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Bioaccumulation of Some Metals in Different Organs of Frozen Spotted Seabass

Alhemmali EM[1]*, Abudabos AO[1], Alfgih HM[1], Alshitshat HA[1], Almestiry JM[2], Haded HA[1]

[1]Department of Zoology, faculty of science, Misurata University, Misurata Libya

[2]Department of food technology, faculty of agriculture, Misurata University, Misurata Libya

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***Corresponding author:** Esmail Mohamed Alhemmali, Department of Zoology, faculty of science, Misurata university, Misurata Libya, Tel: 00218911392357; Email: esmail74science@gmail.com

Abstract

In this study was to estimated bioaccumulation of some metals (Cr, Mn, Fe, Cu, Zn and Pb) in different fish tissue (skin, Muscle, liver and gills) of *Dicentrarchus punctatus*. The samples were collected from local supermarket in Misurata city, Libya in summer, 2017. Tissue of this study was analyzed by atomic absorption spectrophotometer (AAS) to find the concentration of heavy metal (mg/kg).

The results showed that the mean concentration of Zn was higher than Pb in skin, gills. Furthermore, Fe, Zn and Mn were higher in muscle than liver, except Cu and Zn their concentrations were higher in liver. While low concentration of Pb in all study organs, moreover, Cu and Cr in Muscle and gills of fish study.

The order of metals in liver, gills, skin and muscle samples were found to be $Cu > Fe > Mn > Zn > Cr = Pb$, $Cu > Fe > Mn > Zn > Cr = Pb$, $Fe > Zn > Cr > Mn > Cu > Pb$ and $Fe > Zn > Mn > Cr = Cu > Pb$ respectively. Some levels of metals (Cr and Fe) in this study were higher than the maximum permissible limits of FAO and WHO for human consumption.

Keywords: AAS; Bioaccumulation; Organs; Metals; Spotted Seabass

Introduction

Marine organisms could bioaccumulate numerous inorganic pollutants, with chromium (Cr), mangnis (Mn), iron (Fe), copper (Cu), Zinc (Zn) and lead (Pb) contaminants being the most commonly studied elements. These elements are characterized by bioaccumulation, biomagnification in the food chain and tendency to persist in the environment.

Some aquatic organisms such as fish are often at within the aquatic food chain and large amount concentrate of metals in water that build up by drinking sea water during feeding and ion-exchange of dissolved metals across lipophilic membranes and absorption on tissue and membrane surface [1,2]. Heavy metals are taken up through different organs of fish because of the affinity between them, for this reason, many heavy metals are concentrated at different levels in different organs of the body.

Multiple factors including season, physical and chemical properties of water can play a significant role in metal accumulation in different fish tissues. The intake rate of these heavy metals by humans through the consumption of fish causes serious health hazards.

Some heavy metals such as Zn, cu, Mn and Fe are essential for growth and well being of living organisms including man. However, they likely show toxic effects when organisms are exposed to levels higher than normally required. Other elements such as Pb are not essential for metabolic activities and exhibit toxic properties even with traces levels [3].

Fish is a healthy and cheap protein source for a bigger percentage of world population [4]. Fish is a qualified food in terms of energy and nutritious components (essential multiunsaturated fatty acids, exogenic aminoacids, minerals and water-soluble vitamins) in human nutrition [5].

This study aimed to determination of some essential and nonessential metals (Cr, Mn, Fe, Cu, Zn and Pb) in the skin, muscle, gills and liver of Dicentrarchus punctatus were estimated. Moreover, the permissible limit of these heavy metals via fish consumption was discussed.

Materials and Methods

Sample Preparation

Ten samples of Spotted seabass (*Dicentrarchus punctatus*) were collected (frozen fish) from local supermarket in Misurata city, during summer, 2017 (Figure 1). Collected fish were transferred to the laboratory of Aquatic Biology unit, department of zoology, university of Misurata, Libya in poly-ethylene bags, put into container of polystyrene ice box. It washed with distilled water, and dissected for skin, muscle (dorsal muscle without skin), gill and liver and packed in 0.5 gram of the sample were put in volumetric flask, added with 10 mL of concentrated (56%, Merck) nitric acid overnight. The mixture heated on a hot plate in fume hood until a white fume was observed which that the digestion of tissue was complete. Sample was allowed to cool at room temperature, was filtered using filter paper into a 100 cm^3 volumetric flask and made to mark with distal water.

Sample Analysis

Heavy metals analysis was measured by atomic absorption spectrophotometer (AAS) model number ITEM No. 19102, 12, AAS, HiTAchi, of Central laboratory of analysis of Iron and steel factory, Misurata, Libya. Results are expressed as milligrams per gram.

Data Statistics

Statistics were performed using SPSS 11.5 software. A P-value of 0.05 or less was considered statistically significant. For T-test ANOVA compared the metals concentration in skin, muscle, liver and gills.

Results

The study was carried out to determine heavy metals concentration (Cr, Mn, Fe, Cu. Zn and Pb) in different organs such as skin, muscle, liver and gills of *D. punctatus*, collected from local supermarket in Misurata city. Table 1 shows the concentration mean of heavy metals in different organs of fish used for the study. The mean concentrations of Cr were found to be 0.16±0.09, 0.00 0.06±, 0.02± 0.00 and 0.06± 0.00mg/g in the skin, muscle, liver and gills respectively. Manganese concentrations ranged from 0.03±0.08 – 0.38±0.15 mg/g in organs of fish (Table, 1). The highest levels of Fe were found in gills (1.59±0.21) with compared all organs of *D. punctatus*, while the highest levels of Cu were found in liver (0.96±4.20) also Zn (1.45±0.11) was found in skin. Table 1, shown that statistical analysis of metal concentrations showed a significant (P<0.05) difference between gills and liver of Cr and Cu.

Sample	Concentration of heavy metals (mean±S.E.)					
	Cr	Mn	Fe	Cu	Zn	Pb
Skin	0.16±0.09	0.15±0.14	0.16±0.24	0.03±0.08	0.11±1.45	0.00±0.02
Muscle	0.00±0.06	0.32±0.16	0.24±0.44	0.00±0.02	0.04±0.39	0.02±0.00
Liver	0.02±0.00*	0.03±0.08	0.14±0.30	4.20±0.96*	0.21±0.50	0.02±0.00
Gills	0.06±0.00*	0.38±0.15	0.21±1.59	0.17±0.15*	0.29±0.86	0.00±0.02

Table 1: Concentrations mean of heavy metals (mg/kg) in different organs in *D. punctatus*.

Data are presented as means±S.E. of organs of *D. punctatus* of five replicates, (n=5). Values with different superscript letters (*) in the same column are significantly different at the 0.05 level (P≤0.05).

The results of this study shown that the (Figure 1) skin had the highest Cr and Zn concentrations also Mn concentration highest in muscle where compared with all organs of *D. punctatus*. The mean level of Copper (Cu) in liver while the mean Iron (Fe) values were in gills were highest. Mean level of Lead (Pb) in organ of fish were lower than another level metals of currently study.

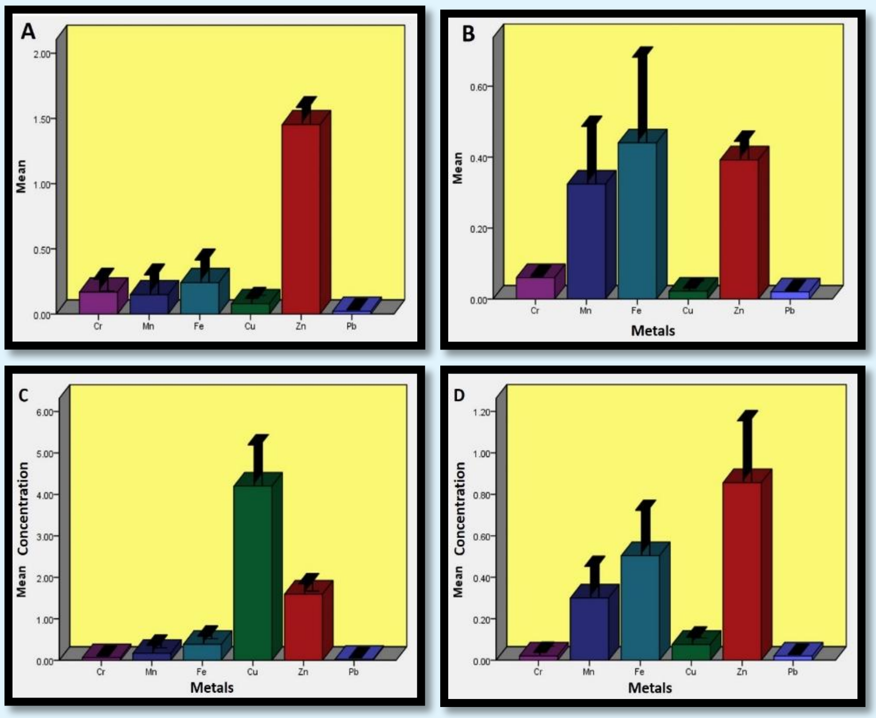

Figure 1: Distribution of metals in fish. A: Skin, B: Muscle, C: Liver, D: Gills.

Discussion

Variation in levels of metals among the fish species is apparent possibly due to differences in metal concentrations in the local environment and chemical characteristics of water from which fishes were caught, ecological needs, metabolism and feeding patterns of fishes, the season in which studies were carried out and also length and weight of the fishes can play a role in accumulation of metals [6].

The present work revealed marked increase of heavy metals concentration such as Cr and Zn in skin, while muscle had high concentration of Mn. Also, Singh et al. and Yılmaz suggested that, Skin tissue showed elevated levels of metals in comparison with muscle tissue. Muscle comparison skin does not come into direct contact with the metals as it is totally covered externally by the skin, that in many ways helps the fish to ward off the penetration of the trace metals and also it is not an active site for detoxification, and therefore transport of trace metals from other tissues to muscle [7-9]. Furthermore, according to Bat, et al., the skin of fishes may be an important site for the uptake of metals due to their high surface area to body ratio [10].

In the investigation, liver has showed higher concentrations of metals such as Cu and concentrations of Fe in gills can be influenced by absorption of metals onto the gill surface, as well as by formation of complexes between the metals and the mucous, which is often impossible to remove them from lamellae prior to the analysis [11]. Furthermore, that iron metal (Fe) were used in anabolic of hemoglobin make the gill a prime site for Fe (essential metal) accumulation [10]. The physiological role of the tissue in fish metabolism influences the concentration of metals. Some tissues such as the liver and the gills are metabolically active, as compared to low tissues metabolism like muscles and protein metalothionein [12].

Finally, the observed differences can be explained by the fact that the concentrations of these metals depend to a great extent on the part of the fish analyzed [13]. Moreover, ecological factors such as season, location, nutrient availability and temperature and salinity of the water, may be contribute to variations in the metal concentrations in fishes.

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