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Effect of oil contamination on lead (Pb) concentration in muscle tissues of *Otolithes ruber* in Persian Gulf waters, Iran

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Abstract

In order to examine and compare Lead metal accumulation levels in muscle tissues of *Otolithes ruber,* 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 0.335 ± 0.165 $mgkg^{-1}dw$ in Bushehr station and 2.684 ± 0.488 $mgkg^{-1}dw$ in Asalouyeh station, and statistically significant differences were observed between the two stations (P=0.003). Based on the obtained concentrations and analysis done it was specified that according to WHO, FAO, ITS, and NHMRC standards, the amount of Lead metal in muscles of *Otolithes ruber* tissues in Bushehr station was lower than the standard limit, but in the Asalouyeh station was higher than the permissible limit standards. According to obtained results, it can be concluded that the use of this species in the fishing port Asalouyeh is dangerous to human health and for use in the food basket should be done taken care required.

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Introduction

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 (Henry *et al.,* 2004, Yilmaz *et al.,* 2007). Heavy metals are constant pollutants which their constant consequences are biomagnifications in food chain in such a way that as a result of this process, their amount in food chain can increase several times as much their amount found in water or air. As a result of the transference of these pollutants to aquatic environments, the probability is that the fish absorbs an amount of some metals through food chain or water from environment (Chale, 2002). 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 and Atli, 2003). 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). From the fisheries viewpoint, *Otolithes ruber* is among migratory and commercially valuable fishes and has an important role in human food program (Ield Bianchi, 1985). The Persian Gulf is the progress of the Indian Ocean waters in the south area of Iran on the edge of the Indian Ocean located in west-northern Oman Sea. The Persian Gulf is a shallow water basin with the average depth 35-40 meters and the area about 240 km^2. This region is connected to the international waters via Hormoz strait (Anon, 1995; Banat *et al.,* 1998). This sea is considered as an important resources for accessing to the great food resources that is invaded by the various pollutants in recent years. According to the studies, the water rotation and exchange time of this sea is estimated about 3 to 5 years probably indicating the pollutants remain in the Persian Gulf for a significant period. It's clear that the effect of pollutants on aquatic environment should be more significant due to semi-closed, shallowness, water limited rotation, salinity and high temperature which are the characteristics of the north part of the Persian Gulf (Pourang *et al.,* 2005).

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). Therefore, studies done in the field of heavy metal contamination in aquatic ecosystems are very important from the human health and public sanitation viewpoints. Thus, the objective of this study is to measure the lead levels in muscle tissues of *Otolithes ruber* 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).

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.

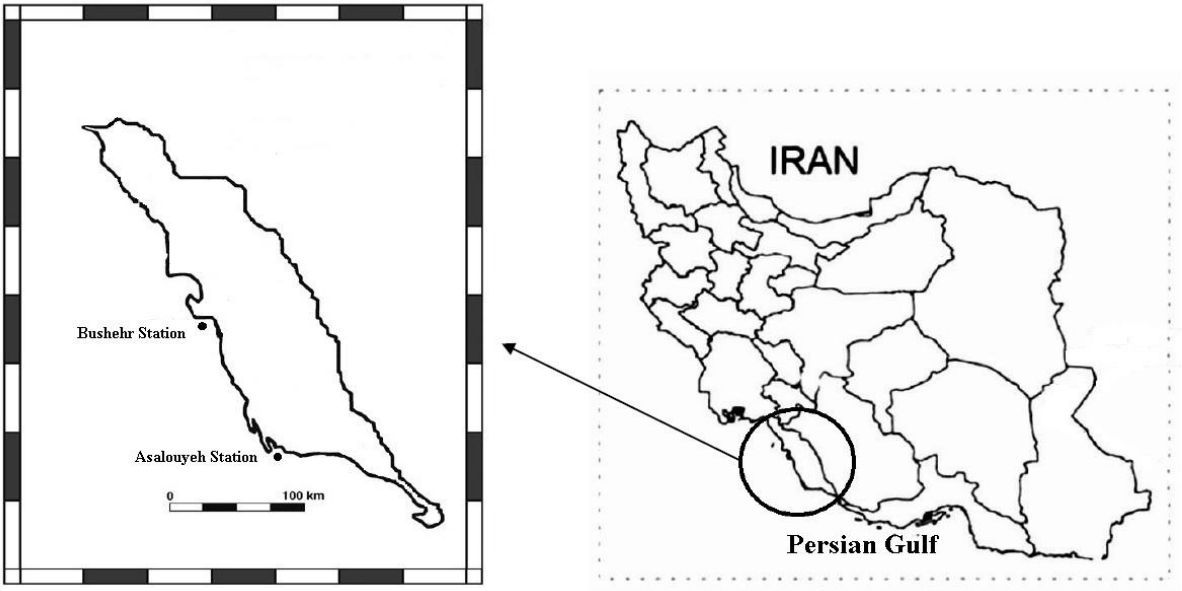

Fig. 1. Location of the sampling areas.

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 h. Homogenized samples (1 g) were weighted and then digested, using a microwave digester (Milestone ETHOS1 advanced microwave digestion system, Italy) with 1 mL H2O2 (30 %) and 7 mL HNO3 (65 %). After digestion, the residues were diluted to 50 mL with distilled water in volumetric flasks. All digested samples were analyzed for Pb using Furnaco auto sampler atomic absorption spectrometer (FS95) (MOOPAM, 1999).

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 376.82 g and mean weight in Asalouyeh was 369.4 g. Biometric results are presented in Table 1.

Table 1. Biometric results of *Otolithes ruber* in Bushehr and Asalouyeh stations (N=10).

	Bushehr Station		Asalouyeh Station	
	Mean	SD	Mean	SD
Total weight	376.82	14.9	369.4	4.96
Total length	34.25	1.46	33.7	0.33
Standard length	30.14	1.55	29	0.67

Lead concentration

The obtained results show that the lowest and the highest lead concentration levels in muscle tissues in Bushehr station was equal to 0.242 and 0.775 $mgkg^{-1}$ dw and in Asalouyeh was 0.25 and 5.25 $mgkg^{-1}$ 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 0.335±0.165 mgkg^{-1} dw and in Asalouyeh station was 2.684±0.488 mgkg^{-1} dw. Based on T-test analysis, significant differences were observed between Lead levels in muscle tissues in both stations (P=0.003). Fig. 2 indicates lead levels in muscle tissues in both Bushehr and Asalouyeh stations.

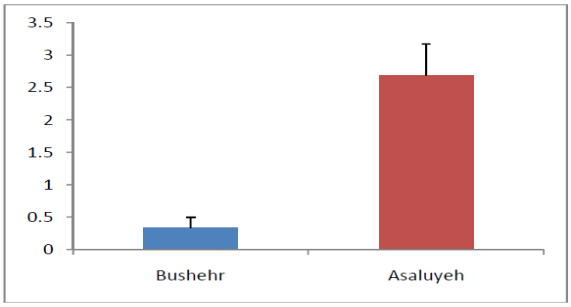

Fig. 2. Comparison of Pb levels in muscle tissues of *Otolithes ruber* in Bushehr and Asalouyeh stations.

Based on the obtained concentrations and comparison done it as specified that based on WHO, FAO, ITS, and NHMRC standards, the amount of lead in *Otolithes ruber* tissues in Bushehr was lower than the standard limit, but in the Asalouyeh station was higher than the permissible limit standards (Table 2).

Table 2. Comparison of Pb concentrations in muscle tissues of *Otolithes ruber* with standards (mgkg^{1}).

Standard	Pb
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
NHMRC (Maher,1986; Darmono and Denton,1990)	1.5
Otolithes ruber, Bushehr	0.335
Otolithes ruber, Asalouyeh	2.684

Table 3. Comparison of Pb concentrations in the present study with the other researches (mgkg^{-1}).

Reference	Pb	Region	Species
Bu-Olayan and Subrahmanyam, 1996	0.4	Persian Gulf, Kuwait shores	*Solea bleekeri*
Bu-Olayan and Subrahmanyam, 1996	1.2	Persian Gulf, Kuwait shores	*Gastrophysus lunaris*
Bu-Olayan and Subrahmanyam, 1996	0.8	Persian Gulf, Kuwait shores	*Acanthopagarus latus*
Bu-Olayan and Subrahmanyam, 1996	0.2	Persian Gulf, Kuwait shores	*Mugil macrolepis*
Bu-Olayan and Subrahmanyam, 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*
Madany *et al.,* 1996	1.04	Persian Gulf, Bahrain shores	*Lutjanus sp.*
Filazi *et al.,* 2003	0.5- 1.1	Black sea, turkey	*Mugil auratus*
Dalman *et al.,* 2006	0.4	Northeastern Aegean, turkey	*Dicentrarchus labrax*
Alkan *et al.,* 2012	0.25	South West Black sea	*Merlangius merlangus euxinus*
Ghanbari *et al.,* 2014	1.459	Persian Gulf, Bushehr	*Brachirus orientalis*
Ghanbari *et al.,* 2014	3.166	Persian Gulf, Asalouyeh	*Brachirus orientalis*
Current study	0.335	Persian Gulf, Bushehr	*Otolithes ruber*
Current study	2.684	Persian Gulf, Asalouyeh	*Otolithes ruber*

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 and Gantt, 1994; Plaskett and Potter, 1979). *Otolithes ruber* is one of the migratory and coastal fish. This species is found in coastal waters highly in regions with muddy bed. The species is benthopleagic to the effect that they live both in bed and water surface. *Otolithes ruber* feeds on smaller fish, crustaceans like shrimps and the other invertebrates (Ield Bianchi, 1985). Heavy metal accumulation in Benthopelagic species in comparison with benthic species probably has a relation with the fish diet (Boustamant *et al.,* 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). In this study, the muscle was chosen as the purpose organ since it has an important role in human feeding and the necessity of the assurance to its health for consumption has a particular importance. 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. Lead, from the dispersion viewpoint is the widest heavy and toxic element in the environment is highly found in the aquatic environment. This element sexists as more constant lead oxide (PbO) and lead dioxide (PbO_2) and the other combinations and is found in fuel products such as gasoline, insecticides and chemical industries. Lead is one of the elements which is measured in evaluation of the environment pollution and has the most harm to the human health (Huss, 1988). 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.* (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.* (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.* (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.* (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 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 fish *Sciaena umbra* as 1.29±0.17 and 0.54±1, respectively. 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.* (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 indicate that the significant differences were generally observed between the rate of lead metal in muscle tissues of *Otolithes ruber* in both stations (P=0.003). According to the obtained results the lead concentration levels in muscle of *Oolithes ruber* in Asaloyeh seaport are higher than the permissible levels of WHO, FAO, ITS and NHMRC standards. The lead metal is one of the most toxic metals and has no bio-function in living organisms including fish and human being. Thus, with respect to the high levels of this metal in Asalouyeh seaport, using the studied species for human consumption is dangerous.

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