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Measuring the concentration of lead in muscle and liver tissues of *Pomadasys kaakan* in Bushehr port, Iran

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Abstract. To evaluate the amount of lead (Pb) concentration in muscle and liver tissues of *Pomadasys kaakan*, sampling from desired fish was conducted in summer and autumn seasons of 2014 in the coastal area of Bushehr port, Iran. After biometrics, the liver and muscle tissues were separated and chemical digestion of samples were done and then, by using Plarograph tool, the concentration amount of lead was measured in the body. Based on the obtained results, the average concentration of lead in muscles tissues was about 6.01 ± 0.710 mg kg^{-1} dry weight and in liver tissue, it was about 6.12 ± 0.902 mg kg^{-1} dry weight. In this study, the amount of lead concentration did not have a significant difference between liver and muscle tissues ($p > 0.05$). Investigating the obtained concentration showed that based on WHO, FAO, ITS standards and Turkish guidelines, the amount of lead in the tissues of liver and muscles of the *P. kaakan* was higher than the limit of these standards in desired region.
Key Words: heavy metals, environment, organisms, *Pomadasys kaakan*, Bushehr.

Introduction. Heavy metals are major pollutants and they enter the water environment as a natural form and also due to some human activities such as oil pollution, sewage and industrial plants and they draw the environment into abyss (Amini Ranjbar & Sotoodenia 2005). After entering the aquatic ecosystems, heavy metals accumulate in tissues and organs of fish, thus entering the food chain (Chen & Chen 1999). The habitat and diet of salt water fish convert them as ideal indicators for monitoring the health of aquatic ecosystems (Harper et al 2007). The amount of absorption and accumulation of heavy metals in aquatic organisms, especially fishes varies with ecological, physical, biological, and chemical characteristics of the organism, and also with the type of element, aquatic organism's physiology in the body of live organisms. Heavy metals are not only considered as a threat for aquatic organisms, but also they pose a greater risk for human consumers of seafood (Abel 1989).

Pomadasys kaakan is a benthic fish species and from a fishery point of view, it is considered an important commercial fish and it has an important role in the human diet. This species feed on crabs, polychaete worms, crustaceans from amphipods and mantis shrimp (Dìaz & Munroe 1998). *P. kaakan* lives in sandy or muddy areas in shallow coastal waters (Masuda & Allen 1993). Juveniles enter the estuaries and mangroves from the sea and spend their life cycle in brackish water (Jeyaseelan 1998). Persian Gulf is a shallow water area in the southern of the Iranian plateau of the Indian Ocean which is located in the northwestern Gulf of Oman. This area is approximately about 232850 square kilometers and its average depth is about 30 to 35 meters (Al-Awadhi 2002). Water exchange time is between three to five years in this basin that show the pollutants remain in the Persian Gulf for a significant period. The north parts of the Persian Gulf are much more influenced by pollutants due to the shallow ness, limited rotation, salinity and high temperature (Sheppard et al 2010; Saeed et al 1995). Generally it was specified that about 30 percent of the total world oil transference is done in Persian Gulf (Pourang et al 2005). The object of this research is to study the amount of lead in the muscle and

liver tissues of *P. kaakan* in the waters of Persian Gulf (coastal of Bushehr port) and comparing it with international standards.

Material and Method

The study area. Bushehr is located between 26°14'' to 30°16'' north latitude and 50°6'' to 52°58'' east longitude and it is located in the southwestern of Iran and margin of Persain Gulf. Bushehr has extraordinary importance in the field of oil, gas and petrochemical industries in the country and even in the world (Figure 1) (Obeidi 2014).

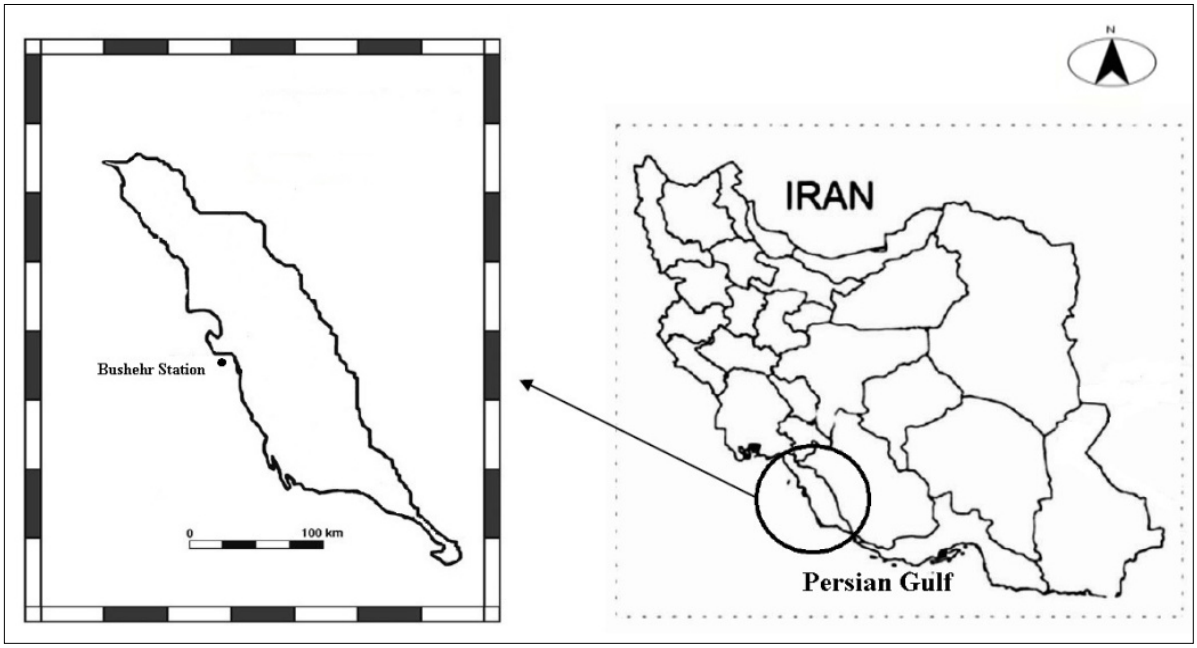

Figure 1. Location of the sampling areas (original drawing).

Sampling. In the summer and autumn of 2014, 20 *P. kaakan* were caught by using nets and hooks from the coast of Bushehr port. 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 and they were maintained before analysis at -30°C.

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 80ºC to prevent contamination. The samples were removed from the fridge. When they reached the environment temperature, biometry operation (total length, total weight) was done. All muscle and liver samples were dried at 80°C for 18 h. Homogenized samples (1 g) were weighted and then digested, using a heater with 10 mL HNO_3. After digestion, the residues were diluted to 25 mL with distilled water in volumetric flasks. All digested samples were analyzed for lead using Furnace auto sampler atomic absorption spectrometer (FS95) (MOOPAM 1999).

Statistical analysis of data. All statistical analyzes were performed by SPSS19 and Excel 2013 programms. And by using one sample Kolmogorov-Smirnov test, the normality of data were confirmed. The average of data were compared by using T-test and the presence or absence of significant difference were determined in 95% ($p = 0.05$). The correlation between length and weight biological changes associated with the concentration of lead were investigated in studied species by Pearson correlation (Zar 1999).

Results and Discussion. The results of bioassay of *P. kaakan* in the Bushehr port showed that in Bushehr city, the weighted average was about 670.2 g and the average of fish length were 34.2 cm. The bioassay results are shown in Table 1. The correlation between length and weight data of *P. kaakan* are also given in Table 2.

Table 1

Biometric results of *Pomadasys kaakan* in Bushehr port (N = 20)

	Mean	*SD*	*Min*	*Max*
Total weight (g)	370.2	254.1	367	1114
Total length (cm)	34.2	4.6	28	42

Table 2

The correlation of length and weight of *Pomadasys kaakan* in Bushehr port

Species	*R*	R^2	*Sig*
Pomadasys kaakan	0.989	0.977	0.000

The obtained results showed that the lowest and highest concentration of lead in the muscle tissue of *P. kaakan* is about 4.632 and 7.357 mg kg^{-1} of dry weight and in liver tissue, it was about 4.263 and 7.983 mg kg^{-1} dry weight. Based on obtained statistical results, mean and standard deviation with 95% confidence level for lead in muscle tissue were 6.01 ± 0.710 mg kg^{-1} dry weight and in liver tissue, it was about 6.12 ± 0.902 mg kg^{-1}. Based on T-test, there was no significant difference between the amount of lead in muscle and liver tissue of *P. kaakan* (p = 0.658). Figure 2 shows the amount of lead in the muscle and liver tissues of *P. kaakan* in the of Bushehr port.

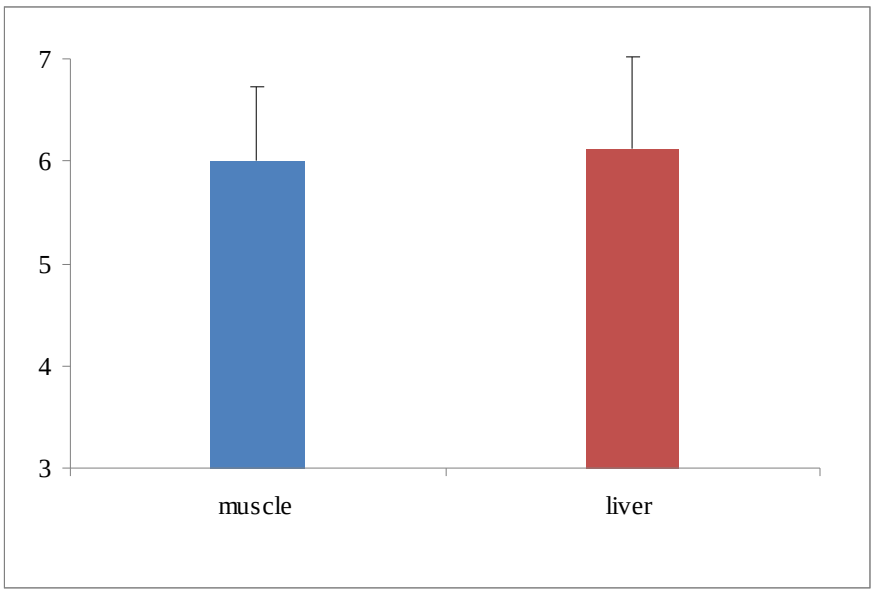

Figure 2. Comparison of lead in muscle and liver tissue of *P. kaakan* in Bushehr port (mg kg^{-1} dry weight).

Based on obtained concentration and conducted comparisons, it was determined that the amount of lead in the muscle and liver tissues of *P. kaakan* is higher than the standards limit of WHO, FAO, ITS and Turkish Guidelines in the studied area.

Table 3

Comparison of the concentration of lead in liver and muscle tissues of *P. kaakan* with standards (mg kg^{-1} dry weight)

Standard	*Lead concentration*
WHO (Biney & Ameyibor 1992; Madany et al 1996)	0.5
FAO (Dural et al 2006)	2
ITS (Dural et al 2006)	0.5
Turkish Guidelines (Dalman et al 2006)	1
Pomadasys kaakan (muscle, present study)	6.01
Pomadasys kaakan (liver, present study)	6.12

Nowadays, marine products have a significant role in providing the food of world's people and by determining the desirability and superiority of these products than other food products, their consumption will increase day by day. Fish has contains proteins, minerals and Omega 3 and also has many positive effects in physical and mental health (Rashed 2001). So, investigating their health status is of particular importance and so, the fishes are suitable biological indicators to measure the pollutions especially the pollutions caused by heavy metals in water resources (Rashed 2001). Accumulation of heavy metals in fishes causes symptoms that are associated with loss of ability to reproduce, skeletal deformation, changes in blood factors, increased susceptibility to infection and finally death which may be due to damage to the immune system of fish (Roberts 2001). *P. kaakan* is a benthic fish and lives in non-transparent waters adjacent to sandy or moody beach with variations in environmental salinity. Benthic species are more exposed to the sediments rich in metals (Huang 2003). Such results can confirm that metal's concentrations are strongly influenced by the environment, nutrition, accumulation of metals and species type (Bustamante et al 2003; Agah et al 2009). Bushehr port is one of the most important fishing and commercial ports of Bushehr and among pollutants factors, we can infer to oil pollutants, motor yachts and fishing and cargo boats and fish dumping in coasts and fuel of water chorus vehicles. Lead causes toxicity in fishes and through the blood circulation, it passes to the fish's tissues. The most harmful effects of presence of lead in the water ecosystems causes disturbance on phytoplankton performance which is considered as one of the important sources of oxygen production in seas (Jones 1999). Lead is one of the four metals that have the greatest effects on human health. Disorder in biosynthesis of hemoglobin and anemia, high blood pressure, miscarriages, neurological disorders, brain damage, infertility among men, reducing the learning power and behavioral disorders on children and kidney damage occurs with exposure on high levels of lead; lead accumulates in liver and muscles and then extends to the bones, teeth and brain (Berlin 1985). Canli & Atli (2003) showed in their investigation that there is no relation between the size of *Mugil cephalus* and lead concentration in muscle tissue. Turkman et al (2008) found the amount of lead in *Sciaena umbra* in liver and muscle was about 1.9 ± 0.17 and 1.00 ± 0.54, respectively. Abdolahpur Monikh et al (2012) investigated the accumulation of heavy metals in benthic fish *Euryglossa orientalis*, and *Cynoglossus arel* tissues and bentopelagic fish *Johnius belangerii* in three estuaries of Persian Gulf. The results showed that fishes of Khor Moses have the highest concentration in liver and muscle of Arvand and Salich khor comparing with same species in other regions. So, the accumulation of heavy metals among studied species is as follows: liver > gill > muscle. Also, a high concentration of lead was observed in *C. arel* and *J. belangerii*. Imanpour et al (2011) found a significant negative correlation between lead concentration and the body weight of *Esox lucius*. Correlation between concentration of a metal with a dilution effect of the fat tissues and physical factors was negative. This hypothesis is also confirmed with a low percentage of fat tissues of juvenile fish (Shulman 1974; Weatherley & Gill 1987).

Table 4

Comparing the concentration of lead in the present study with other conducted studies (mg kg^{-1} dry weight)

Reference	*Lead*	*Region*	*Species*
Nussey et al (2000)	8.102	Viet Bank Dam, south Africa	*Labeo umbratus*
Canli & Atli (2003)	5.32	North Mediterranean	*Mugil cephalus*
Pourang et al (2005)	2.32	North of Persian Gulf	*Epinephelus coioides*
Pourang et al (2005)	1.9-2.8	North of Persian Gulf	*Solea elongata*
Pourang et al (2005)	0.87-8	North of Persian Gulf	*Psettodes erumei*
Alkan et al (2012)	0.20-0.01	South West Black Sea	*Mullus barbatus ponticus*
Alkan et al (2012)	0.25-0.01	South West Black Sea	*Merlangius merlangus euxinus*
present study	6.01	Persian Gulf, Bushehr	*P. kaakan (muscle)*
present study	6.12	Persian Gulf, Bushehr	*P. kaakan (liver)*

Conclusions. Lead usually enters the environment through the natural resources as well as fossil fuels and remains in water, soil, and air for a long time. Another characteristic of this element is that it is combined with other elements and materials in water and sticks to oil sediments. The results of this research show that in general there is no significant relation between lead in muscle and liver tissue of *P. kaakan* ($p = 0.658$). Also the amount of lead in muscle and liver tissue of *P. kaakan* is more than WHO, FAO, ITS standard and Turkish Guidelines in the studied area.

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