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Distribution of metals (lead, vanadium, nickel, selenium) in the tissues of benthic fish, oriental sole, from two sites of Persian Gulf

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Abstract: In order to examine and compare lead, vanadium, nickel and selenium metals accumulation levels in muscle tissues of Oriental sole (*Brachirus orientalis*), sampling fish was done in both Bushehr and Asalouyeh stations during the summer 2013. After biometry of the samples, muscle tissues were separated and chemical digestion was done. Lead, vanadium, nickel and selenium accumulation levels in tissues were measured by using a graphic furnace atomic absorption instrument. Based on the obtained results, mean concentrations of lead, vanadium, nickel and selenium in Bushehr station were 1.459±0.747, 0.246±0.006, 1.378±1.656, 4.28±0.846 $mgkg^{-1}$ dw, respectively and in Asalouyeh station were 3.166±2.447, 0.288±0.087, 2.208±2.445, 3.72±0.498 $mgkg^{-1}$ dw, respectively. Based on the obtained concentrations and comparison done it as specified that based on WHO and FAO standards, the amount of lead, nickel and selenium in both stations was upper than the standard permissible levels.

Key words: Persian Gulf; Benthic; muscle; Oriental sole

1. Introduction

Heavy metals are non-biodegradable materials having significant mobility through food chains and are also potentially toxic to organisms (Chen and Chen, 1999). They are discharged into the marine environment through various anthropogenic resources such as petrochemical wastewaters, agricultural and mineral runoffs, the transport of oil and domestic wastewater (Karadede et al., 2004). Heavy metals are available in aquatic environments, especially in coastal regions and their release in the environment is due to the rapid overgrowth of industry as well as human and urban populations (Thiyagarajan et al., 2012). Among animal species, fishes are apt to absorb these metals and their harmful influences and have high absorption levels of these metals because of long exposure to the contaminants (Olaifa et al., 2004).

Persian Gulf is a shallow-water basin with an average depth of 35-40 meters and an area about 232850 km^2. This area is connected to the international waters via Hormuz strait (Anon, 1995; Banat et al., 1998; Saeidi et al., 2008). The analysis of metal levels was better in living organism tissue and have more advantages than using water or sediment samples. Since some animals accumulate rare metals in high concentrations, they can provide us with strong information about the environment pollution (Laboy-Nieves and Conde, 2001). Among the aquatic animals, fish and birds have significant importance to monitor the environmental pollutions due to their place in upper levels of food chain and their food consumption (Khosravi et al., 2011). Therefore, studies done in the field of heavy metal contamination in aquatic ecosystems are very important from the human health and public sanitation viewpoints. On the other hand, in these studies, balance state preservation of the aquatic ecosystems is considered as a secondary objective. Brachirus orientalis is benthic and live in shallow territorial waters on muddy and sandy beds (Ield Bianche, 1985). Since commercial and valuable fish present in the Persian Gulf form a chief part of diet of people of south area of Iran, in this research measuring the lead, vanadium, nickel and selenium concentration in muscle tissues of *Brachirus orientalis* in the Persian Gulf waters (Bushehr and Asalouyeh seaports) and comparing it with the international standards have been carried out.

2. Material and Method

2.1. Study aerya

Bushehr is located in 28°55´19.84" N and 50°50´4.76" E of southwestern Iran and on the edge of the Persian Gulf. Asalouyeh is located in 28°28´24.48" N and 52°36´49.79" E on the edge of the Persian Gulf, 300 kms east of Bushehr and 570 kms west of Bandar Abbas and has a distance of 100 kms to the South Pars gas area located along the Persian Gulf (Fig. 1).

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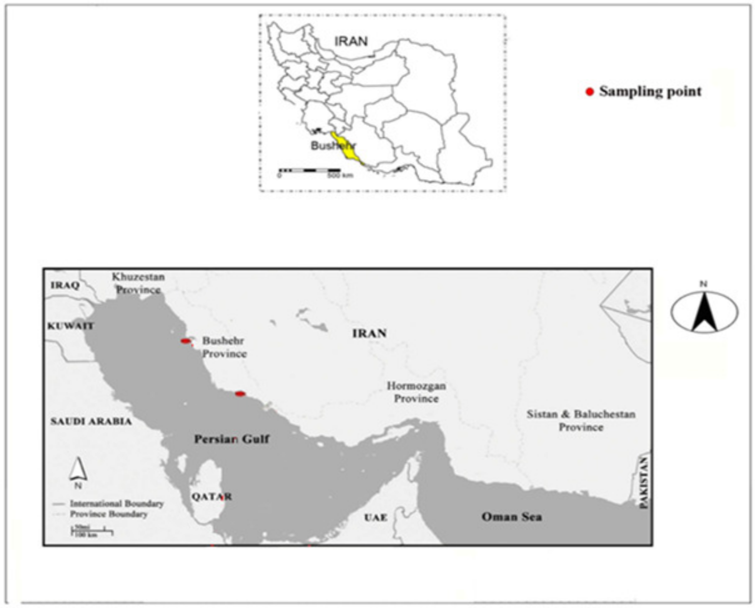

Fig. 1: Location of the sampling areas

2.2. Sampling

20 samples were caught by trawl net in regions, Bushehr and Asalouyeh seaport during summer season 2013 to do this research. Then, the samples were placed in a plastic bag and coded and were placed in an ice bucket full of ice in order to be transferred in the laboratory. The samples were transferred to Islamic Azad University Bushehr branch laboratory after fishing. The fish samples were kept at a temperature of -30° C by the analysis time in the laboratory.

2.3. Sample preparation

First all lab dishes which were going to be used were placed in HNO_3 for 24 hours and then they were washed by using distilled water and finally they were placed in an oven at a temperature of 80°C to prevent contamination. The samples were removed from the fridge. When they reached the environment temperature, biometry operation (total length, standard length, total weight) was done. All muscle samples were dried at 80° C for 12 hours. Homogenized samples (1 g) were weighted and then digested, using a microwave digester (Milestone ETHOS1 advanced microwave digestion system, Italy) with 10 mL HNO_3. After digestion, the residues were diluted to 50 mL with distilled water in volumetric flasks. All digested samples were analyzed for lead, vanadium, nickel and selenium using Furnaco auto sampler atomic absorption spectrometer (FS95) (MOOPAM, 1999).

2.4. Statistical analysis

One sample Kologorov-Smirnov test in SPSS®18 was used to check the validity of the data normalization. Then, one way sample T-test was used to check interactions between heavy metals and stations. Data have been presented in diagrams as Mean±SD with 95% of the confidence interval. Excel software was used to draw diagrams (Zar, 1999).

3. Results

3.1. Biometric results

Biometric results indicated that mean weight in Bushehr was 358.96 g and mean weight in Asalouyeh was 212.38 g. Biometric results are presented in Table 1.

Table 1: Biometric results of Oriental sole in Bushehr and Asalouyeh stations (N=20)

	Bushehr Station		Asalouyeh Station	
	Mean	SD	Mean	SD
Total weight	358.96	13.1	212.38	11.96
Total length	27.81	1.53	27.05	1.36
Standard length	24.57	1.28	22.79	0.96

3.2. Metal concentrations

According to the obtained statistical results mean and standard deviation (SD) with the confidence interval in 95% level of lead in Bushehr station was

1.459±0.747 $mgkg^{-1}$ dw and in Asalouyeh station was 3.166±2.447 $mgkg^{-1}$ dw. Based on T-test analysis, no significant differences were observed between lead levels in muscle tissues in both stations (P=0.055). According to the obtained statistical results mean and standard deviation (SD) with the confidence interval in 95% level of vanadium in Bushehr station was 0.246±0.006 $mgkg^{-1}$ dw and in Asalouyeh station was 0.288±0.087 $mgkg^{-1}$ dw. Based on T-test analysis, no significant differences were observed between vanadium levels in muscle tissues in both stations (P=0.181). According to the obtained statistical results mean and standard deviation (SD) with the confidence interval in 95% level of nickel in Bushehr station was 1.378±1.656 $mgkg^{-1}$ dw and in Asalouyeh station was 2.208±2.445 $mgkg^{-1}$ dw. Based on T-test analysis, no significant differences were observed between nickel levels in muscle tissues in both stations (P=0.395). According to the obtained statistical results mean and standard deviation (SD) with the confidence interval in 95% level of selenium in Bushehr station was 4.280±0.846 $mgkg^{-1}$ dw and in Asalouyeh station was 3.720±0.498 $mgkg^{-1}$ dw. Based on T-test analysis, significant differences were observed between selenium levels in muscle tissues in both stations (P=0.03).

Table 2: Heavy metal levels in muscle tissues of Oriental sole in Bushehr and Asalouyeh stations ($mgkg^{-1}$ dw)

Heavy Metals	Stations	
	Bushehr Mean±SD	Asalouyeh Mean±SD
Pb	1.459±0.747	3.166±2.447
V	0.246±0.006	0.288±0.087
Ni	1.378±1.656	2.208±2.445
Se	4.280±0.846	3.720±0.498

Based on the obtained concentrations and comparison done it as specified that based on WHO and FAO standards, the amount of lead, nickel and selenium in both stations was upper than the standard permissible levels and based on WHO standard, the amount of vanadium in both stations was lower than standard permissible levels (Table 3).

Table 3: Comparison of heavy metal concentrations in muscle tissues of Oriental sole with WHO and FAO standards ($mgkg^{-1}$ dw)

Standards	Pb	V	Ni	Se
WHO (FAO/WHO, 1976)	0.5	0.5	0.2	-
FAO (Burger and Gochfeld, 2005; Dural et al., 2006)	0.5	-	-	2
Oriental sole in Bushehr	1.459	0.246	1.378	4.28
Oriental sole in Asalouyeh	3.166	0.288	2.208	3.72

4. Discussion

An increase in the amount of the released pollutants in marine environment have been considered in a lot of studied during the last decade. One of the main issues attracting a large number of researchers' attention is heavy metal contaminations and their influences on the environment (Yilmaz et al., 2007; Henry et al., 2004). Toxic elements such as heavy metals are considered as the most important environmental contaminants (Turkmen and Ciminli, 2007). Age, length, weight, sex, ecological needs, feeding habits, heavy metal concentrations in water and sediments, exposure period of the fish to the aquatic environment, fishing season, and physical and chemical properties of the water (salinity, pH, hardness and temperature) are the effective factors in heavy metal concentrations in different organs of the fish (Ghanbari et al., 2014; Canli and Atli, 2003). From a fisheries viewpoint, *Brachirus orientalis* is among commercially valuable fishes and has an important role in human food programs (Dìaz and Munroe, 1998). *Brachirus orientalis* is benthic and live in shallow territorial waters on muddy and sandy beds. Benthic and sedentary species show various metal concentrations in their tissues. These differences are probably caused by different accumulation methods and food ration within them. Benthic species are exposed more to the sediments rich in metals, and interaction with benthic animals and indicate higher metal concentrations in their tissues (Huang, 2003). However, these findings can prove that mental concentrations are highly under the influence of habitat, feeding habits, mental accumulation capacity and kind of species (Agah et al., 2009; Bustamante et al., 2003). Bushehr seaport is one of the most important fishing and commercial seaports and the following are among its polluting factors: oil contaminations, direct discharge of coastal habitat drainage (waste waters), motor boats and fishing and cargo ship traffic fishing waste discharge into coast, the rest of the metal hull of the sunken ships, aquatic vehicle oil and fuel, direct discharge of water produced by ships and the abundant remaining waste related to fishing implements in water. Asalouyeh seaport, in addition to the presence of fishing pier has the largest world oil and gas installations (South Pars oil particular region) influencing the environment directly and indirectly. Abu Hilal and Ismail (2008) examined the rate of the heavy metals in 11 fish species in the North area of the Aucuba Gulf in the Red sea. They observed that the lead levels in muscle and liver was lowers than gill. Turkmen et al. (2008) calculated the rate of lead in the liver and muscle of the *Sciaena* umbra as 1.29±0.17 and 0.54±0.1, respectively. Orhan et al. (2010) in the study of heavy metal in the Sciaena umbra calculated the highest and the lowest levels of lead metal as 4.93±0.13 and 0.29±0.02 mgkg-1, respectively. Sepe et al. (2003) obtained the vanadium rate existing in species of anchovy, red mullet and mackerel of Adriatic Sea as follows 89.9, 79.1, and 43.5 mg/kg respectively. Lavilla et al. (2008) also during study on species of fish, seashell and crustaceans in Spain, obtained that the vanadium rate in these species is in 0.82 – 5.14 mg/g limits. Eslami et al. (2011) determined the concentrations of some heavy metals in muscle tissues of Rutilus frisii Kutum in Tajan River. The results indicated that the nickel metal levels in muscle tissues were equal to 2.650±0.094 μgg^{-1} which this metal along with lead which are among non-essential metals had higher levels in muscles in comparison to essential metals. Moreover, the existing nickel levels in muscle tissues were higher than the international standards. Skorupa (1998) carried out a study to examine the relationship between selenium in tropical and cold waters' fish. The results indicated that fish of tropical region waters have the minimum acute toxicity of selenium. Dietz et al. (2003) in their research concluded that inorganic selenium is turned into organic selenium through metabolism process and its organic forms usually have less toxicity. Hamilton (2004) in his studies stated that the selenium rate in liver is higher than the edible tissues in fish.

Therefore, Based on the high levels of lead, nickel and selenium metals in this study it can be concluded that the use of this species in these regions are rather dangerous and will naturally have bad effects on the consumers of these products.

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