Albanian j. agric. sci. 2021;20 (1): 9-13

RESEARCH ARTICLE

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Heavy Metals Accumulation in Liver Tissue of Red Mullet and European Hake

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Abstract

Mercury, lead, cadmium and chrome concentration levels were determined in liver tissue of two different fish species of Adriatic Sea, Red mullet (*Mullus barbatus*) and European hake (*Merluccius merluccius).* The concentration levels of heavy metals were measured by using atomic absorption spectrophotometer (AAS). Heavy metals concentration in both liver tissue of fish species ranged as follows, Hg: 0.02-0.15, Pb: nd-0.04, Cd: 0.11-0.22, Cr: 0.10-0.13 (mg/kg wet weight). As expected, liver tissue of red mullet showed different variation of mercury ($p<0.001$), as well as variation between same fish species with different weight. The result of the study confirmed the fact that liver tissue of Red mullet and European hake are an important location and indicator of heavy metal pollution. Based on the economic and culinary importance of both fish species among consumers it will be of specific interest the further monitoring with the goal to safeguard the consumers health.

Keywords: Heavy metals, European hake, liver tissue, red mullet.

1. Introduction

Heavy metals contamination of aquatic environment has become a matter of concern because of their toxicity to animals and humans. Their presence in water environment is related both by natural and anthropogenic sources. Heavy metals have the ability to accumulate and bioaccumulate in different tissues of fish especially in demersal and predatory species [12,13]. Recently most of studies are focused not only in the determination of heavy metals in muscle tissue of fish as the edible part of it, but also in liver [3, 8, 11]. Liver tissue of fish is a key organ of metabolisms in general. Several studies have showed the importance of liver as an biological indicator of heavy metal pollution [17]. In the present study, concentration levels of heavy metals were determined in liver tissue of two scientifically and culinary important fish species of Adriatic Sea, Red mullet and European hake.

2. Material and Methods

2.1. Fish liver tissue sampling

Fish samples namely red mullet (*Mullus barbatus*) and European hake (*Merluccius merluccius*) were collected from various local fisherman subjects of Durresi bay (2010-2012). According to the weight the fish samples were divided in two main groups: small fish size (mean weight of 60 g) and large fish size (mean weight 140 g). The fish samples before they were sent to the laboratory of Toxicology, Institute of Veterinary and Food Safety, Tirana they were first, weighed, catalogued and conserved at - 18◦C. The study included a total of 40 samples, 20 for each fish species (small & large fish size).

2.2. Determination of metal liver tissue of fish species

A total of 40 samples of liver tissue were evaluated for the concentration level of mercury, cadmium, lead and chrome by using an Atomic Absorption Spectrophotometer (AAS). The liver tissue of both fish

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(Accepted for publication 29.03.2021)
***ISSN**: 2218-2020,*

species was first homogenized in a blender; then dried at 100 ºC. One g of sample was weighed and then treated with 10 ml of HNO_3 and 5 ml of concentrated H_2SO_4 and let in overnight. The next day they were dried at 150º C for at least, 30 minutes and 50 ml of it were put into a normal flask, and filled with tap water. The heavy metals were measured by ICP-OES, Optima 2100 Dv produced by Perkin Elmer. The obtained results were expressed as mg/kg wet weight (mg/kg ww).

2.3 Statistical evaluation of the data

The comparison of the data between two groups was held by using student test, possibilities less than ($p<0.05$) were considered statistically important. The entire statistic evaluation was carried out by using SPSS 20.0 (Statistical Package for Social Science). The statistical data on the below tables (tab.1 and 2) comprises standard deviation, standard error, p value and interval of confidence.

3.Results and Discussion

3.1 Heavy metal concentration in liver tissue of Red mullet and European hake

The average mean concentration level and (SD) of mercury, lead, cadmium and chrome in liver tissue of fish samples are presented in the below tables (Tab. 1 and 2). As expected, liver tissue samples of fish species showed different variation of metals accumulation, as well as variation between same fish species with different weight.

Especially concentration level of mercury (Hg) varies among liver tissue samples according to fish species and weight (Tab. 1, 2).

Heavy metal occurrence in liver tissue samples of Red mullet: From the comparison of the data resulted that exist a significant statistical difference of mercury accumulation in liver tissue samples of Red mullet ($p< 0.001$) with different size. The highest concentration levels of Hg (mg/kg ww) was detected in liver tissue of large fish size (0.151±0.045), compared to small fish size (0.032±0.009).

As observed from table 1 lead resulted below the detection level (nd) in all liver tissue samples of small fish size, while in large fish size resulted to be (0.043±0.072).

Based to the results of the study mean concentration levels of lead ($p=0.076$), cadmium ($p=0.928$) and chrome ($p=0.850$) in liver tissue samples of Red mullet doesn't showed an important statistical difference.

Table 1. Average mean concentration levels of heavy metals in liver tissue of red mullet (mg/kg ww)

Fish species, red mullet *(Mullus barbatus)*, liver tissue								
Heavy metals	**weight**	**N**	**Average**	**SD**	**SE**	**t value**	**df**	**p***
Hg	small	10	.0320	.0098	.0031	-8.1516	18	**<0.001**
	large	10	.1510	.0451	.0143			
Pb	small	10	.0433	.0726	.0230	1.8849	18	.076
	large	10	.0000	.0000	.0000			
Cd	small	10	.1103	.1154	.0365	-.0916	18	.928
	large	10	.1149	.1090	.0345			
Cr	small	10	.1210	.0811	.0256	-.1916	18	.850
	large	10	.1300	.1233	.0390			

* ***"t" student test***

Heavy metal occurrence in liver tissue samples of European hake: Referring to the data of the below table (2) mean concentration levels of mercury ($p=0.109$), cadmium ($p=0.941$) and chrome ($p=0.688$) in liver tissue of European hake doesn't show significant statistical differences. Based in table 2, lead resulted in all liver tissue samples of European hake, small and large fish size below the detection level (nd).

Table 2. Average mean concentration level of heavy metals in liver tissue of European hake (mg/kg ww)

Fish species, European hake (Merluccius merluccius), liver tissue

Metalet	weight	N	Average	SD	SE	t value	df	p*
Hg	small	10	.0200	.0044	.0014	-1.6873	18	.109
	large	10	.0314	.0209	.0066			
Pb	small	10	.0000					
	large	10	.0000					
Cd	small	10	.2182	.2215	.0700	-.0754	18	.941
	large	10	.2252	.1928	.0610			
Cr	small	10	.1028	.0437	.0138	-.4078	18	.688
	large	10	.1172	.1030	.0326			

* ***"t" student test***

Referred to figure (1) mean concentration levels of mercury, lead, cadmium in general reached higher values in liver tissue of Red mullet instead of European hake (except for Cd). It is not surprising that Red mullet reached higher levels of heavy metals accumulation in liver tissue. As reported by literature benthic fish species as Red mullet are in fact more exposed to heavy metal contamination than other fish [1,10, 11, 13, 14]. These fact is in total accordance to our study. In the other hand the differences of contamination of fish species by heavy metals is widely influenced not only by fish species but also to, size, sex, age, metabolisms, feeding habit, ecological difference, route of exposure, dose, contamination gradient of water etc [2, 3, 6, 11, 16]. In case of Hg accumulation, biokinetic parameters as well environmental characteristics play an important role [1].

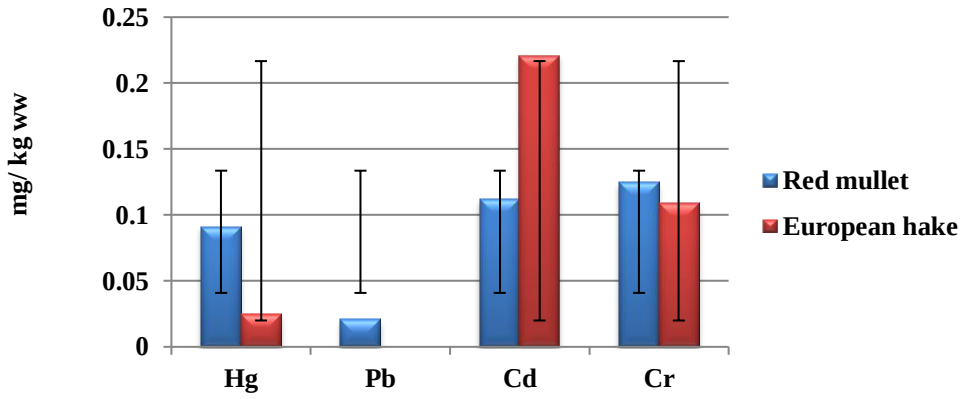

Figure 1: Comparison of average mean concentration levels and (SD) of heavy metals in liver tissue between fish species.

It was interesting to note that lead resulted almost (except Red mullet liver samples, tab.1) in all liver tissue samples in both species below the detection level. These finding agrees with the data of in literature which reports decreased levels of lead in aquatic environment [7, 13, 15].

These last decade scientist used widely fish as bio - indicator of heavy metals pollution [4]. Red mullet being a benthic species tend to concentrate contaminants to higher degree than other species. These was the main reason way these specie is fully recommended as monitoring specie [5]. Referred to the result of our study Red mullet showed higher concentration of metals in liver tissue samples. Liver is not only the main organ of metabolisms of protein, fat and carbohydrates but also of chemical contaminants such as heavy metals. Liver has the ability to accumulate, biotransform and detoxify heavy metals[9, 17]. In summary both liver tissue samples of fish species were contaminated at different levels with heavy metals. These result suggests and confirm the fact that liver tissue of fish is an important indicator of chemical contamination of water environment and aquatic animals by heavy metals. Based on the results

of the study it will be of further interest the monitoring of both fish species by heavy metals and other chemical compounds, to ensure the human and environment health.

4.Conclusions

The present study provides important information on the concentration of heavy metals in two commercially important fish species of Adriatic Sea. Red mullet and European hake liver tissue samples resulted to be contaminated at different levels with heavy metals. As suggested by FAO tissues of Red mullet and Euroepan hake may serve as an important indicator of heavy metals pollution not only of the aquatic environment but also to the species itself.

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