Determining Mercury Contamination in Indian Spiny Turbot, *Psettodes erumei*, from Jask Port Coastal Waters, Iran

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Abstract

In this research we assessed the concentration of total mercury in the muscle, liver and gill tissues of Indian spiny turbot, *Psettodes erumei* caught from Jask coastal waters in Hormozgan province. Fifteen fish specimens were caught using trawl in spring season 2008. After biometrical measurements and sex determination, muscle, liver and gill tissues were collected; mercury was extracted from the tissues using chemical digestion method with pure nitric acid and its concentration was determined using AAS. The mean concentration of Mercury among body parts, but not between males and females, showed significant differences (P<0.05). The analyses of results using one way t-test showed that muscle and liver contained the lowest and the highest concentration of Hg, respectively. The concentration of Hg in gill was 19.98±1.35 μg.Kg⁻¹ dw. The analyses of results showed that concentration of total Hg in muscle tissue was lower than the limit set by WHO, FAO and UKMAFF standards. Mercury content in sediment samples compared with American and Canadian standards and was lower than that of ERM, PEL, SEL and greater than that of SQRT, ISQG, ERL, and LEL standards.

Keywords: Gill, Indian spiny turbot, Liver, Mercury, Muscle, *Psettodes erumei*

1. Introduction

Large quantities of mercury are released into aquatic environments, particularly from effluents discharged from mercury cell chlor-alkali plants (Arribe’re et al., 2003) and from industrial wastes, geochemical activities and mining of metals (Gu”mgu”m, U”nlu”, Tez, and Gu” Isu”n, 1994; Lee and Stuebing, 1990).

Discharging of heavy metals into marine environments damage species diversity and richness as well as ecosystem characteristics. Damage is usually enhanced because metals are bioaccumulated and as such their toxicity effect persists (Matta, Milad, Manger, and Tosteson, T.1999).

Human populations are usually exposed to mercury toxicity through consuming seafood. Marine fauna can acquire metals from food, suspended matter, or directly from seawater (Mustafa Tu” Zen, 2002).
Some marine organisms are able to bioconcentrate certain metals above the level found in the surrounding environment. This raises the potential for metal contamination throughout the food chain (Mustafa Tu¨ Zen, 2002) and provides the means for developing marine pollution monitoring programs (UNEP, 1993; Uthe et al., 1991). Fishes are often at the top of the aquatic food chain and usually concentrate large amounts of some metals (Mansour and Sidky, 2002) and as such are popular targets for heavy metal monitoring programs (Rayment and Barry, 2000).

The main objective of this study was to assess the concentration of total mercury in sediment samples and muscle, liver and gill tissues of Indian spiny turbot, Psettodes erumei caught from the Jask port coastal waters in Hormozgan province, Iran.

2. Materials and Methods

2.1. Biology and Ecology of Psettodes erumei

Indian spiny turbot has an oval and flat body, but thicker than of many other flatfishes. Mouth is large with strong teeth; maxillary extends well beyond hind edge of lower eye; both eyes on left and right side; upper eye lying immediately below dorsal edge; gillrakers not developed. Dorsal fin origin well posterior to eyes; anterior fin rays spinous. Maximum size about 60 cm but commonly about 40 cm (Fig. 1). Found almost throughout the area and is widespread in the Eastern Indian Ocean and Western Central Pacific, lives on muddy and sandy bottoms of the continental shelf down to about 100 m depth. Is a demersal species and feeds mainly on bottom-living animals (carnivorous). It is caught mainly using bottom trawls ((Fischer and Bianchi, 1983).

2.2. Sampling and Sample Preparation

Jask port is the main supply source of Indian spiny turbot in Iran. The fish specimens were collected from west of Jask port coastal waters in Hormozgan province, Iran and geographic coordinates of sampling area is 25°,39°22° northern and 57°,45°06° eastern. Sampling took place over a 3-month period between March 2008 and June 2008. After determining sex and measuring biometrics, specimens were frozen and transported to the laboratory.

Specimens were washed with distilled water and liver (Evans et al., 1993), muscle (Adams and Onorato, 2005) and gills (Pourang, 1995) from frozen fish were collected using plastic knife in the laboratory. After weighing muscle, liver and gill tissues, samples were dried in 560 °C oven to constant weight. Then, samples were packed in polyethylene bags and stored until extraction for total mercury as described by Bastos et al (1998).

Tissue samples were digested using standard procedures in accordance with US EPA Method 245.1 (EPA, 1991; Frick, 1996) to convert all mercury in the sample to Hg (II). Oxidative digestion of dry samples was carried out using a mixture of 6 ml concentrated nitric acid (HNO3) and (1.0 g) fish sample. The mercury in each digested sample was reduced to elemental mercury by reaction with excess stannous chloride. This elemental mercury was purged from solution in a gas-liquid separator and swept into an atomic absorption spectrometer for detection and quantification by cold vapor Unicam919 atomic Absorption spectrometer following standardized procedures (EPA, 1991; Booeshahgi et al., 1995).
Standard fish-tissue reference material (DORM-3) were obtained from the National Research Council of Canada for each group of 20 or fewer fish samples analyzed (EPA, 1991; Frick, 1996).

Top 10-20 cm sediment samples were collected in triplicate using a van Veen grab during low tide in March 2008. Only the topmost sediment 5 cm was carefully removed with a plastic spoon and transferred to plastic vessels. Samples were stored on ice before analysis (ASTM1991).

Air dried sediment samples were oven dried at 500 C for 24 h to constant weight. Then, samples were ground in an agate mortar and sieved through 2 mm mesh in order to separate the coarse particles and further with planktonic net (Zhang et al., 2007).

For digestion of sediment, 0.5 g of sediment samples was extracted twice with 4 mL of HNO3/HCl (3:1 v/v) at 550 C (Qari et al., 2005). Triplicate subsamples were analyzed using a Unicam919 atomic absorption spectrometer, and get value of Indian spiny turbot, Psettodes erumei Hormozgan province coastal water (Jask port).

\[ R.E = \frac{c \cdot V - g \cdot V}{c \cdot V} \times 100 = 2.4\% \]

Standard deviation of the mean of length (cm) and weight (gr) of Indian spiny turbot was calculated. The significant differences in total mercury contents of muscle, gill and liver tissues between males and females were determined at \( P \leq 0.05 \).

The minimum, maximum and mean ± se (μg. g\(^{-1}\)) of total mercury in sediment calculated by (Table 1).

<table>
<thead>
<tr>
<th>Station</th>
<th>Minimum</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Jask</td>
<td>0.42</td>
<td>0.58</td>
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3. Results and Discussion

A total of 15 Indian spiny turbot were analyzed in this research. Females were generally longer than males. Average weight and height of male and female fish were 693.7±143.4 and 1135.3±216.3 g and 32.4±2.8 and 37.3±3.3 cm. Mean standard deviation of weight and height were 0.5±.

3.1. Mercury Contents in the Tissues

The average mercury content in muscle with the highest and the lowest values observed in a female (2.55±0.24μg.Kg\(^{-1}\)) and a male (1.71±0.17 μg.Kg\(^{-1}\)), respectively. The average mercury contents for liver and gill tissues were 57.44 and 23.12 ± 1.83 μg.Kg\(^{-1}\) respectively with similar trends as of muscles.

![Fig. 2. Correlation between muscle tissue mercury content with weight (a) and length (b) in Indian spiny turbot](download)

There were similar positive correlations (\( P > 0.05 \)) between length and weight of fish and mercury bioaccumulation in muscle tissues (Fig. 2). This finding agreed with findings of Al majed and Preston (2000) and Gremillion et al. (2005). It seems positive relationship exists between mercury concentration and length (or weight) of fish in aquatic environments in many parts of the world (Weis, 2004, Mirlean et al., 2005). However, Mercury levels detected in tissues of...
Indian spiny turbot collected from Jask coastal water were generally low and differed between tissues significantly (P < 0.05); For example, the liver and muscle tissues showed the highest and the lowest mercury in them, respectively.

Results of mercury contents (as μg.Kg⁻¹ dw) in muscle, gill and liver tissues of female and male Indian spiny turbot showed no significant differences (P ≤ 0.05) (Fig. 3).

Fig. 3. Mercury contents (as μg.Kg⁻¹ dw) in muscle, gill and liver tissues of female and male Indian spiny turbot

3.2. Comparison with Guidelines

Dietary standards and guidelines applicable in the UK for fish have been summarized by MAFF (Agusa Tetsuro et al., 2004) for Hg (0.3 μg. g⁻¹ dry wt.) and by WHO and FAO (R.B. Voegborlo et al., 2005) for Hg (0.5 μg. g⁻¹ dry wt.).

Difference between the mean of total mercury content in muscle tissues of Psettodes erumei in Jask port, Iran (0.002 μg. g⁻¹ dw) and global standards was significant (P > 0.05). Result of this experiment was lower than of MAFF, WHO and FAO standards limits. As for Mercury in Jask port sediments, it was determined that findings of this investigation were lower than that of ERM, PEL, SEL but higher than that of SQRT, ISQG, ERL, and LEL. Standards.

4. Conclusions

The relatively low content of total mercury found in muscle, liver and gill tissues is an indication of lower potential for metal contamination in Jask port marine ecosystem. Although, liver, muscle and gill tissues had bioaccumulated lesser mercury, respectively, and despite overall lower bioaccumulation detected, the results of this study revealed the fact that Indian spiny turbot could be designated as an environmental indicator species for mercury contamination monitoring.

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