



Determination of Copper and Zinc in Tiger Tooth Croaker Fish Muscles Collected from Makoran, Oman Sea

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Abstract

In this study zinc and copper levels in muscle of Tiger tooth fish from Posm, Chabahar and Ramin, at Oman Sea were detected. The results showed that the zinc and copper levels varied from 3.5-6 and 1.15-4.06 mg. kg⁻¹ dw, respectively. The Zn and Cu concentrations in the fish muscles were lower than the permissible limits suggested by international agencies such as Food and Agriculture Organization (FAO), World Health Organization (WHO) and Federal Environmental Protection Agency (FEPA).

Keywords: Tiger Tooth Fish; Chabahar Bay; Oman Sea; Copper; Zinc; Minerals

Abbreviations: WHO: World Health Organization; FAO: Food and Agriculture Organization; FEPA: Environmental Protection Agency

Introduction

Fishes are important source of protein, essential fatty acids and also essential elements in the diet [1,2]. Among different minerals zinc (Zn) and copper (Cu) are two important essential elements for cell metabolism. Although zinc and copper are two essential elements, but can be toxic at high concentrations. Copper is an essential element for the formation of hemoglobin and some enzymes in human; however, high intakes can result in damage to liver and kidneys [3]. Zinc is an essential constituent of all living organisms for various enzymes

such as carbonic anhydrase, transferrin, ferritin, and flavin iron enzymes. Fish is one of the mineral sources for human body. From the nutrition point of view, the evaluation of the zinc and copper levels in muscle of Tiger tooth fish, which are commonly consumed in the Oman Sea, is important. Oman Sea is input path of fresh water flows to the Persian Gulf via Arabian Sea and Indian Ocean. Also it is an important (and vital) shipping route for the oil-producing countries in the ROPME Sea Area. Chabahar Bay, which is situated in the Makran Coastline in Sistan and Baluchestan Province, South-east of Iran, is a free port and the only industrial zone in the coast of the Gulf of Oman.

The main goals of this study were to investigate zinc and copper distribution in muscle of Tiger tooth fish from

Posm, Chabahar and Ramin, Oman Sea and to compare the element levels with guidelines.

Materials and Methods

18 fishes (Tiger tooth) was collected at Posm (60.2-60.25E; 25.3-25.35N), Chabahar (60.6-60.65E; 25.25-25.3N) and Ramin (60.75-60.8E; 25.2-25.3N) in January 2018, 6 fishes (3 small and 3 bigger ones) per station (Figure 1). The samples were transferred to labeled plastic bags, stored on ice and the same day transported to the laboratory for further treatment and analysis. Prior to analysis, length and weight of the fish were determined. The muscle tissues were separated and weighted. The samples were deep frozen and lyophilized and again weighted to determine the water content. Then, the samples were homogenized by manual grinding in a ceramic mortar and kept in the deep freezer until analysis [4].

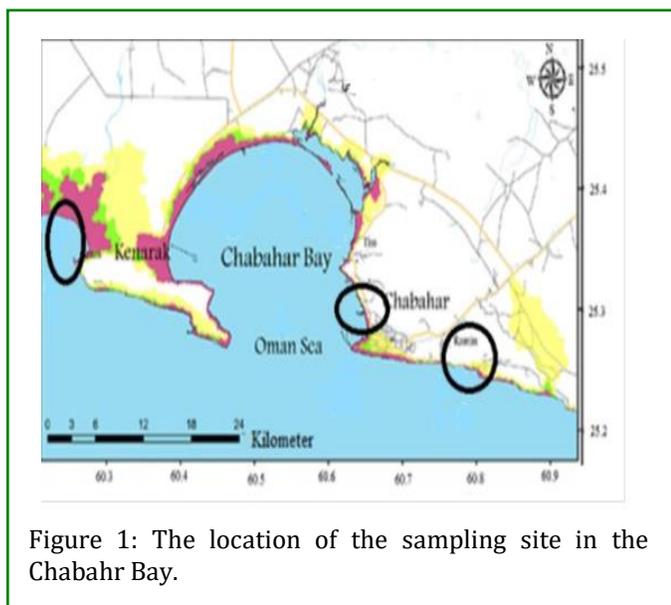


Figure 1: The location of the sampling site in the Chabahr Bay.

The results of biometry showed that length of small and big fishes were in the range of 24-26 and 29.8-39 and their corresponding weight were in the range of 120-182 and 296-575, respectively. There was a strong significant correlation between fish weight and length ($y=28.25x-543.08$ and $R^2=0.95$, (Table 1). In this study the length of fishes was used as an indicator of its size. The humidity in fish muscle was 48%. One gram of muscle tissue was digested by mixture of glacial nitric acid and Perchloric acid in during 12 hours and subsequently was treated by Hydrogen peroxide at 80°C for 1 hour and the 3 hours at 150°C [5,6,7]. The digested sample was filtered and its volume was adjusted to 25 ml. Zinc and copper were detected using ICP-MS (HP 4500, equipped with auto sampler Asx-520). Standard addition method was used to detect the recovery ($96\pm3\%$). The limits of detection were set as three times of the standard deviation on the procedural blanks. All the reported data were over than the detection limit ($2\ \mu\text{g}\cdot\text{kg}^{-1}$) of analyzing instrument.

Results

The copper concentrations in the fish muscle tissues varied from 1.15 to 4.06 mg. kg^{-1} dw with an average level of 2.4 mg. kg^{-1} dw (Table 1). The highest cooper concentration was detected in the muscle tissues of small fishes from Ramin.

The zinc concentration in the fish muscle tissues varied from 3.5 to 6 mg. kg^{-1} dw with an average level of 4.7 mg. kg^{-1} dw (Table 1). Although the size of Tigertooth fishes in Chabahar were bigger than those in Posm station, but the lowest zinc concentration was found in the fish muscle from Chabahar. Big fishes in Posm and Chabahar accumulated less zinc levels than small ones, while this pattern was observed for copper in Posm and Ramin (Figure 2).

Stations	Fish size	Length	Weight	Average Length cm	Average Weight gr	Zn (ppm)	Average (ppm)	Cu	Average (ppm)
		cm	gr					(ppm)	
Posm	Big	32.3	335	28.2	233	4.2±0.42	4.75	1.23±0.11	1.6
	Small	24.2	132			5.3±0.39		2.04±0.18	
Chabahar	Big	34.2	421	29.8	299	3.5±0.33	3.55	2.26±0.18	1.7
	Small	25.3	177			3.6±0.40		1.15±0.13	
Ramin	Big	36.8	524	30.8	345	6.0±0.54	5.7	3.71±0.33	3.9
	Small	24.7	165			5.4±0.37		4.06±0.39	

Table 1: Zinc and copper levels (mg kg^{-1} d.w) in the fish muscle tissues as well as the fish sizes.

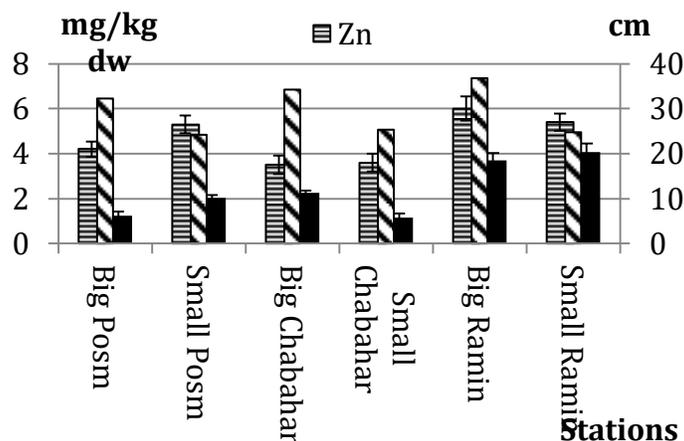


Figure 2: Copper and zinc levels in muscle tissues of Tiger tooth fish from different stations, as well as fish sizes.

Regardless of fish sizes, average levels of copper and zinc in the fish muscle from different stations were compared (Figure 3).

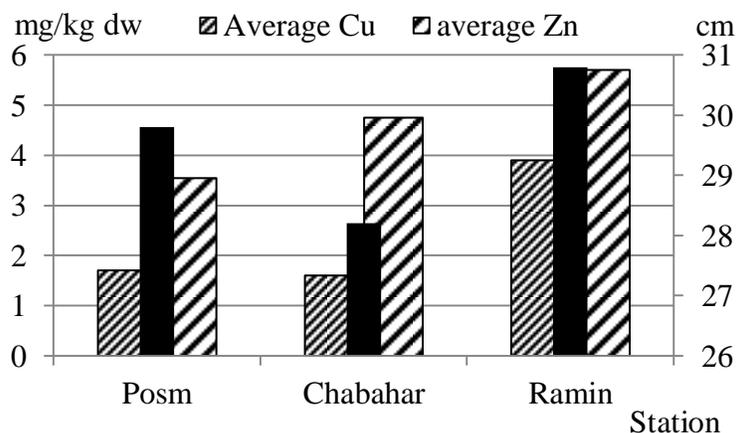


Figure 3: The average copper and zinc levels in muscle of Tiger tooth fish muscle as well as fish size (Length).

The results showed that from western to eastern (Posm) parts of the Oman Sea (Ramin) the accumulation of copper in the fish muscle increased. However the fish sizes from Ramin was bigger than the two other stations, but accumulation trend was more than the increasing trend of sizes. Tiger tooth fishes from Posm with

relatively lower size had less copper accumulation in its tissues.

In order to compare the average metal concentrations in the muscle tissues, metal international standards were used (Table 2).

New Zealand (d)	Australia (c)	WHO (b)	FAO (a)	Ramin Average	Chabahar Average	Posm Average	Elements
30	10-70	10	20	3.9	1.7	1.6	Cu
150	40	1000	50	5.7	3.55	4.75	Zn

(a) FAO [5] (b) Hassanpour et al., [7] (c) Darmono et al., [4] (d) Radojevi M, et al. [9].

Table 2: Comparison between the average metal concentrations and international standards in fish (mg g⁻¹ of dry weight).

Conclusion

Based on the findings of the current study, periodic monitoring is necessary to survey the extent of human effects on the ecologic balance and human health. In this research, the concentration of copper and zinc and human health risk resulting from the consumption of fish from Chabahar Bay were assessed. The maximum Cu concentration was detected in the small fish muscle from Ramin as 4.06 mg kg⁻¹ d.w, This indicates that Cu concentrations were lower than the permissible limits suggested by international agencies such as Food and Agriculture Organization (FAO), World Health Organization (WHO), Australian and New Zealand guidelines [8-12].

The FAO guideline for maximum Zn content is 50 mg/kg [8,13]. The concentrations of Zn in the present study were lower than the guidelines (Table 2 and Figure 3).

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