Mesopo. Environ. j, Vol:3, No:3,pp(30-41), 2017
ISSN 2410-2598
Mesopotemia Environmental journal
journal homepage:www.bumej.com

Seasonal variation of some heavy metals in the tissues of two important Marine Fish Species *Epinephelus coioides* and *Euryglossa orientalis* from Iraqi marine waters, north west arabian gulf

Faris J. M. Al-Imarah[1], Ali H. Amteghy[2], Ghasan A. Al-Najar[3] and Ahmed Y, Hammood[1]

[1]Dept. Marine Chemistry, Marine Science Centre,
[2] Dept. of Appl. Mar. Sci., Faculty of Marine Sciences,
[3]Dept. Marine Invertabrate. Marine Science Centre, Basrah University, Basrah –Iraq

Corresponding Author :

To cite this article:

Al-Imarah, F. J. M; Amteghy, A.H; Al-Najar. G. A; and Hammood. A. Y; Seasonal Variation of some Heavy Metals in the Tissues of two important Marine Fish Species *Epinephelus coioides* and *Euryglossa orientalis* from Iraqi Marine Waters, North West Arabian Gulf. *Mesop. environ. j.* 2017, Vol.3, No.3, pp 30-41.

Abstract

Seasonal variations in the concentrations of six heavy metals (Cd, Cu,Mn, Ni, Pb and Zn) were determined in different tissues (muscles, livers , Ovaries , Intestines and gills) of *Epinephelus coioides* (serranidae) *and Euryglossa orientalis* from Al-Amiq port within National Iraqi Waters at Northern Arabian Gulf during the period October 201٤ and November 201٥. Heavy metals in fish samples were analyzed by atomic absorption spectrophotometry (AAS) after acid digestion. Two-way ANOVA statistics were used to compare the data among seasons, species, and organs (level of 0.05). the bioaccumulation of the heavy metals was species-related as the accumulations of the heavy metals analysed in the tested two fishes were of the following trend: *Epinephelus coioides* > *Euryglossa orientalis.* Accumulation of total heavy metals in Epinephelus coioides, the following order Zn > Cu > Cd > Mn > Ni > Pb is found, while that for *Euryglossa orientalis*, the following order: Cu > Zn > Mn > Cd > Ni > Pb is found. In the organs of *Epinephelus coioides*, heavy metals Cd, Cu, and Zn recorded the higher concentrations during summer season, high concentrations of Mn recorded during spring, and lower concentrations were recorded for Ni and Pb during all seasons. In the organs of *Euryglossa orientalis* higher concentrations of heavy metals were recorded for Cd during summer season, Cu during autumn season, Mn during spring season, Ni and Zn were low during all seasons, and Zn during winter season. The levels of Cd, Ni, and Zn in this study were higher than the maximum permissible limits (FAO, and WHO) for human consumption and that of Cu, Mn, and Pb are still lower.

Key Words: Fishes, Organs, Marine waters, heavy metals, pollution, Bioaccumulation

Introduction

Heavy metals discharges to the marine environment are of great concern all over the world, and have a great ecological significance due to their toxicity and accumulative behavior[1] . Marine organisms concentrate in their tissues the contaminants present in sea water and heavy metals are critical in this regard because of their easy uptake into the food chain and because of bioaccumulation processes [2].Because of toxicity and accumulative behavior of heavy metals, they can make different changes in aquatic environment such as species diversity[3]. These metals concentrated at different contents in organs of fish body [4]. Fish is an important food source for human[5]. Therefore, heavy metals in aquatic environments are transferred through food chain into humans. Since, fishes are highly consumed by human being and may accumulate large amounts of some metals from the water, it is important to determine the concentration of heavy metals in commercial fish in order to evaluate the possible risk of fish consumption for human health [6]. Studies from the field and laboratory experiments showed that accumulation of heavy metals in a tissue is mainly dependent upon water concentrations of metals and exposure period [7,8]. The harmful effects of heavy metals and metalloids to biota in the marine environment have been recognized. Fish and shellfish are good bio indicators of trace element contamination in the marine environment since they occupy different a tropic levels and can display large bioaccumulation factors Fish accumulate toxic chemicals such as heavy metals directly from water and diet, and contaminant residues may ultimately reach concentrations hundreds or thousands of times above those measured in the water, sediment and food [9-11]. Heavy metals are normal constituents of marine environment that occur as a result of pollution principally due to the discharge of untreated wastes into rivers by many industries. Bioaccumulation of heavy metals in tissues of marine organisms has been identified as an indirect measure of the abundance and availability of metals in the marine environment [12]. So, monitoring fish tissue contamination serves an important function as an early warning indicator of sediment contamination or related water quality problems [13,14] and enables us to take appropriate action to protect public health and the environment[]. Multiple factors including season, physical and chemical properties of water can play a significant role in metal accumulation in different fish tissues [15,16]. Several studies [17-21] have also indicated that fish are able to accumulate and retain heavy metals from their environment depending upon exposure concentration and duration as well as salinity, temperature, hardness and metabolism of the animals. Adeyeye et al.[22] referred to that the concentration of metals was a function of fish species as it accumulates more in some fish species than others. Previos studies that using different species of fishes as bioindicator for pollution monitoring because most of fish tissues can accumulate heavy metals from aquatic environment [23-28], due to this reason a few studies have been reported dealing with different fish species collected from area closed to the present study area. Fish have been the most popular choice as test organisms because they are presumably the best-understood organisms in the aquatic environment [29] and also due to their importance to human as a protein source [30]. Therefore, this research project aimed at to determine the levels of contamination and the bioaccumulation of Cd, Ni, Cr, Co and Pb in two common and eatable fishes *Epinephelus coioides* and *Euryglossa orientalis* that are of commercial importance in Shatt Al-Arab Estuary, Northern Arabian Gulf.

Materials and Methods

A total of 200 each of *Epinephelus coioides* (serranidae) and *Euryglossa orientalis* fishes were caught (50 each species during winter, summer, spring and Autumn) for the period Oct.2014 – Nov.2015 from Al-Amiq port at the Northern Arabian Gulf (35º36'31"N, 50º48'23"E) as shown in Fig.(1).

Figure (1). Location map for sampling station.

The average weight and length for each fish species were (758 gm and 395 mm) and(358 gm and 285 mm) respectively. Fish samples used in this study are shown in fig.(2). Heavy metals were extracted according to the method explained by ROPME [31], and measurements were conducted by Flame Atomic Absorption Spectrophotometer Model PG, AA500.

a) Epinephelus coioides b) *Euryglossa orientalis*

Figure 2. Two marine fish species used for bioaccumulation of heavy metals: *a) Epinephelus coioides and b) Euryglossa orientalis*

Statistical program SPSS was used to analyze the data statistically. Two-way ANOVA was employed to find the significant differences of heavy metal concentrations in fish organs with regard to seasons [32]. The significance was set at 0.05.

Results

The seasonal variation in the level of metals Cadmium (Cd) , Copper (Cu), Manganese (Mn) , Nickel (Ni), Lead (Pb) and Zinc (Zn) in the tissues (muscles, liver, Ovaries, Intestines and Gills) of fishes *Epinephelus coioides* and *Euryglossa orientalis* are given in tables (1-3) and (5-7) respectively:
Statistical analysis which is shown in table (4) for the results of the fish *Epinephelus coioides*, indicated that Cu, Mn, Pb and Zn showed significant differences between seasons and all tissues of the fish .but Cd levels varied significantly in all fish tissues and Ni levels showed no significant differences between seasons and all tissues of the studied fishes. While Statistical analysis for the results of *Euryglossa orientalis* which is shown

in table (8) indicated that Mn ,Ni, Pb and Zn showed significant differences between seasons and all investigated fish tissues, but Cd and Cu levels varied significantly in all tissues of the fishe

Table 1. Bioaccumulation of selected Heavy Metals in different Seasons and Organs of *Epinephelus coioides* within this Study, Oct. 2014 to Nov. 2015.

.

Season	Tissue	Cd	Cu	Mn	Ni	Pb	Zn
Winter	Muscles	0.4	0.97	0.5	0.002	ND	4.9
	Liver	0.7	3.23	0.8	0.1	0.02	20.8
	Ovaries	0.3	2.61	0.2	0.02	0.09	13.0
	Intestines	1.2	6.79	1.1	0.2	0.31	58.1
	Gill	1.2	8.23	1.7	0.3	0.02	15.4
Spring	Muscles	0.7	2.32	0.3	0.2	ND	20.9
	Liver	0.2	8.7	0.3	0.5	0.55	15.5
	Ovaries	ND	3.79	0.4	0.1	0.04	9.7
	Intestines	1.4	3.26	2.8	0.1	0.02	15.1
	Gill	0.7	1.54	1.5	0.7	0.19	11.5
Summer	Muscles	2.2	3.14	0.5	0.3	ND	2.1
	Liver	2.0	4.73	ND	0.5	0.33	74.5
	Ovaries	2.8	3.21	0.7	0.1	0.03	16.8
	Intestines	2.2	0.75	0.8	0.1	0.12	10.3
	Gill	0.8	10.64	1.2	0.7	0.13	51.1
Autumn	Muscles	0.5	5.42	0. 7	0.3	ND	4.5
	Liver	2.3	3.42	2.2	0.5	0.01	ND
	Ovaries	3.2	7.44	0.7	0.1	0.03	20.9
	Intestines	2.4	0.11	0.1	0.1	0.07	15.6
	Gill	0.7	0.06	2.1	0.7	0.08	10.5

ND = Below the detection limit.

Table 2 Bioaccumulation of selected Heavy Metals , mean and Std. Deviation in different Seasons for *Epinephelus coioides* within this Study.

Tissue		Zn	Pb	Ni	Mn	Cu	Cd
Gill	Mean	22.12	0.10	0.60	1.62	5.11	0.85
	Std.Dev.	19.43	0.07	0.20	0.37	5.11	0.23
	Minimum	10.5	0.02	0.30	1.20	0.06	0.7
	Maximum	51.1	0.19	0.70	2.10	10.64	1.2
Intestines	Mean	24.77	0.13	0.12	1.20	2.72	1.80
	Std.Dev.	22.34	0.12	0.05	1.14	3.03	0.58
	Minimum	10.3	0.02	0.10	0.10	0.11	1.2
	Maximum	58.1	0.31	0.20	2.80	6.79	2.4
Liver	Mean	36.93	0.22	0.40	1.10	5.02	1.30
	Std.Dev.	32.64	0.26	0.20	0.98	2.54	1.01
	Minimum	15.5	0.01	0.10	0.30	3.23	0.2
	Maximum	74.5	0.55	0.50	2.20	8.70	2.3
Muscles	Mean	8.10		0.20	0.43	2.96	0.95
	Std. Dev.	8.62	N.D	0.14	0.11	1.86	0.84
	Minimum	2.1		0.00	0.30	0.97	0.4
	Maximum	20.9		0.30	0.50	5.42	2.2
Ovaries	Mean	15.10	0.04	0.08	0.50	4.26	2.10
	Std. Dev.	4.83	0.02	0.04	0.24	2.17	1.57
	Minimum	9.7	0.03	0.02	0.20	2.61	0.3
	Maximum	20.9	0.09	0.10	0.70	7.44	3.2
Total	Mean	20.58	0.12	0.28	0.99	4.01	1.36
	Std. Dev.	19.26	0.15	0.23	0.77	2.99	0.92
	Minimum	2.1	0.01	0.00	0.10	0.06	0.2
	Maximum	74.5	0.55	0.70	2.80	10.64	3.2
	Permissible limits[33]	40	0.5	70-80	2-9	30	0.5

Table 3. Bioaccumulation of selected heavy metals,mean and Std. Deviation in different organs of *Epinephelus coioides* within this Study.

Season		Zn	Pb	Ni	Mn	Cu	Cd
Autumn	Mean	12.87	0.04	0.34	1.27	3.29	1.82
	Std. Dev.	7.01	0.03	0.26	1.04	3.25	1.16
	Minimum	4.5	0.01	0.10	0.10	0.06	0.5
	Maximum	20.9	0.08	0.70	2.20	7.44	3.2
Spring	Mean	14.54	0.20	0.32	1.06	3.92	0.75
	Std. Dev.	4.31	0.24	0.26	1.09	2.80	0.49
	Minimum	9.7	0.02	0.10	0.30	1.54	0.2
	Maximum	20.9	0.55	0.70	2.80	8.70	1.4
Summer	Mean	30.96	0.15	0.34	0.80	4.49	2.00
	Std. Dev.	30.66	0.12	0.26	0.29	3.71	0.73
	Minimum	2.1	0.03	0.10	0.50	0.75	0.8
	Maximum	74.5	0.33	0.70	1.20	10.64	2.8
Winter	Mean	22.44	0.11	0.12	0.86	4.36	0.76
	Std. Dev.	20.74	0.13	0.12	0.57	3.02	0.42
	Minimum	4.9	0.02	0.00	0.20	0.97	0.3
	Maximum	58.1	0.31	0.30	1.70	8.23	1.2
Total	Mean	20.58	0.12	0.28	0.99	4.01	1.36
	Std. Dev.	19.26	0.15	0.23	0.77	2.99	0.92
	Minimum	2.1	0.01	0.00	0.10	0.06	0.2
	Maximum	74.5	0.55	0.70	2.80	10.64	3.2

Table 4. Analysis of variance (ANOVA) for *Epinephelus coioides* fish from Al-Amiq port of the Arabian Gulf-Iraq.

Metal	Effect	Sum of square	Degree of freedom	Mean of square	F	Sig.
Cd	Tissue	3.443	4	0.861	1.676	0.225
	Season	5.693	3	1.898	3.696	0.046
	Error	5.647	11	0.513		
	Total	50.790	19			
	Corrected Total	15.484	18			
Cu	Tissue	20.209	4	5.052	0.416	0.794
	Season	4.434	3	1.478	0.122	0.946
	Error	145.680	12	12.140		
	Total	493.209	20			
	Corrected Total	170.323	19			
Mn	Tissue	3.448	4	0.862	1.389	0.306
	Season	0.311	3	0.104	0.167	0.916
	Error	6.204	10	0.620		
	Total	28.030	18			
	Corrected Total	10.229	17			
Ni	Tissue	0.749	4	0.187	15.332	0.000

	Season	0.165	3	0.055	4.507	0.024
	Error	0.146	12	0.012		
	Total	2.640	20			
	Corrected Total	1.060	19			
Pb	Tissue	0.068	3	0.023	0.919	0.470
	Season	0.050	3	0.017	0.684	0.584
	Error	0.221	9	0.025		
	Total	0.599	16			
	Corrected Total	0.339	15			
Zn	Tissue	1439.143	4	359.786	0.928	0.482
	Season	789.681	3	263.227	0.679	0.583
	Error	4265.060	11	387.733		
	Total	14734.700	19			
	Corrected Total	6680.098	18			

Table 5. Bioaccumulation of selected Heavy Metals in different Seasons and Organs of *Euryglossa orientalis* fish within this Study, Oct. 2014 to Nov. 2015.

Season	Tissue	Cd	Cu	Mn	Ni	Pb	Zn
Winter	Muscles	0.2	0.481	0.1	0.5	0.02	6.0
	Liver	0.5	0.485	ND	0.3	0.031	16.2
	Ovaries	0.4	0.292	ND	0.2	ND	11.8
	Intestines	0.006	0.599	ND	ND	ND	28.1
	Gill	1.0	0.532	ND	0.4	0.053	34.5
Spring	Muscles	0.5	5.71	ND	0.4	ND	11.4
	Liver	1.4	2.83	1.5	ND	3.91	33.2
	Ovaries	ND	4.61	4.8	0.3	ND	10.3
	Intestines	0.4	2.29	1.5	0.3	ND	10.8
	Gill	1.1	8.79	9.1	2.6	0.3	6
Summer	Muscles	2.4	10.34	0.01	0.1	0.11	15.6
	Liver	3.2	6.56	0.07	0.1	0.744	20.9
	Ovaries	0.7	6.66	2.1	0.7	0.6	10.5
	Intestines	1.2	4.47	0.5	0.3	0.301	4.9
	Gill	1.2	6.66	1.01	ND	0.17	15.8
Autumn	Muscles	1.5	53.1	ND	0.7	0.06	12.3
	Liver	1.6	53.3	3.5	ND	0.04	23.6
	Ovaries	1.3	22.8	2.6	0.5	0.01	14.9
	Intestines	1.2	90	ND	ND	0.01	4.9
	Gill	1	59	0.8	1	ND	38.7

N.D : Below the Detecting limit

ISSN 2410-2598

Table 6 Bioaccumulation of selected Heavy Metals , mean and Std. Deviation in different Seasons *of Euryglossa orientalis* within this Study .

Season		Zn	Pb	Ni	Mn	Cu	Cd
Autumn	Mean	18.88	0.03	0.73	2.30	55.64	1.32
	Std. Dev.	12.93	0.02	0.25	1.37	23.88	0.23
	Minimum	4.9	0.01	0.5	0.80	22.80	1.00
	Maximum	38.7	0.06	1.0	3.50	90	1.60
Spring	Mean	14.34	2.10	0.90	4.22	4.84	0.85
	Std. Dev.	10.75	2.55	1.13	3.60	2.59	0.47
	Minimum	6.00	0.30	0.3	1.50	2.29	0.40
	Maximum	33.20	3.91	2.6	9.10	8.79	1.40
Summer	Mean	13.54	0.38	0.30	0.73	6.93	1.74
	Std. Dev.	6.07	0.27	0.28	0.86	2.11	1.02
	Minimum	4.90	0.11	0.1	0.01	4.47	0.70
	Maximum	20.90	0.74	0.7	2.10	10.34	3.20
Winter	Mean	19.32	0.03	0.35	0.10	0.47	0.42
	Std. Dev.	11.73	0.016	0.12	-	0.11	0.37
	Minimum	6.00	0.02	0.2	0.10	0.29	0.006
	Maximum	34.50	0.05	0.5	0.10	0.59	1.00
Total	Mean	16.52	0.45	0.56	2.12	16.97	1.09
	Std. Dev.	10.17	1.02	0.61	2.53	25.54	0.76
	Minimum	4.9	0.01	0.1	0.01	0.29	0.006
	Maximum	38.7	3.91	2.6	9.10	90	3.20

Table 7 Bioaccumulation of selected Heavy Metals, mean and Std. Deviation in different Organs of *Euryglossa orientalis* within this Study .

Tissue		Zn	Pb	Ni	Mn	Cu	Cd
Gill	Mean	23.75	0.17	1.33	3.63	18.74	1.07
	Std. Dev.	15.46	0.12	1.13	4.73	27.06	0.09
	Minimum	6.00	0.05	0.4	0.80	0.53	1.00
	Maximum	38.7	0.30	2.6	9.10	59.00	1.20
Intestines	Mean	12.17	0.15	0.30	1.00	24.33	0.70
	Std. Dev.	10.97	0.20	0.00	0.70	43.80	0.59
	Minimum	4.9	0.01	0.3	0.50	0.59	0.006
	Maximum	28.10	0.30	0.3	1.50	90	1.20
Liver	Mean	23.47	1.18	0.20	1.69	15.79	1.67
	Std. Dev.	7.16	1.84	0.14	1.72	25.12	1.12
	Minimum	16.20	0.03	0.1	0.0	0.48	0.50
	Maximum	33.20	3.91	0.3	3.50	53.30	3.20
Muscles	Mean	11.32	0.06	0.42	0.055	17.40	1.15
	Std. Dev.	3.98	0.04	0.25	0.06	24.13	1.00
	Minimum	6.00	0.02	0.1	0.01	0.48	0.20
	Maximum	15.60	0.11	0.7	0.10	53.10	2.40
Ovaries	Mean	11.87	0.30	0.42	3.16	8.59	0.80
	Std. Dev.	2.12	0.41	0.22	1.43	9.83	0.45

	Minimum	10.30	0.01	0.2	2.10	0.29	0.40
	Maximum	14.90	0.60	0.7	4.80	22.80	1.30
Total	Mean	16.52	0.45	0.56	2.12	16.97	1.09
	Std. Dev.	10.17	1.02	0.61	2.53	25.54	0.76
	Minimum	4.9	0.01	0.1	0.01	0.29	0.006
	Maximum	38.7	3.91	2.6	9.10	90	3.20
Permissible limits [33]		40	0.5	70-80	2-9	30	0.5

Table 8. Analysis of variance (ANOVA) in *Euryglossa orientalis* fish from Al-Amiq port of the Arabian Gulf-Iraq.

Metal	Effect	Sum of square	Degree of freedom	Mean of square	F	sig.
Cd	Tissue	2.417	4	0.604	2.016	0.162
	Season	5.020	3	1.673	5.584	0.014
	Error	3.296	11	0.300		
	Total	33.340	19			
	Corrected Total	10.556	18			
Cu	Tissue	517.027	4	129.257	0.857	0.517
	Season	10074.969	3	3358.323	22.262	0.000
	Error	1810.234	12	150.853		
	Total	18165.548	20			
	Corrected Total	12402.230	19			
Mn	Tissue	13.447	4	3.362	0.521	0.726
	Season	23.119	3	7.706	1.195	0.401
	Error	32.242	5	6.448		
	Total	135.695	13			
	Corrected Total	77.141	12			
Ni	Tissue	1.974	4	0.494	1.500	0.300
	Season	.639	3	0.213	0.648	0.609
	Error	2.303	7	0.329		
	Total	9.980	15			
	Corrected Total	5.276	14			
Pb	Tissue	2.677	4	0.669	0.969	0.488
	Season	6.369	3	2.123	3.073	0.112
	Error	4.145	6	0.691		
	Total	16.433	14			
	Corrected Total	13.544	13			
Zn	Tissue	672.352	4	168.088	1.741	0.206
	Season	135.212	3	45.071	0.467	0.711
	Error	1158.728	12	96.561		
	Total	7424.500	20			
	Corrected Total	1966.292	19			

Heavy metals in Epinephelus coioides were behave as follow: The concentration of Cd ranged between ND in ovaries during spring season upto 3.2 µg/g dry weight in the ovaries during autumn season, while Cu ranged between 0.06 µg/g in gills during autumn upto 10.64 µg/g in gills during summer season, Mn ranged between ND in liver during summer and 2.8 µg/g dry weight in the intestine during summer season, Ni recorded the lowe values between 0.0٠2 µg/g dry weight in the muscles during winter to 0.7 µg/g dry weight in the gills during summer and autumn, Pb recorded the lowest values ranged between ND in the muscles during summer

and autumn upto 0.55 µg/g dry weight in the liver during spring, while Zn recorded the hightest values in the range ND in liver during autumn and 74.5 µg/g dry weight in liver during sumer season.
In the organs of *Epinephelus coioides,* heavy metals Cd, Cu, and Zn recorded the higher concentrations during summer season, high concentrations of Mn recorded during spring, and lower concentrations were recorded for Ni and Pb during all seasons. Accumulation of total heavy metals concentration in the organs of *Epinephelus coioides* during all seasons were in the following order Zn > Cu > Cd > Mn > Ni > Pb.
For *Euryglossa orientalis,* the behaviour was as follow: Cd recorded concentrations ranged between 0.006 µg/g dry weight in intestines during winter season and 3.2 µg/g dry weight in liver during summer season, Cu ranged between 0.292 µg/g dry weight in the ovaries during winter season and 90 µg/g dry weight in the intestines during autumn season, Mn ranged between ND in most organs during winter season and 9.1 µg/g dry weight in gills during spring season, Ni ranged between ND in most organs during all seasons and 2.6 µg/g dry weight in gills during spring season, Pb ranged between ND in most organs during all seasons and 3.91 µg/g dry weight in liver during spring season, while Zn recorded values ranged between 4.9 µg/g dry weight in the intestines during summer and autumn seasons and 38.7 µg/g dry weight in the gills during autumn season.
In the organs of *Euryglossa orientalis,* higher concentrations of heavy metals were recorded for Cd during summer season, Cu during autumn season, Mn during spring season, Ni and Zn were low during all seasons, and Zn during winter season.
Accumulation of total mean heavy metal concentration in organs of *Pseudorhombus malayanus* during all seasons was observed in the following order of : Cu > Zn > Mn > Cd > Ni > Pb .
The levels of Cd, Ni, and Zn in this study were higher than the maximum permissible limits[33] for human consumption and that of Cu, Mn, and Pb are still lower. Safe disposals of domestic sewage and industrial effluents as well as enforcement of laws enacted to protect our environment are therefore advocated.

Discussion

The levels of Cd, Cu, Mn, Ni, Pb and Zn were determined in the muscle in each species because of its importance for human consumption and also in the gill since gills tend to accumulate metals [34]. These organs as well as other active organs are good indicators of chronic exposure to heavy metals [12].
The higher levels of Zn and Cu can be attributed to their biological role in normal metabolism and the growth of plankton and fish, which cause them to have an active uptake and storage [35] . The highest concentrations of Cu, Zn, Cd, and Pb were found in tissues of fish from the selected site in which water of this site contained high levels of the measured metals [36]. Humanitarian today is facing high level of pollution with different pollutants among which the heavy metals are dangerous and hazardous. Pollutants and heavy metals are found in the aquatic environment in many forms, they can be found as organic and inorganic complexes or suspended molecules or dissolved ions and these forms differ with respect to their bioavailability toxicities [37]. Heavy metals are naturally found in the environment but in very low concentrations [38](. The determination of heavy metals ions in aquatic system was useful in controlling the pollution specially undegradable metals, thus they differed from hydrocarbonic pollutants of varied chemical composition that lost some of their toxic characteristics with changing their chemical composition, so it is difficult to remove easily the heavy metals from the environment by natural processes in comparison with most of organic pollutants, but the ions of these metals can combine with salts to form complexes that settle on the bottom [39]
The accumulation of heavy metals in fish differed according to the method by which the metals were absorbed and fish sp. and kind of metal [40]. Seasonal variations observed in the metals concentration could be attributed to the differences in local pollution, bioavailability of metals (variations among physiochemical factors) and fish metabolism (growth cycle, reproduction and feeding) [41-43]. In addition, some other indirect activities such as energy demand activities, atmospheric deposition and runoff inputting, that could lead to metal contamination, are variable among seasons. The spawning period of L. abu takes place in winter (January and February). During this period, the feeding habits of L. abu might get altered [44]. This alteration in feeding habits could be the reason of observed difference in metal concentrations between the seasons [45]. Heavy metals in aquatic environment and aquatic biota pose a risk to fish consumers and other wild life. Heavy metals may enter aquatic ecosystem from different natural and anthropogenic sources including industrial or domestic sewage, storm runoff, leaching from landfills-/dump sites and atmospheric deposit [46-48].

Contamination of heavy metals in fish are usually compared with the permitted level recommended by the Food and Agriculture Organization and World Health Organization [33]. Locally, From Tables 3 and 7,the levels of Zn , Cu , Mn, Ni and Pb in all different kinds of fish were lower than the levels of compared to the permissible limits set by FAO/WHO[33]. In the tissues (muscles, liver, Ovaries, Intestines and Gills) of *Epinephelus coioides* and *Euryglossa orientalis*, the concentration of cadmium was found higher compared to the permissible limit set by FAO/WHO [33]. Trace element concentrations in this study were lower than FAO/WHO [33](guideline values indicating that fish from Iraqi water bodies are safe for human consumption. except Cd which was above limited exceed FAO/WHO [33]. However, people with high fish consumption rates may accumulate increased levels of these metals over time. Long-term exposure to small amounts of copper causes stomach upset, nausea, and diarrhea and can lead to tissue injury and disease. Cadmium and lead are dangerous contaminants even at low concentrations their effects being more pronounced in children than adults once exposed over the same period. In general, The low levels of metals reported in this study could be attributed to the size of fish and their positions in the food web [49] since these factors are responsible for pollutant accumulation in fish. Cd bioaccumulation was more than almost two times the permissible amount in the fish meat (1.06 and 1.36mg/L). Thus, Cd accumulation in these fishes that form part of almost every day diet of the local population is a matter of alarm and therefore such information should be made available to the local people who could be affected by overexposure to Cd on a regular basis. They should also be taught to recognize early symptoms of such metal toxicity. Generally, heavy metals showed organ specific accumulation in this study. The accumulation of a particular metal depends to a large degree on the presence of the metal ion in the water column, the physiological role of each element, and the preference of an element to bind to or replace some elements in the tissue.

Table (9) shows concentration of heavy metals in different fish species collected from nearby study area

References	Ni	Pb	Cd	Cu	Mn	Zn	Type
[50]	109	-	5.9	9.5	6.72	-	*Liza subviridis*
[51]	1.46	-	24.53	19.5	5.73	-	*Acanthopagruslatus*
[36]	12.59	5.3	-	29.4		-	*Chirocentrusdorab*
[52]	1.9	0.011	6.89	1.2	0.6	-	Otolithesruber
[52]	1.7	0.19	4.6	63.9	0.1	-	*Tenualosailisha*(Hamilton,1822)
This study	0.28	0.12	1.36	4.01	0.99	20.58	*Epinepheluscoioides*
This study	0.56	0.45	1.09	16.7	2.12	16.52	*Euryglossa orientali*

References

[1]**Matta, J., Milad, M., Manger, R., Tosteson, T.** Heavy metals, lipid peroxidation, and ciguatera toxicity in the liver of the Caribben barracuda (Sphyraena barracuda). Biological Trace Element Research, 70: 69–79, 1999.

[2]**Beijer, K., and Jernelöv, A.** Sources, transport and transformation of metals in the environment. In: Friberg, L., Nordberg, G.F., Vouk, V.B. (Eds.), Handbook on the Toxicology of Metals. Elsevier, Amsterdam, pp. 68–84, 1986.

[3]**Hantoush, A. A., Al-Najare, G. A., Amteghy, A. H., Al-Saad,H.T., and K. Abd Ali, K**. Seasonal variations of some trace elements concentrations in Silver Carp *Hypophthalmichthys molitrix* Consolidated from farms in central Iraq. *Marsh Bulletin*, 7*(2):126-136, 2012.*

[4]**Khaled, A.** Trace metals in fishes of economical interset from the west of Alexandria, Egypt. Chem. and Econ., 25(4):229-246, 2009.

[5]**M.T. Ronagh, Savari, A., Papahn,F., and M.A. Hesni,M. A**. Bioaccumulation of Heavy Metals in *Euryglossa orientalis* from the Hendijan Seaport (Coastal of Persian Gulf), Iran. *Journal of Biological Sciences, 9: 272-275, 2009.*

[6]**Cid, B.P., Boia, C., Pombo, L., Rebelo, E.** Determination of trace metals in fish species of the Ria de Aveiro (Portugal) by electro thermal atomic absorption spectrometry. Food Chemistry, 75(1): 93-100, 2001.

[7] **Kalay, M., Ay, O. and Canli, M.** Heavy metal concentrations in fish tissue from the Northern Mediterranean sea. *Bull. Environ. Contam. Toxicol*., 63:673-681, 1999.

[8]**Kalay, M., Canli, M.,** Elimination of essential (Cu, Zn) and nonessential (Cd, Pb) metals from tissues of a freshwater fish Tilapia zillii following an uptake protocol. Tr. J. Zoology, 24: 429–436, 2000.

[9]**Goodwin, T. H., Young, A., Holmes, M., Old, G., Hewitt, N., Leeks, G., Packman, J. and Smith, B**. "The Temporal and Spatial Variability of Sediment Transport and Yields within the Bradford Beck Catchment, West Yorkshire," *Science of the Total Environment*, Vol. 314, pp.475-494, 2003.

[10]**Labonne, M., Basin, S., Othman, D. and Luck, J.** "Lead Isotopes in Muscels as Tracers of Metal Sources and Water Movements in a Lagoon (Thau Basin, S. France),"*Chemical Geology*, Vol. 181, No. 1-4, pp. 181-191, 2001.

[11]**Osman, A., Wuertz, S., Mekkawy, I., Exner, H., and Kirschbaum, F** "Lead Induced Malformations in Embryos of the African Catfish Clarias Gariepinus (Burchell, 1822)," *Environmental Toxicology*, Vol. 22, No. 4, pp. 375-389, 2007.

[12]**Kucuksezgin, F.A., Kontas, O., Altay, E. and Uluturhan, D. E.** Assessment of marine pollution in Izmir Bay; Nutrient heavy metal and total hydrocarbon concentrations: *Environ. Int.*, 32:41-51, 2006.

[13]**Mansour, S. and Sidky, M**. "Ecotoxicological Studies. 3. Heavy Metals Contaminating Water and Fish from Fayoum Governorate, Egypt," *Food Chemistry*, Vol. 78, No. 1, pp. 15-22, 2002.

[14]**Barak, N. and Mason, C**. "A Survey of Heavy Metal Levels in Eels (Anguilla anguilla) from Some Rivers in East Anglia, England - The Use of Eels as Pollution Indicators," *Internationale Revue Der Gesamten Hydrobiologie*, Vol. 75, No. 6, pp. 827-833, 1990.

[15]**Hayat, S., Javed, M. and Razzaq, S.** "Growth Performance of Metal Stressed Major Carps viz. *Catla Catla, Labeo Rohita and Cirrhina Mrigala* Reared under Semi-Intensive Culture System," Pakistan Veterinary Journal, 27(1):8-12, 2007.

[16]**Romeo, M., Siau, Z., Sidoumou, Y. and Gnassia, M. B.** "Heavy Metal Distribution in Different Fish Species from the Mauritania Coast," *Science of the Total Environment*, Vol.232, No. 3, pp. 169-175, 1999.

[17]**Ademoroti, C.M.A.** Environ. Chem. and Toxico., Foludex Press Ltd., Ibadan 171 – 204, 1996.

[18]**Cusimano, R.F., Brakke, D.F. and Chapman, G.A.** Effects of pH on the Toxicity of Cadmium, Copper and Zinc to Steelhead trout (*Salmogairdneri). Can. J. Fish Aquat. Sci.*,43, 1497-1503, 1986.

[19]**Heath, A.G.** Water Pollution and Physiology. CRC press Inc., Boca Raton. 145 pp, 1978.

[20]**Allen, P.** Chronic Accumulation of Cadmium in the edible Tissues of *Oreochromis aurus*(Steindachner): Modification by Mercury and Lead. *Arch. Environ. Contam. Toxicol.*,29, 8-14, 1995. [21]**Karthikeyan, S., Palaniappan, P.L.R.M. and Sabhanayakan, S**. Influence of pH and water hardness upon Nickel accumulation in edible fish *Cirrhinusmrigala. J. Environ. Biol.*,**28**,484-492, 2007.

[22]**Adeyeye, E.I., Akinyugha, R.J., Febosi, M.E. and Tenabe, V.O.** Determination of some metals in *Clariasgariepinus*(Cuvier and Valenciemes), *Cyprinuscarpio*(L) and *Oreochromisniloticus*(L) fishes in a polyculture fresh water pond and their environment. *Aquacut.*,47, 205-214, 1996.

[23]**Abdul-Hassan, J.K. and Dhia K. Kareem**. Synergistic effects of some heavy metals and salinity on survival of Gumbusia affinis. Basrah J. Agric. Sci., 2 (1, 2): 71-80, 1998.

[24]**Abdul-Hassan, J.K., Ahmed, H.K. and Abdul-Jabbar, H.S.** Effect of different levels of copper, cadmium and vanadium on the survival of Gumbusia affinis. Basrah J. Agric. Sci., 2(1,2): 103-112, 1989.

[25]**Ali, M.H.H and Fishar, M.R.** Accumulation of trace metals in some benthic invertebrate and fish species relevant to their concentration in water and sediment of Lake Qarun, Egypt. Egypt. J. of Aquat. Res., 31: 289 – 302, 2005.

[26]**Canlı, M., Atlı, G.** The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, Zn) levels and the size of six Mediterranean fish species. Environmental Pollution., 121: 129-136, 2005.

[27]**Ashraf, W.** Levels of selected heavy metals in tunn fish. Arabian J. Sci. Engin., 31(1A): 89-92.

[28]**Dalman, O; Demirak, A. Balcı, A**. Determination of heavy metals (Cd, Pb) and trace elements (Cu, Zn) in sediments and fish of South-eastern Aegean Sea (Turkey) by atomic absorption spectrometry. Food Chemistry., 95: 157-162, 2006.

[29]**Buikema, A. L. (Jr), Niederlehner, B. R. and Cairns, J. (Jr)** Biological Monitoring: Part IV –Toxicity Testing. Water Res. 16: 239-262, 1982.

[30]**Kime, D.E., Ebrahimi, M., Nysten, K., Roelants, I., Rurangwa, E., Moore, H.D.M. and Ollevier, F.** Use of computer assisted sperm analysis (CASA) for monitoring the effects of pollution on sperm quality of fish, application to the effects of heavymetals. *Aquatic Toxicology*. 36: 223-237, 1996.

[31]**ROPME,** Manual of Oceanographic Observation and Pollution Analyses Methods ROPME/ P.O Box 16388.Blzusafa, Kuwait, 1982.

[32]**Bailey, N.** Statistical methods in biology, 2nd ed. John Wiley, New York, 1982.

[33]**WHO/FAO**, National Research Council Recommended Dietary 626 Allowances (10^{th} ed). National Academy Press. Washington, DC. USA. 1989.

[34]**Marcovecchio, J.E.,** The use of Micropogonias furnieri and Mugil liza as bioindicators of heavy metals pollution in La Plata River Estuary, Argentina. Sci. Total Environ; 323: 219-226, 2003.

[35] **Dhinakaran, D. I., Muthukrishnan,S., Kaleeswaran A.,S,. Jeyanthinathan,M. Umasankari, M. and Thilagavathi, S.** Bioaccumulation of Heavy Metals in Two Marine Fishes**.** Middle-East Journal of Scientific Research 22 (3): 333-338, 2014.

[36] Al-Najare, G. A. The Bioaccumulation of some heavy metals in fish *chirocentrus dorab* collected from Iraqi Marine Waters. J. of King saud University, 26(2) in press, 2014.

[37]**Tokalioglu, S.; Kartal, S. and Elci, L.,** Speciation anddetermination of heavy metals in lake waters by atomic absorption spectrometry after sorption on amberlite XAD-16 Resin. *Analytical Sciences*, 16(1):1169-1174, 2000.

[38]**Ososkov, V.K. and Kebbekus, B.B..Pre concentration**, (1997). speciation and determination of dissolved heavy metals in natural water, using ion exchange and graphite furnace atomic absorptionspectrometry. *U.S. Environmental Protection Agency*, 1997.

[39]**Al-Najare, G. A.** Seasonal changes to some of heavy metals in the muscles of three species of fish (Cyprindae) from Al-Hawizeh Marshe and south Hammar. M.Sc. Fisheries and Marine Resources, Coll. of Agriculture, Basrah University, 2009.

[40]**Abida B., HariKrishna S., and Irfanulla K.** Analysis of Heavy metals in Water, Sediments and Fishsamples of Madivala Lakes of Bangalore, Karnataka. *International Journal of Chem. Tech. Research,* 1(2):245-249, 2009.

[41]**Aucoin, R. Blanchard, C. Billiot, C. Partridge, D. Schultz, K. Mandhare, M. J. Beck and J. N. Beck**. Trace metals in fish and sediments from Lake Boeuf, South- eastern Louisiana. Microchemical Journal, 62(2):299-307, 1999.

[42]**Eastwood, S., and Couture,P.,** Seasonal variations in condition and liver metal concentrations of Yellow Perch (Perca flaescens) from a metal-contaminated environment. Aquatic Toxico., 58(1):43-56, 2002.

[43**] Mendil D**, Determination of trace metal levels in seven fish species in lakes in Tokat, Turkey. Food Chem 90:175–179, 2005.

[44]**Ahmad, T., Salman, N. A., and N. A. Hussain**, Effects of some experimental conditions on the behaviour and survival of Liza abu (Heckel) from Basrah, Iraq. J. of The Faculty of Marine Sci., 3:50 63, 1983.

[45]**Yılmaz, F., N. Ozdemir, A. Demirak and A. Levent Tuna.** Heavy metal levels in two fish species Leuciscus cephalus and Lepomis gibbosus. Food Chemistry, 100(2):830-835, 2007.

[46] **Forstner,U. and Wittman,G. T. W**. (1981). Metal polution in the aquatic environment. Springer Verlage.

[47]**Bhupander K, Mukherjee DP, Sanjay K, Meenu M, DevPrakash SK, Sharma CS**, Bioaccumulation of heavy metals in the muscle tissue of fishes from selected aquaculture ponds in east Kolkata wetlands. Ann.. Biol. Res. 2(5):125-134, 2011.

[48]**Laxmi Priya S, Senthilkumar B, Hariharan G, PaneerSelvam A, Purvaja R, Ramesh R** Bioaccumulation of heavy metals in mullet (*Mugilcephalus*) and Oyster (*Crassostreamadrasensis*) from Pulicat lake, south east cost of India, Toxicol. Ind. Health 27(2):117-126, 2011.

[49]**Mwakio, P. T., and J.S. Muhalulukhu**, Lake Victoria Fisheries: Status, biodiversity and management, *Aquatic Ecosystem Health and Management Society*, 2003.

[50]**Al-Najare, G.A.** Concentration of metals in the fish *Liza subviridis* from the Iraqi marine Estimation. J. of King abdulaziz University, Marin Sciences, 23(1):129-146p, 2012.

[51]**Al-Najare, G.A., Hantoush, A.A., Al-Shammary, A.C. and Al-Saad, H.T.** Bioaccumulation of heavy metals in *Acanthopagrus latus* collected from Iraqi marine waters. Iraqi Journal of Aquaculture: 10(2):107-122p, 2013.

[52]**Al-Najare, G. A. Jaber, A. A. Talal, A.H. Hantoush, A. A** The concentrations of heavy metals (copper, nickel, lead, cadmium, iron, manganese (*Tenualosa ilisha* (Hamilton,1822) hunted from Iraqi Marine Water. Mesopotamia Environmental Journal Mesop.,1(3):31-43, 2015.