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The measurement of heavy metal (lead) concentration in muscle tissues of *Brachirus orientalis* in Bushehr and Asalouyeh seaports, Persian Gulf, Iran

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Abstract

In order to examine and compare Lead metal accumulation levels in muscle tissues of *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 accumulation levels in tissues were measured by using a graphic furnace atomic absorption instrument. Based on the obtained results, mean Lead concentrations in muscle tissues were 1.459 ± 0.747 mgkg-1dw in Bushehr station and 3.166 ± 2.447 mgkg-1dw in Asalouyeh station, and no statistically significant differences were observed between the two stations (P=0.055). Based on the obtained concentrations and analysis done it was specified that according to WHO, FAO, ITS, and Turkish Guidelines standards, the amount of Lead metal in muscles of *Brachirus orientalis* was higher than the permissible standard levels in both study stations and it can be concluded that using this species in these regions are rather dangerous and it will naturally have bad effects on the consumers of these products and necessary care should be taken to use it in the food meals.

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Introduction

An increase in the amount of the released pollutants in marine environment has 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 (Henry *et al.,* 2004, Yilmaz *et al.,* 2007). Heavy metals are accumulated in tissues and organs of the fish after they entered the aquatic ecosystems and finally they enter the food chains and are considered as a potentially toxic factor for microorganisms (Chen & Chen., 1999). Heavy metals are entered the marine environments through various anthropogenic resources such as the petrochemical wastewater, mineral and agricultural runoffs, the oil transport and domestic wastewater (Karadede *et al.,* 2004). 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 (Canli & Atli., 2003). According to this fact, all essential and non-essential metals can be toxic. This amount of bioaccumulation is usually determined by measuring the accumulated metals by living organisms which are the main purpose in biological control (Zhou *et al.,* 2008; Rainbow., 1993). Heavy metals are not only a threat to the aquatic animals but also are considered a great risk to the consumers of marine foods contaminated with these metals (Abel., 1989). From a fisheries viewpoint, *Brachirus orientalis* is among commercially valuable fishes and has an important role in human food programs (De Astarloa & Munroe., 1998). The sea fishes' habitat and diet have changed them into the ideal indices for monitoring the aquatic ecosystem health (Harper *et al.,* 2007). The Persian Gulf is a shallow water basin in the south area of the Iranian plateau on the edge of the Indian ocean located in west-northern Oman sea. Its area is almost about 232850 km² and its average depth is 30 to 35 m (Al-Awadhi., 2000). The water exchange time in this basin is between 3 to 5 years indicating the pollutants remain in the Persian Gulf for a significant period (Sheppard *et al.,* 2010). The north parts of the Persian Gulf are much more influenced by the pollutants due to the shallowness, water limited rotation, great vaporization, salinity and high temperature (Pourang *et al.,* 2005). 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. Thus, the objective of this study is to measure the Lead levels in muscle tissues of *Brachirus orientalis* in the Persian Gulf waters (Bushehr and Asalouyeh seaports) and to compare them with the international standards.

Materials and methods

Study area

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.

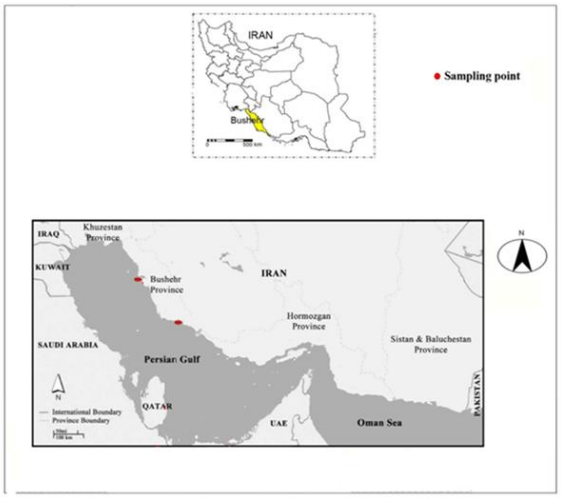

Fig. 1. Location of the sampling areas.

Sampling

20 samples were caught by trawl net in both 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.

Sample preparation

First all lab dishes which were going to be used were placed in nitric acid 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. Then the muscle tissues were separated and some sample muscles were transferred into the complete clean dishes (washed using nitric acid) and were placed in an oven at a temperature of 80° C for 18 hours to be dried completely . Dried samples were transferred into a mortar to be grinded completely. After grinding the samples they were placed in a desiccator to prevent them absorbing air moisture. Acid digestion is performed to release all metal connections with tissues. In this regard, 1 g dried and constant tissues were transferred into a beaker and 10 ml concentrated nitric acid were added to digest the dish contents and the samples were placed in the room temperature for 30 minutes until the primary digestion was done. Then the samples were heated in a heater located under the hood having a steam system in a temperature of 90° C to be dried. When the samples were cooled and reached the environment temperature, they were sieved from a 45 mm Whatman filter paper and were transferred to 25 ml dishes and were reached the necessary volume. Finally, the samples were transferred into lidded polyethylene dishes to be injected into the instrument (MOOPAM., 1999). A graphite furnace atomic absorption instrument was used to measure the lead metal levels.

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±SDs with 95% of the confidence interval. Excel software was used to draw diagrams (Zar., 1999).

Results

Biometric results

Biometric results indicated that mean weight in Bushehr was higher in comparison to Asalouyeh station. Mean weight in Bushehr was 358.96 g and mean weight in Asalouyeh was 212.38 g. Biometric results are presented in table 1 and table 2.

Table 1. Biometric results of *Brachirus orientalis* in Bushehr station (cm; N=10).

	Mean	SD	Min	Max
Total weight	358.96	259.8	129.7	931.5
Total length	27.81	5.48	21	39
Standard length	24.57	5	19.1	35

Table 2. Biometric results of *Brachirus orientalis* in Asaloyeh station (cm; N=10).

	Mean	SD	Min	Max
Total weight	212.38	31.99	165.2	255.4
Total length	27.05	1.36	25	29
Standard length	22.79	0.96	21.8	24.5

Table 3. Correalation between length and weight indices in *Brachirus orientalis* in Bushehr and Asalouyeh.

	R	R^2	Sig
Bushehr	0.982	0.964	0.000
Asalouyeh	0.937	0.877	0.000

Table 4. Comparison of Lead concentrations in muscle tissues of Brachirus orientalis with standards (mgkg1).

Standard	Lead
WHO (Biney and Ameyibor.,1992; Madany *et al.,* 1996)	0.5
FAO (Dural *et al.,* 2006)	0.5
ITS (Dural *et al.,* 2006)	0.5
Turkish Guidelines (Dermirak *et al.,* 2006)	1
Brachirus orientalis, Bushehr	1.459
Brachirus orientalis, Asalouyeh	3.166

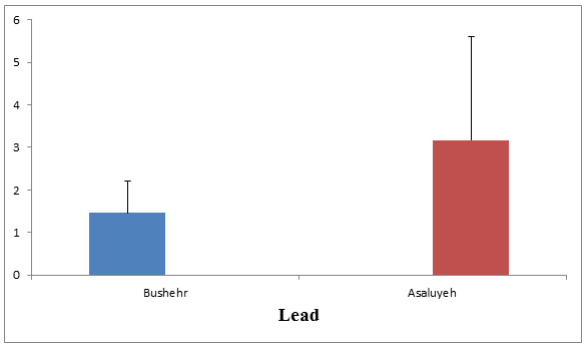

Fig. 2. Comparison of Lead levels in muscle tissues of Brachirus orientalis in Bushehr and Asalouyeh stations.

Lead concentration

The obtained results show that the lowest and the highest lead concentration levels in muscle tissues in Bushehr station was equal to 0.122 and 2.418 $mgkg^{-1}$ dw and in Asalouyeh was 1.1 and 7.75 $mgkg^{-1}$ dw, respectively. 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 nickel levels in muscle tissues in both stations (P=0.055). Figure 2 indicates lead levels in muscle tissues in both Bushehr and Asalouyeh stations.

Based on the obtained concentrations and comparison done it as specified that based on WHO, FAO, ITS, and Turkish Guidelines standards, the amount of lead in *Brachirus orientalis* tissues was higher than the standard permissible levels.

Discussion

Nowadays all animals' habitats are in humans' hands more than any other time. Human activities are the main factor of pollution in nature and different types of the environmental polluting resources are also created with the industry development and day by day they are increasing. Mining oil resources, oil tanker traffic, discharging industrial and domestic waste and drainage and agricultural drainage and production of petrochemical materials are among the destruction factors and consequently the destruction of aquatic environment. The presence of these pollutants cause different chemical combinations especially heavy metals to enter the aquatic ecosystem (Wicker & Gantt., 1994; Plaskett & Potter., 1979). *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 (Bustamante *et al.,* 2003; Agah *et al.,* 2009). 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 (wastewaters), 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. South Pars particular region is located near Asalouyeh city and pier. Due to the location of oil and gas fields in the sea, all this region installations are located along the coastal line and also several oil regions are located on the sea near it. Lead, from the dispersion viewpoint is the widest heavy and toxic element in the environment and is highly found in the aquatic environment and if it is absorbed through food, it is very toxic for the consumers. This element enters the environment as a result of utilizing mines, battery manufacturing industries, fossil fuels, paint manufacturing, glass industries, acid rains and vehicles (Marian, 1992). This metal is one of the four metals having the most effects on human health. Disorders in hemoglobin biosynthesis and anemia, blood pressure increase, injury to the kidney, abortion of fetus, disorders in nervous system, injury to the brain, men infertility, decrease in learning ability and behavior disorders in children are the negative results of lead increase in human body (Berlin., 1985). Moreover, disorders in Phytoplankton function as one of the important resources of oxygen production in the seas and consequently the disturbance of the world balance of the aquatic organisms are the most important undesirable results of the presence of lead in aquatic ecosystem (Dermirak *et al.,* 2006).

Farkas *et al.* (Farkas *et al.,* 2003) in their studies observed a significant interaction between the rate of lead concentrations with length and weight in the bream and Tiger tooth croaker fish. Turkmen *et al.* (Turkmen *et al.,* 2004) examined heavy metal concentrations on 3 economical fish species of the Mediterranean sea named *Saurida undosquamis, Sparus aurata, Mullus barbatus*. The results indicated that the lead metal limit was 0.09 to 6.95 mg/kg dw. In the study of Franca *et al.* (Franca *et al.,* 2005) the rate of lead in the fish *Solea senegulensis* was calculated as 2.9±0.7 µg/kg dw. In the study of Stavros *et al.* (Stavros *et al.,* 2007) the rate of lead in the skin of *Tursips truncates* of the south coasts of the Atlantic was calculated as 0.14±0.11µg/g ww. Abu Hilal & Ismail (Abu Hilal & 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.* (Turkmen *et al.,* 2008) calculated the rate of lead in the liver and muscle of the fish *Sciaena umbra* as 1.29±0.17 and 0.54±1, respectively. Orhan *et al.* (Orhan *et al.,* 2010) in the study of heavy metal in the fish *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. Monikh *et al.* (Monikh *et al.,* 2012) in their study examined heavy metal concentrations in benthic fish tissues *Euryglosa orientalis ,Cynoglossus arel* and benthopelagic fishes *Johnius belangerii* in three estuaries of the Persian Gulf. The results indicated that metal accumulation in tissues on the study species are as follows: liver>gill>muscle. In addition, high concentrations of the lead metal were observed in the species *Cynoglossus arel*.

The results of this study show that no significant differences were generally observed between the rate of lead metal in muscle tissues of *Brachirus orientalis* in both station (P=0.055). According to the obtained results, the lead concentration levels in muscle of *Brachirus orientalis* have been higher than the permissible levels of WHO, FAO, ITS, and Turkish Guidelines standards in both stations. Lead heavy metal which is considered as one of the pollutants of the aquatic ecosystems not only influences on aquatic animals and has negative effects on them but also influences on humans who are the consumers of these aquatic animals and cause some problem for humans. Therefore, Based on the high levels of lead metal 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 and necessary care should be taken to use it in the food basket.

Table 5. Comparison of Lead concentrations in the present study with the other researches (mgkg-1).

Refrence	Pb	Region	Species
Bu-Olayan., 1996	0.4	Persian Gulf, Kuwait shores	*Solea bleekeri*
Bu-Olayan., 1996	1.2	Persian Gulf, Kuwait shores	*Gastrophysus lunaris*
Bu-Olayan., 1996	0.8	Persian Gulf, Kuwait shores	*Acanthopagarus latus*
Bu-Olayan., 1996	0.2	Persian Gulf, Kuwait shores	*Mugil macrolepis*
Bu-Olayan., 1996	0.4	Persian Gulf, Kuwait shores	*Sillego sihana*
Pourang *et al*,2005	2.32	Northern Persian Gulf	*Epinephelus coioides*
Pourang *et al*,2005	1.9-2.8	Northern Persian Gulf	*Solea elongata*
Pourang *et al*,2005	0.8	Northern Persian Gulf	*Psettodes erumei*
Current study	1.459	Persian Gulf, Bushehr	*Brachirus orientalis*
Current study	3.166	Persian Gulf, Asalouyeh	*Brachirus orientalis*

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