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Zinc Concentration in Tissues of Spangled Emperor (*Lethrinus nebulosus*) Caught in Northern part of the Persian Gulf

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Abstract

Concentrations of zinc were determined in liver, muscle as an edible tissue and skin of a demersal fish, Spangled emperor (*Lethrinus nebulosus*) from fisheries stations in Bandar Abbas and Bandar Lengeh (Northern part of Persian Gulf) during autumn 2007 and spring 2008. After preparation of the samples and digestion with microwave, concentrations of zinc were determined using Flameless Atomic Absorption Spectrophotometer (THERMO FS95). The mean of fish weights were 1320.7g (308-3054) and the mean Zn levels in the liver, muscle and skin of all samples were 0.326 (0.039-0.856), 0.084 (0.041-0.265) and 0.0228 (0.0011-0.0508) µg/g dry weight, respectively. The positive correlations between liver weight and concentrations of Zn in the liver (µg/g dw) were observed ($p<0.05$). There were significant differences between concentrations of zinc in the skin in regions, moreover between concentrations of zinc in muscle and skin in seasons ($p<0.05$). The mean Zn in different tissues was less than those reported from other regions of the Persian Gulf (Qatar, Oman and UAE). Based on the results, the Zn content found in the studied fish samples is no sufficient to cause toxic effects on human health when these fish are included in the diet.

Key words: Trace element, Bioaccumulation, Zn, Pollution, Fish quality.

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سنجش مقدار روی در بافت های ماهی شهری معمولی صید شده در مناطق شمالی خلیج فارس

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چکیده

در این تحقیق مقادیر روی موجود در بافت های کبد، عضله به عنوان مهمترین بافت خوراکی و پوست ماهی تجاری وابسته به کف، با نام محلی شهری معمولی (*Lethrinus nebulosus*)، تهیه شده از صیدگاه های بندرعباس و بندر لنگه در بازه زمانی پاییز ۱۳۸۶ تا بهار ۱۳۸۷ اندازه گیری شد. نمونه ها پس از آماده سازی و هضم بوسیله دستگاه مایکروویو با دستگاه جذب اتمی کوره‌ای (THERMO مدل FS 95) مورد آنالیز قرار گرفتند. میانگین وزن ماهیان مورد مطالعه بر حسب گرم برابر با (۳۰۵۴-۳۰۸) ۱۳۲۰/۷ و به ترتیب میانگین غلظت روی در بافت های کبد، عضله و پوست برابر با (۰/۸۵۶-۰/۰۳۹) ۰/۳۲۶، (۰/۲۶۵-۰/۰۴۱) ۰/۰۸۴و (۰/۰۵۰۸-۰/۰۰۱۱) ۰/۰۲۲۸ میکروگرم بر گرم وزن خشک بود. نتایج حاصل از تحلیل آماری نشان داد همبستگی مثبت بین وزن کبد و مقدار روی در کبد (µg/g dw) وجود دارد ($P<0/05$). تفاوت معنی داری بین مناطق از نظر مقدار روی موجود در پوست و نیز بین فصول از نظر مقدار روی در پوست و عضله وجود داشت ($P<0/05$). مقایسه میانگین غلظت روی موجود در این بافت ها با مقادیر ارائه شده در کشورهای دیگر سواحل خلیج فارس (قطر، عمان، امارات متحده عربی) نشان میدهد که مقدار روی کمتر از مقادیر گزارش شده در این کشور هاست. بر اساس نتایج، غلظت‌های یافت شده در نمونه ها و مقادیر مجاز تعیین شده توسط مراجع جهانی، مقدار روی موجود در این ماهیان تأثیر منفی بر سلامتی انسان ندارد.

کلمات کلیدی: عناصر کم مقدار، تجمع زیستی، آلودگی، کیفیت گوشت ماهی.

Introduction:

Marine organisms, in general, accumulate contaminants from the environment and therefore have been broadly used in marine pollution monitoring studies. Heavy metals discharged into the marine environment can damage both marine species diversity and ecosystems, due to their toxicity and accumulative behaviour (Sivaperumal *et al.*, 2007).

Heavy metals can be categorized as: potentially toxic (aluminium, arsenic, cadmium, antimony, lead, mercury) probably essential like nickel, vanadium, cobalt and essential like copper, zinc, selenium etc. (Tuzen and Soylak, 2007; Yalcin *et al.,* 2008;). The essential metals can also be toxic when excessively elevated intake is of concern. Heavy metal contaminants discharged through sewage outfalls, urban storm water, agricultural and industrial runoff have the potential to accumulate in marine ecosystems and cause a human health risk if concentrations in fish tissues exceed maximum permitted concentrations (Fabris *et al.*, 2006).

The accumulation patterns of contaminants in fish and other aquatic organisms depend both on their uptake and elimination rates (Guven *et al.*, 1999). Numerous reports describe metal residues in wild fish from marine species (Yilmaz, 2003). These studies are largely based on accumulating high levels of trace metals in different tissues of the fish, such as liver, gills, and muscle.

Fishes are often the top consumers in aquatic ecosystems and thus metal concentrations in fish can act as an indicator of the state of the environment (Van den Broek *et al.*, 2002).

The Persian Gulf is a shallow basin with an average depth of 35–40 m and a total area of around 240 sq. km. It joins free international waters through the Strait of Hormoz. The Gulf comprises a relatively shallow, semi enclosed water body with very high evaporation rates and poor flushing characteristics.

Aquatic and related fauna such as mussels, clams, barnacles, colonizing sea birds, dolphins and fish are popular targets of heavy metal-monitoring programs in marine ecosystems because sampling, sample preparation and chemical analysis are usually simpler, more rapid and less expensive than alternative choices such as water, sediments and soil (Rayment & Barry, 2000).

The present study was carried out to determine the level of zinc in liver, muscle and skin samples of Spangled emperor (*Lethrinus nebulosus*) from Bandar Abbas and Bandar Lengeh areas, located on the north of Persian Gulf. Both cities have direct connection to Persian Gulf. The fish and fish products for the people in those ports are generally catched and carried by local vehicles from the Persian Gulf. It should be noted that Spangled emperor is considered to be an essential part of the diet in the region. No data exist on Zinc levels in this fish from mentioned areas.

Materials and methods:

The study was carried out on fish samples collected in Bandar Abbas and Bandar Lengeh Areas, South of Iran and Northern Part of Persian Gulf (Fig.1). Sampling took place twice in October 2007 at the beginning of cold season and May 2008 approximately on the beginning of summer climatic condition in area. The total and fork lengths were recorded to the nearest millimeter using a measuring board. Whole wet weight was measured using an electronic balance and recorded to the nearest gram.

Fig.1. Sampling locations in Persian Gulf, Bandar Abbas (circle) & Bandar Lengeh (square) regions

All liver and muscle samples were dried at 80ºC (Agusa *et al.*, 2004) and skin samples were dried at 105ºC (Wong *et al.*, 1999) for 12 h. The biometric data of the fish are shown in Table 1. Homogenized samples (0.5 g) were weighed and then digested, using a microwave digester (Milestone ETHOS1 advanced microwave digestion system, Italy) with 1 ml H_2O_2 (30%) and 7 ml HNO_3 (65%) (Both Merck). Samples were digested for 30-40 min at 200 °C according to system instruction. After digestion, the residues were diluted to 50 ml with distilled water in volumetric flasks. Concentrations of zinc were measured with Furnace auto sampler atomic absorption spectrometer (FS95).

The non-parametric techniques employed to further analyze variables because the distributions of variables were not normal. Spearman's correlation coefficients were used to examine relationships between zinc and the biological characteristics. Regional and seasonal differences in zinc concentration in tissues were tested by non-parametric independent sample and Mann Whitney tests. The level of significance was set at $p<0.05$. In this study, heavy metal concentrations were expressed on a dry-weight basis (µg/g dry wt.). These statistical analyses were executed by the SPSS program (version 15).

Results and discussion:

An economically important species in the northern regions of Persian Gulf was investigated, namely spangled emperor (*Lethrinus nebulosus*, shehri-e-maamooli). This species is a demersal carnivore and feeds on echinoderms, worms, mollusks and crustaceans (De Mora *et al.*, 2004). It is found in a variety of habitats including coral reefs, sea grass beds and mangroves from near shore to a depth of 75 m (Grandcourt *et al.*, 2006); to sum up, this species could be an indicator for impact of heavy metals pollution in these regions.

Rayment & Barry (2000) focused on importance of diet on heavy metal accumulation by fish. They found heavy metal accumulation in fish in the order of omnivorous> phytoplankton feeder> zooplankton feeder> carnivorous> macrophyte feeder.

The average size and weight values of fish samples in two sampling areas are given in Table 1. The fish weight, total length and fork length ranged 0.83-2.232 kg, 38-52 and 34-48 cm, respectively. The mean of fish weights were 1320.7g (308-3054).

The levels of zinc that was measured in *L. nebulosus* tissues are presented in Table 2 (µg/g dry weight).

Table1: Characteristics of spangled emperor from northern part of Persian Gulf

Region	n	Statistics	Total length (Cm)	Fork length (Cm)	Weight (g)	Liver Weight (g)
Bandr Abbas	52	Mean	45.79	41.20	1461.34	11.32
		SE	1.11	0.84	91.29	1.32
		Min	36.50	24	308	1.70
		Max	59.70	54.30	3054	44.03
Bandar Lengeh	42	Mean	43.06	39.24	1246.44	7.42
		SE	0.96	0.86	75.63	0.78
		Min	30.20	27.30	420	0.91
		Max	53.30	49.30	2147	19.64

The positive correlation between liver weight and concentrations of Zn in the liver (µg/g dw) were observed ($p<0.05$). There were significant differences between regions, and concentrations of zinc in the skin in Bandar Lengeh samples was higher than Bandar Abbas ones ($p<0.05$).

Concentrations of zinc in sampled fishes in muscle tissue were relevant to the Australia New Zealand Food Standard Code (150 µg/g wet weight), (Rayment and Barry, 2000), also concentrations in liver were less than certified values in DOLT2 (85.8 µg/g wet weight), (Poikane *et al.*, 2007). Studies regarding to the residues of metals in fish skin which is consumed by human are infrequent (Yilmaz, 2003).

As it was indicated in Table 3, the concentrations of zinc in tissues of *Lethrinus nebulosus* was less than other reported fish species in different waters and also less than this species in other regions of Persian Gulf. The concentrations of zinc in northern part of Persian Gulf were sequenced in this way: Liver> muscle> skin, in contrast, the concentrations in skin were higher than muscle of fish in Iskenderun Bay (Yilmaz, 2005). In all species that illustrated in Table 3 the concentrations of zinc in liver were higher than muscle. In general**,** liver can be considered as target organ for assessing metal accumulation.

The positive correlations between concentrations of Zn in liver, muscle and skin were no observed ($p<0.05$).

There was no size dependence of the Zn content neither in the liver nor the muscle in samples, the highest concentration of Zn (0.2654 µg/g dry w.) in muscle was measured in a 0.697 kg spangled that's one of the smallest one from Bandar Abbas. For comparison (Table 3), pervious measurements of Zn in muscle of spangled emperor have been reported in the ranges 6.5 µg/g dry w in Qatar (De Mora *et al.*, 2004).

The ATSDR standard of Zinc Permissible intake for human health is equal to 0.3 mg/kg/day. Considering this dose, results of study and normal consumption of fish product, it can be concluded that spangled emperor caught in Persian Gulf is free of harmful zinc concentrations.

Table2: Zinc concentrations (µg/g dry weight) in different tissues of spangled emperor from northern part of Persian Gulf (Mean ±SE, Min, Max)

Tissue	Statistics	Zn conc. (µg/g) in Bandar Abbas fish samples	Zn conc. (µg/g) in Bandar Lengeh fish samples
liver	Mean± SE	0.345±0.024	0.301±0.31
	Min	0.085	0.039
	Max	0.808	0.856
muscle	Mean± SE	0.092±0.016	0.080±0.006
	Min	0.043	0.041
	Max	0.265	0.206
skin	Mean± SE	0.020±0.002	0.024±0.001
	Min	0.001	0.012
	Max	0.050	0.042

Conclusion:

This study provides information on the zinc distribution in Spangled Emperor (*Lethrinus nebulosus*) caught in two important ports of North Persian Gulf in the Iran territory. Based on the results, the Zn content found in the studied fish samples is no sufficient to cause toxicological effects on human health when these fish are included in the diet. In relation to this, it is recommendable that monitoring studies for different heavy metals are periodically performed to assess the human exposure to these toxic elements through fish and fishery product consumption.

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Table 3: Comparison of zinc concentrations in tissues of fish from different regions

Area	Species	Tissues	Zn	References
Persian Gulf Iranian waters	*Lethrinus nebulosus*	Muscle	0.084	This study
		Liver	0.326	
		Skin	0.022	
		Muscle*	0.063	
		Liver*	0.248	
		Skin*	0.013	
Iskenderun Bay (Turkey)	*Mugil cephalus*	Muscle	47.25	Yilmaz, 2005
		Skin	103.74	
Persian Gulf Qatar (Al Dakhira)	*Lethrinus nebulosus*	Muscle	6.5	De Mora *et al.*, 2004
		Liver	228	
Persian Gulf UAE (Dhannah)	*Lethrinus nebulosus*	Muscle	11.5	
		Liver	1160	
Oman (Raysut)	*Lethrinus nebulosus*	Muscle	11.1	
		Liver	1627	
Iskenderun Bay (Turkey)	*Trachurus mediterraneus*	Muscle	30.42	Yilmaz, 2003
		Skin	68.15	
Ponds in Bohemia	*Cyprinus carpio*	Muscle*	3.2	Svobodova *et al.*, 2002
		Liver*	64.4	
Hong Kong (Tolo Harbour)	*Siganus oramin*	Muscle	4.63	Man So *et al.*, 1999
		Liver	44.92	
		Muscle*	6.79	
		Liver*	41.02	

Concentrations are in μg/g dry weight, except the cases are denoted with asterisk, which are in μg/g wet weight.

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