, the Persian Gulf's contained environment, makes it a natural

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repository for pollutants. It has also been subjected to a wide range of human perturbations. The Gulf marine ecosystem is under stress, in particular from the impacts of unprecedented coastal reclamation, oil exploration, production and oil tankers movement (Al-Saleh & Shinwari, 2002; Dugo et al., 2006; Agah et al., 2009; Ganjavi et al., 2010).

Available information suggests that the concentrations of toxic metals in many ecosystems are reaching unprecedented levels. Due to the steady load of contaminated dust in overcrowded cities, the ambient concentrations of toxic metals are now among the highest ever being reported. Metals are elements that generally do not break down further into less harmful constituent; they accumulate where they are released (Ruangsomboon & Wongrat, 2006; Ganjavi et al., 2010; Saei- Dehkordi et al., 2010; Storelli et al., 2010).

The problem of pollution is attracting the attention of people around the world. With increased urbanization and industrialization, there has been a rapid increase in the municipal wastewater (sewage water and industrial effluents), which in turn has intensified the environmental pollution. The pollutants like heavy metals after entering into aquatic environment accumulate in tissues and organs of aquatic organisms (Dugo et al., 2006).

Reactions of these elements depends on the concentration, physiochemical properties, chemical bonds and their solution on the absorption, accumulation, distribution in body and physiological effects on metals. In recent years, there has been an increasing interest in the utilization of fishes as bioindicators of the integrity of aquatic environmental systems (Fuhrer et al., 1996; Laimanso et al., 1999; Hayes, 2001; Al- Saleh & Shinwari, 2002; Agah et al., 2009; Ganjavi et al., 2010; Saei- Dehkordi et al., 2010).

Platycephalus indicus is an important fish that can be used as bio indicators for survey of heavy metals in the Persian Gulf; The present study was conducted to investigate and determine concentration of Cd (Cd) and Pb (Pb) in liver and muscle tissues of *Platycephalus indicus* (flathead) in Minab, Qeshm Island and Khamir Port (Persian Gulf). Moreover, the seasonal effect (winter and summer) on accumulation of Cd and Pb in the tissues of flathead fish were investigated. Finally, concentrations of these heavy metals were compared with global standards for human consumption.

2. Materials and Methods

2.1. Sampling and Samples Preparation

Samples of *Platycephalus indicus* fish of both sexes were collected from three stations (Minab, Qeshm Island and Khamir Port) in the Persian Gulf during two seasons (winter and summer). Each time, approximately 30 samples of different sizes were collected, placed in an ice box, transported to the laboratory and kept in a freezer (-20 °C) prior to the analysis (Moopam, 1999). The fish samples were then defrosted and their standard length and weight were recorded. Whole fish were dissected on a clean bench shortly after thawing with the aid of a stainless steel knife which had been cleaned with acetone and hot distilled water prior to use. The fish samples were finally preserved in clean dry polyethene bottles prior to analysis (Moopam, 1999).

2.2. Heavy Metals Analysis

The concentration of metals (Pb and Cd) was measured using Atomic Absorption Spectrometry (AAS) (Al- Saleh and Shinwari, 2002; Emami Khansari et al., 2005; Uluozlu et al., 2007; Ganjavi et al., 2010).

2.3 Data Analysis

Data of concentration of metals (Pb and Cd) were analyzed based on organ (liver and muscle), season (winter and summer) and station (Minab, Qeshm

Island and Khamir Port). Statistical analysis of the data was carried out using SPSS V16. In order to classify and reduce the variables to the detect relationships between them without losing much information, One- Way ANOVA was performed. Prior to ANOVA a Klomogrov- Smirnov test was accomplished to analyze normality of data distribution. Moreover, to assess significant differences between the element levels in the different tissue and stations the data were analyzed by One- Way ANOVA and factor analysis. A p- value at a significant level of 5% or less indicates that significant relationships between variables exist.

3. Results

Concentrations of heavy metals Pb and Cd) in liver and muscle tissues of *Platycephalus indicus* caught from Minab, Qeahm Island and Khamir port in winter are shown in Tables 1 and 2. Results showed that concentration of Pb and Cd in liver and muscle tissue of *Platycephalus indicus* fishes as well as in between stations were significatly correlated. In this study, the concentrations of Pb and Cd in fish tissues in different stationsranked as follows: Khamir Port>Qeshm Island>Minab and Minab >Qeshm Island> Khamir Port (Table1).

Results showed concentration of Pb in Qeshm Island was significantly higher than that in khamir Port and Minab ($P<0.05$), but Cd accumulated in fish tissues was significantly higher in Minab than that in Qeshm Island and Khamir Port ($P<0.05$).

Concentrations of Pb and Cd in liver and muscle of *Platycephalus indicus* in Minab, Qeshm Island and Khamir Port were compared . Results showed that Pb accumulation of *P. indicus* in study sites differed significantly between liver and muscle tissue in winter and summer ($P< 0.05$).

Results also showed that Cd concentration was higher in liver than muscles in both seasons in all locations ($P< 0.05$).

Table 1. Concentrations of Pb and Cd in liver and muscle tissues of *Platycephalus indicus* from Minab, Qeshm Island and Khamir port in winter (Mean ± S.D).

tissue	Station / metal	Minab	Qeshm Island	Khamir Port
liver	Pb (ng. g^{-1} w.w)	0.0058 ± 0.0040 [a]	0.0204 ± 0.0021 [b]	0 .0333 ±0.0180 [c]
	Cd (ng. g^{-1} w.w)	0.0056 ± 0.0240 [c]	0.0049± 0.0025 [b]	0.0042 ±0.0025 [a]
muscle	Pb (ng. g^{-1} w.w)	0.0038 ± 0.0028 [a]	0.0064 ± 0.0035 [b]	0.0088 ±0.0059 [c]
	Cd (ng. g^{-1} w.w)	0.0481 ± 0.0024 [c]	0.0259 ± 0.0330 [b]	0.0138 ± 0.0046 [a]

*Different script in rows illustration significant differences between groups at Duncan's test ($P< 0.05$).

Table 2. Concentrations of Pb and Cd in liver and muscle samples of *Platycephalus indicus* from Minab, Qeshm Island and Khamir port in summer (Mean ± S.D).

tissue	station / metal	Minab	Qeshm Island	Khamir Port
liver	Pb (ng. g^{-1} w.w)	0.0084± 0.0059 [a]	0.0532 ± 0.0212 [c]	0.0266 ± 0.0018 [b]
	Cd (ng. g^{-1} w.w)	0.0059 ± 0.0022 [c]	0.0050 ±0.0025 [b]	0.0047 ± 0.0028 [a]
muscle	Pb (ng. g^{-1} w.w)	0.0051 ± 0.0039 [a]	0.0123 ±0.0083 [c]	0.0101 ± 0.0072 [b]
	Cd (ng. g^{-1} w.w)	0.0335 ± 0.0155 [c]	0.0259 ±0.0134 [b]	0.0208 ± 0.0072 [a]

*Different script in rows illustration significant differences between groups at Duncan's test ($P< 0.05$).

4. Discussion

Canli and Atli (2003) suggested that concentration of Cd in muscle of *Sparus auratus* was higher than that in skin. Also, Chen (2002) showed that Pb significantly accumulated in gills, livers, stomach and intestine tissue of *Tilapia gallier, Crarias lazera* and *Osteoglossidae*. The concentrations of Pb were in the following order gills>liver>stomach>intestine. Heavy metals (Zn, Cu and Mn) accumulation were significantly different from liver, muscle and skin tissues in *Lethrinus lentgan* (Al-Yousf et al., 2003) similar to findings in this research. Also, Gaspic et al. (2002) illustrated Pb concentrations in liver of *Merluccius merluccius* and *Mullus barbatus* from Adriatic Sea were greater than that in muscle and skin. Results of the present study showed that Pb was accumulated more in liver tissues of *Platycephalus indicus*, while Cd tended to be accumulated in the muscle. Mormede and Davies (2001) showed an *invert regime* of Pb and Cd accumulation in liver of *Micromesistius poutassou*. Moreover, *Merluccius merluccius* and *Aphanopus carbo* showed the same results.

Several studies have indicated accumulated levels of both non-essential and essential heavy metal load in muscle and liver tissues of fishes (Fuhrer et al., 1996; Laimanso et al., 1999; Hayes, 2001; Al- Saleh & Shinwari, 2002; Agah et al., 2009; Ganjavi et al., 2010; Saei- Dehkordi et al., 2010). Fish death or injury due to metal contamination is considered the primary cause of reducing fish populations through the food chain (Al- Saleh & Shinwari, 2002; Dugo et al., 2006; Agah et al., 2009; Ganjavi et al., 2010). The bioaccumulation of heavy metals after entering into aquatic environment is common in tissues and organs of aquatic organisms and is depended on ecological, physical, chemical and biological conditions (sexuality, weight, age, feeding habits and tissues) and physiology of organisms as well as metal characteristics and quantity (Fuhrer et al., 1996; Laimanso et al., 1999; Hayes, 2001; Al- Saleh & Shinwari, 2002; Agah et al., 2009; Ganjavi et al., 2010; Saei- Dehkordi et al., 2010). The results of the present study showed that, location (Minab, Qeshm Island and Khamir port), season (winter and summer) and target tissue (liver and muscle) would affect the bioaccumulation of Pb and Cd in *Platycephalus indicus*. Results also showed that the concentrations of Pb and Cd in the muscle of flathead was below the standard levels required by FAO/ WHO, in all fish and in all stations for human consumptions (Table 3), and thus no health concern is warranted at this time.

Table 3. Global standard of limit concentration of Pb and Cd of *Platycephalus indicus* in muscle for human fish consumptions

Global standard / Metal	Cd (ng. g^{-1} w.w)	Pb (ng. g^{-1} w.w)	Reference
FAO/ WHO[1]	0.5	2.14	FAO/ WHO, 2010
EC[2]	0.1	0.4	Ganjavi et al., 2002
Platycephalus indicus	0.08	0.02	Present study

[1] Food and Agriculture Organization
[2] European Communities

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