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STUDIES ON RELATIONSHIP BETWEEN BODY LENGTH, WEIGHT AND ELEMENTS CONTENTS IN FISH *CHIROCENTRUS NUDUS* SWAINSON (1839) IN IRAN

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ABSTRACT

Determination of toxic elements in seafood was important for the health of humans and marine organisms. This study was carried out on effects of total length and weight on concentration of toxic and non-toxic elements in fish of *Chirocentrus nudus* of Persian Gulf, Iran. For this purpose, 20 pieces of fish in two different fish sizes were purchased from Behbahan fish market and transferred to laboratory of Khatam-al-Anbia University of Technology, Behbahan, Iran. The fish muscle after the preparation, which contains washing, biometrics and abdominal discharges, was separated. Finally, the samples elements were analyzed after extraction and digestion processes using an atomic absorption apparatus. The obtained results were compared with the World Food Standards. The concentration of elements in different amounts in fish Kharo were as follows: Fe >Zn >Pb >Cd >Ni. Results showed that with increase fish length and weight, the amount of toxic and non-toxic elements such as Ni, Pb, Fe and Zn, except Cd, were increased significantly. It can be concluded that, although the concentration of elements found in the fish in both sizes were lower than the standard levels proposed for humans, but excessive consumption fish caught from contaminated areas, can be dangerous for human health.

Keywords: *Chirocentrus nudus*; elements; fish muscle; fish length and weight

INTRODUCTION

Fish is a suitable indicator for measuring the concentration of toxic elements in water systems, which are different in size and age. **(Burger et al., 2002; Lukáčová et.al., 2014)**. At the same time, fish in many parts of the world are consumed by humans as food, and fish can damage human health. The importance of measuring toxic elements in fish and seafood is related to food management and human health **(Romeoa et al., 1999; Jordao et al., 2002)**. Since marine food resources are one of the most important ways of transmitting toxic elements to humans, assessing and controlling the amount of different marine food contamination and identifying contaminating sources, modifying or eliminating, has a significant impact on human health and life. The effect of these elements on humans and marine foods depends on the type of element and its concentration. The biological effects of lead in fish include reduced fetal growth, preventing reproduction and preventing growth, increasing levels of gas, vascular problems, and inappropriate kidneys. Also, lead in the human body is transmitted through the blood to various organs of the body, and in particular, it binds to the bones and causes calcium intake and calcium deficiency in humans. This element, especially in children, causes brain damage and depression in the nervous system **(Jalali and Meshgi, 2007)**. Several studies have been conducted to compare the length, age, and weight of fish with toxic minerals, with different results **(Katsuhisa et al., 2014; Yi and Zhang, 2012)**. This shows that the exposure time of this element is an important factor for its condensation in tissue fish. The concentration of different toxic elements in fish species is different, but in this study, muscle of fish was important because of the important role in human nutrition and the need to ensure its health. Studied sample was *Chirocentrus nudus*. Its weight varies from 250 g to 5 kg. The maximum length of this fish was 1 m and its standard sizes were 45 cm. Although the fish from point of quality in the Persian Gulf was low-level fish, but it was including delicious fishes obtained from in Persian Gulf. Due to the high marketability of this fish, we reviewed on the concentration of toxic elements found in the Kharu fish to determine the health status of the fish in different sizes and valuable information for the fish consumption provided in

Figure 1 White fin Kharo fish.

different sizes.

Studies have been conducted to investigate the concentration of toxic elements in fishes of Iran Persian Gulf **(Shahriari, 2005; Hashim et al., 1996; Agha et al., 2010)**. However, few studies have been conducted in terms of these elements in different sizes of the fishes.

Barletta et al. (2012) Showed that the condensation of toxic elements to critical parts of the fish like the muscle depends on the environmental variables. Muscle and liver in fish, has been widely studied for toxic elements. **Al-weher (2008)**, studied on the levels of toxic elements Cu, Cd, and Zn in three fish species found in the North Sea of Jordan. Also, **Pourang et al. (2005)** showed the concentration of toxic elements in the tissues of five species Sturgeon in Southern Black Sea (Caspian Sea). **Agusa et al. (2004)**, studied on the elements in the muscle tissue of the five species of Javier fish in the different countries of the Caspian Sea. **Zhelyazkov et al. (2014)** examined the presence of some toxic elements in the *Alburnus alburnus* and *Rutilus rutilus* in the Zarishchev Lake in Bulgaria. **Fuentes-Gandara et al. (2016)** examined the biological resources of Hg, Cd, Zn, Cr and Pb in the muscle, liver and trap tissues. **Zheng et al. (2008)**, studied on toxic concentration of muscle in 19 species of Yangtze River fish. The results showed high levels of toxic elements except Zn in intestine compared with fish muscle.

Scientific hypothesis

Aim of this study was to determination of elements of cadmium (Cd), nickel (Ni), lead (Pb), iron (Fe) and zinc (Zn) in fish kharkh tissue in two different sizes and compare it with world standards and investigation on effect of the fish length of the weight on the concentration of toxic elements found in the fish tissue. The fish's length and weight do not have much effect on the toxic elements stored in the fish, unless the environment of the fish is contaminated.

MATERIAL AND METHODOLOGY

Sampling station

This research was carried out in the harbor of Bushehr port, Southern Iran. This port is one of the most important fishing and fishing areas in the Persian Gulf, Iran and there are many fish in various harbors, the most important of which are shardai, poetry, white halvah, Shank, Sangasar etc.

Preparation of samples

Twenty fishes of Khuro were bought in two different sizes from the Behbahan city market in the spring 2018 and they were clean completely were placed in plastic packages. After transferring samples to Fisheries Laboratory of Natural Resources Faculty of Khatam-al-Anbia University of Technology in Behbahan, total length and weight all samples were recorded. Then, the samples were rinsed with distilled water to exit the viscous layer and foreign particles of toxic elements absorbent from the body surface. First, all the laboratory dishes were washed with detergent and then the dishes were put for 24 h in nitric acid so that completely cleaned. Finally, it was washed with distilled water and then dried. The head, tail and internal organs of the body first separated the fish by knife, and then the muscle tissue was separated and transferred to the pre-cleaned containers.

Fish Biometric

Before the preparation of the samples for measuring the concentration of toxic elements in the fillet, the fish total length and weight of the samples were calculated as shown in the below Table 1.

Table 1 Average total length and weight of fish *Churocentrus nudus.*

Samples	Weight (g)	Total length (cm)
Big kharo fish	973.33 ±30.55	63.66 ±0.57
Small kharo fish	746.66 ±15.27	56 ±1.00

Measuring the elements

The samples were placed in an oven for 18 h at a temperature of 80 °C and, after leaving the oven it was completely powdered in a Chinese dish **(**Model Apha, Awwa, Wef, 1992). The dry method was used for digestion of the samples. First, 1 g of the prepared sample transferred to dish and 10 mL of concentrated nitric acid was added to digest the contents of the dishes, and the samples were placed at room temperature for 30 min to initially digest. The samples were then heated to a temperature of 90 °C in under a hood with a steam system to dry. After cooling and reaching the ambient temperature, the sample was transferred from a 45 mm Watten filter paper and transferred to a Balloon Jogege 25 mL and reached to a volume of 25 mL. Finally, the samples were transferred into the polyethylene containers for injection into the apparatus **(**Model, Moopam, 1999). For measuring the elements contents in all samples, atomic absorption apparatus was used. Apparatus: ICP - OES: Simultaneous ICP - OES(Varian 735 - ES) equipped with charge coupled device (CCD) detector and SPS3 Autosampler (Varian) has been used for the determination of elements. Instrumental and operating conditions for ICE - AES measurements. Power (K W), Plasma flow rate ($L.Min^{-1}$), Auxiliary flow rate ($L.Min^{-1}$), Nebulizer flow rate ($L.Min^{-1}$), Viewing configuration, Viewing height (mm), Replicate read time (s). Apparatus: ICP- OES: Simultaneous ICP- OES(Varian 735- ES) equipped with charge coupled device (CCD) detector and SPS3 Autosampler (Varian) has been used for the determination of elements. Instrumental and operating conditions for ICE- AES measurements. Power (K W), Plasma flow rate ($L.Min^{-1}$), Auxiliary flow rate ($L.Min^{-1}$), Nebulizer flow rate ($L.Min^{-1}$), Viewing configuration, Viewing height (mm), Replicate read time (s).

Statisic analysis

The obtained data in this study was analyzed for significant differences with the help of analysis of variance (ANOVA) conducted using SPSS 16.0 software (IBM Corporation).

RESULTS AND DISCUSSION

Table 2, the amounts of toxic and non-toxic elements in *Chirocentrus nudus* were shown in two small and medium sizes. The results of this experiment showed that the amounts of toxic elements of cadmium, nickel, lead, iron and zinc in different tissues were different. In fact, exept cadmium, with increase the size of fish, other elements also showed a significant increase. The concentration of iron in the tissue of the fish was higher than other toxic elements. Non-similar letters in each column showed a significant difference $p > 0.05$.

According to the Figure 2, the toxic metal content of cadmium in the tissue of Khoro, with small size was 1.87 ±0.01 ppb, and in fish greater was 1.60 ±0.06 ppb was reported, that showed significant different between the two experimental groups. In fact, with the increase in the size of the fish, the amount of of cadmium in the tissue of the fish kharo has decreased.

Table 2 The elements contents found in *Chirocentrus nudus* muscle in different sizes.

Samples	Cd (ppb)	Ni (ppb)	Pb (ppb)	Fe (ppm)	Zn (ppm)
Big kharo fish	1.60 ±0.06[a]	1.78 ±0.03[a]	3.82 ±0.08[a]	61.55 ±2.03[a]	2.05 ±0.05[a]
Small kharo fish	1.87 ±0.01[b]	1.47 ±0.11[b]	2.33 ±0.12[b]	46.10 ±0.40[b]	1.46 ±0.01[b]

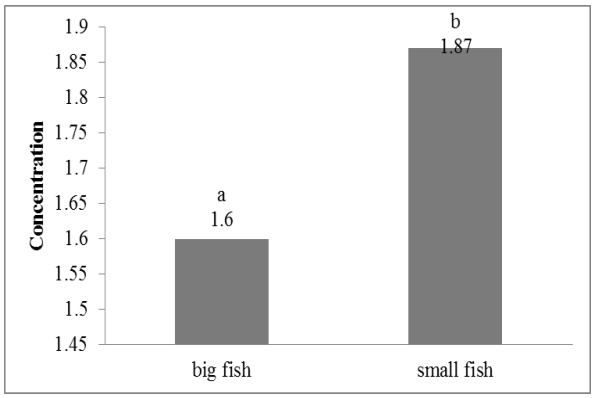

Figure 2 The Average of concentration of Cd in the fish muscle *Chirocentrus nudus* in two different sizes.

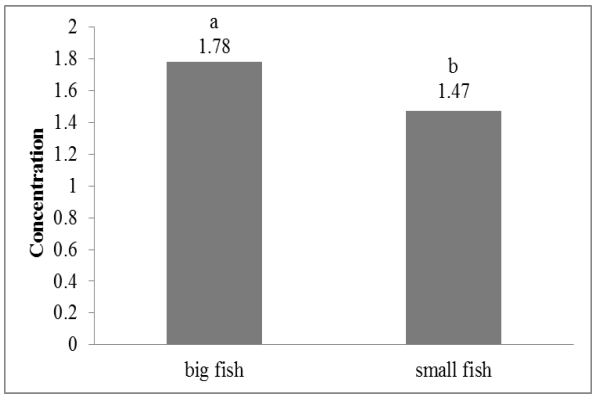

Figure 3 The Average of concentration of Ni in the fish muscle *Chirocentrus nudus* in two different sizes.

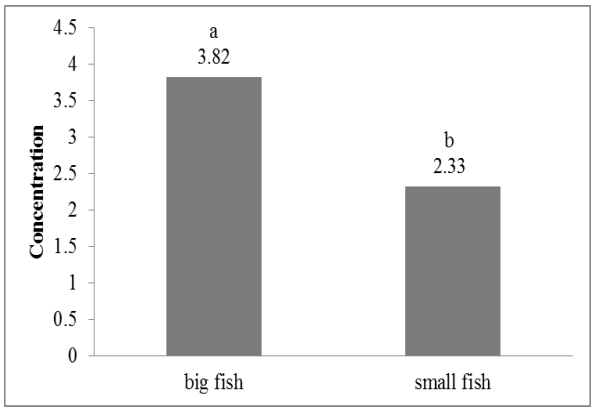

Figure 4 The Average of concentration of Pb in the fish muscle *Chirocentrus nudus* in two different sizes.

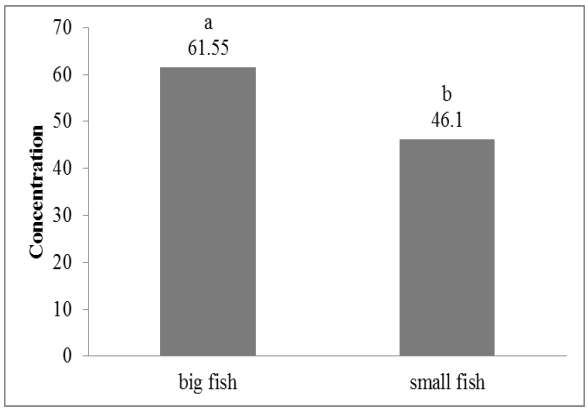

Figure 5 The Average of concentration of Fe in the fish muscle *Chirocentrus nudus* in two different sizes.

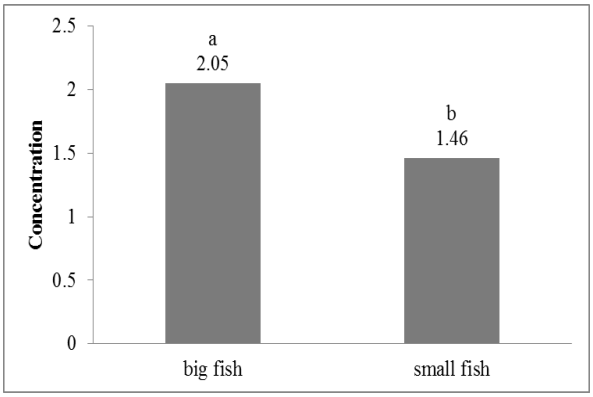

Figure 6 The Average of concentration of Zn in the fish muscle *Chirocentrus nudus* in two different sizes.

The Figure 3 results of this experiment showed that there is a significant difference in the amount of nickel in the tissue of fish Kharo in the two experimental groups, so that its value in fish larger found 1.78 ±0.03 ppb and in fish smaller was 1.47 ±0.11 ppb reported.

Lead was measured another metal in this study, which was 3.82 ±0.88 ppb in fish big and 2.33 ±0.12 ppb in small fish. There was a significant difference between the two groups, which results shown in Figure 4.

As shown in Figure 5, the amount of iron found in the fish big was higher than that of the smaller fish and found a significant difference. The amount of iron found in fish big found 61.55 ±2.03 ppm and 46.10 ±0.40 ppm in the fish smaller was recorded.

This study showed that the toxic metal content of zinc in the large fish filet was higher than the fish smaller, with a significant difference. The average concentrations of zinc for large fish were reported 2.05 ±0.05 ppm and 1.46 ±0.01 ppm for small fish as shown in Figure 6.

In recent decades, due to the nutritional characteristics of fish and its role in preventing certain diseases, the tendency to fish consumption has increased. Fish and other aquatic foods are rich in nutrients such as protein, unsaturated fatty acids, vitamins and iron, zinc, calcium, iodine, etc. But because toxic elements are present in the tissue and are transmitted to the human body through the food chain, fish should be prevented from contaminating the environment **(Agusa et al., 2004)**. Over the past few decades, the increase in toxic elements in the industry has caused significant pollution through sewage. Because of their toxicity and persistence in water, these elements can cause many problems for aquatic animals. Fish is an important source of human nutrition and is an important part of many natural food chains. Therefore, determining the level of pollutants in fish is important because it is present in the fish that feeds it. **(Burger and Gochfeld, 2005)**. Heavy metal adsorbent tissues are organs that are very variable and dependent on various factors such as metals concentration, age, size, physiological status, type of biology, nutritional behavior and fish growth rate **(Chapman et al., 1996)**. Based on the present study, the change size of fish Kharo, the concentration of elements in fish tissues also changed, and these changes were significantly different. In other words, with the exception of cadmium (Cd), the longer the water is exposed to the pollutants in the aquatic environment, the more pollutants accumulate in fish body. Iron element found the highest concentration among other elements in the fish tissue, while nickel showed lowest concentration in the tissue. These data were agreed with the data of other researchers, but iron was the highest concentration in different organs of the fish **(Mahboob et al., 2016; Alinoor and Obiji, 2010).** In this research, it was observed that the amounts of Cd, Ni, Pb elements in the fish fillet was 1.60, 1.78, 2.33, 46.10 and 1.46 ppb respectively, and in fish with smaller size, 1.87, 1.47, 3.82, 61.55 and 2.05 ppb respectively; and the concentration of iron and zinc in the large fish was 46.10 and 1.46 ppm, respectively, in the small fish 61.55 and 2.05 ppm reported. The results of this experiment were in many items agreed with other researcher's results. **Yi and Zhang (2012)** reported there is a positive relationship between fish size and level of elements in most of the tested samples, and the mercury and chromium contents present in yellow catfish head and found a negative relationship and its amount decreased. **Katsuhisa et al. (2014)** A similar study on the effects of length, weight, and age on the concentration of toxic elements in dolphin muscle, which according to their reports was found a positive correlation between the concentrations of the cadmium, nickel, lead, iron and the mercury in muscle, liver and kidney dolphin and body length, weight, and age, but a negative correlation was found for such elements as zinc, magnesium and copper. **Karadede et al. (2004)**, found a positive correlation between concentration of mercury, zinc, copper and cadmium in the *Lethrinus lentjan* species with the length and weight of fish. A different assessment has been made in relation to toxic elements polluting the marine environment in the Persian Gulf and Oman Sea. In most of these studies, the concentration of toxic elements, especially mercury, has increased with increase fish age and size **(De Mora et al., 2004)**. It has been showed that for *Branchiostoma belcheri* there was a significant positive relationship between the amounts of copper and zinc with the length of the fish, and between concentration of mercury and cadmium with the length and weight of the fish, but there was not found, however, no significant relationship between fish length and weight and the amount of lead. But in this the study, cadmium content showed a significant decrease with increase fish size, and with fish size, lead content found a significant increase. The results of the two studies may be related to species differences, nutritional behavior, and immigration issues. The lead concentration obtained from the present experiment was reported 3.82 ppb in large fish, which was less than the other world standards. But in the present study, the concentration of this metal was 1.87 ppb in smaller fish and 1.60 ppb in larger fish, which was below the world standard levels. Absorption of 3 – 330 $mg.day^{-1}$ of cadmium is toxic and 1.5 – 9 $mg.day^{-1}$ will be deadly for humans. This metal infects on kidneys. Chronic symptoms of cadmium contamination include renal dysfunction, reduced fertility, weakness, tumor, and liver function disorders **(Waalkes, 2000)**. According to the World Health Organization, the daily tolerable and safe intake of nickel metal is 0.005 $mg.kg^{-1}$ body weight **(Samali Sari et al., 2007)**. According to the results of this study, the amount of nickel in the white muscle of the fish in both sizes was lower than the world standard, so there is no problem for consumption and human health. The zinc content recorded in this study was 2.05 ppm in larg fish and 1.46 ppm in the smaller fish. There is no the acceptable level of zinc in the muscle of the fish. Our study average values found lower compared to Chinese food standards (50 $mg.kg^{-1}$), Canadian food standards (100 $\mu g.g^{-1}$), Hungarian standards (150 $\mu g.g^{-1}$) and a range of international standards (40 – 100 $\mu g.g^{-1}$) **(Pourang et al., 2005).** Therefore, it can be concluded that this metal is not dangerous for the consumption of the fish. It has been reported that toxicity due to excessive consumption of zinc lead to electrolyte imbalance, nausea, anemia, and lethargy **(Prasad, 1984)**. **FAO and WHO (1976)** determined limit toxic elements consumption based on body weight. For an adult (60 kg body weight), the standard daily intake of lead, copper and zinc was 214 µg, 3 and 60 mg for muscle, respectively, which were much higher compared the values obtained from this report.

CONCLUSION

Concentration of toxic elements near to safe levels found limitations for human consumption and should be reported to populations that continuously use contaminated water. Toxic elements that accumulate in fish were dangerous for the environment as well as for human health. Despite the fact that there was no high level of toxic elements were found in the studied fish, there are potential risks to the future due to the development of industries and the expansion of agriculture around aquatic environments. The findings from this study also showed that people should be careful about regular use of fish caught from infected environments, especially larger fishes, because according to the results, although the concentration of the tested elements was lower than world standards. However, with increase fish size, the concentration of toxic and non toxic elements in fish muscle also were increased significantly.

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