CONCENTRATION OF PB AND CD IN WATER AND IN SELECTING ORGANS OF GATTAN *Lucibarbus xanthopterus* FROM TIGRIS RIVER, SOUTHERN BAGHDAD CITY, IRAQ

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ABSTRACT

A total of 85 specimens of *Lucibarbus xanthopterus* were collected from three sites from Tigris River during November 2015 to April 2016 , total length ranged among 7-33cm, fish were divided into four length groups. Heavy metal analysis was done and included measurement of Pb and Cd concentrations in water and in gills, muscle, liver and kidney of *L. xanthopterus*. The results showed that the mean concentration of Pb was higher than Cd in water and fish organs. The present results demonstrated that the concentration of both Pb and Cd in fish liver and kidney are much higher than that in gills and muscle. Pb level followed the sequence: liver > kidney > muscle > gills from site 1 and 2, while the orders of level of Pb in organs are as: kidney > liver > muscle > gills from site 3. As referring to levels of Cd that followed the sequence: liver > kidney> gills > muscle from site 1 and 3 , while the orders of concentration level of Cd in organs are as : kidney > liver > gills > muscle from site 2.

It can be concluded that the mean concentration values of dissolved Pb in water and fish tissues recorded more than dissolved Cd in all stations .

INTRODUCTION

Tigris River is one of the main important Rivers in Iraq, sharing with Euphrates River as the main water resources, and irrigation made it possible for the local people to develop agriculture. Un treated domestic sewage, oil wastes, rubber factories, industrial waste water, high salinity and hardness of water and radioactive weapons used in the wars are all the principal contributors of pollutants in Iraq particularly over the last few decades (26). Among the environmental pollutants, lead and cadmium are of particular concern, due to their potential toxic effect and ability to bio accumulate in aquatic ecosystems (3). Fish attracted a lot of attention as bioindicators for monitoring aquatic pollution, due to their relatively large body size, long life cycle, position in the aquatic food chain and their use for human consumption (25& 29). *Lucibarbus xanthopterus* appears to have great economic and ecological importance , its population are currently in decline due to environmental degradation and human activities. *L. xanthopterus* omnivorous feeders with dominant of animal components, which feed near to the bottom (7). The present work has been carried out to study the bioaccumulation of two heavy metals (Pb and Cd) in water and in selected organs (gills, muscle, liver and kidney) for fishes collected from Tigris River at Baghdad City.

MATERIALS AND METHODS

STUDY AREA

Tigris River divides Baghdad City into a right side (Karkh) and left (Rusafa) sections with a flow direction from north to south. Three sampling sites were chosen on Tigris River. The first site was located near water sewage of the Karkh Directorate, the second site was located at the confluence of the Diyala

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River with Tigris River, the third was located near Ibn –Khateeb Hospital (Fig.1).

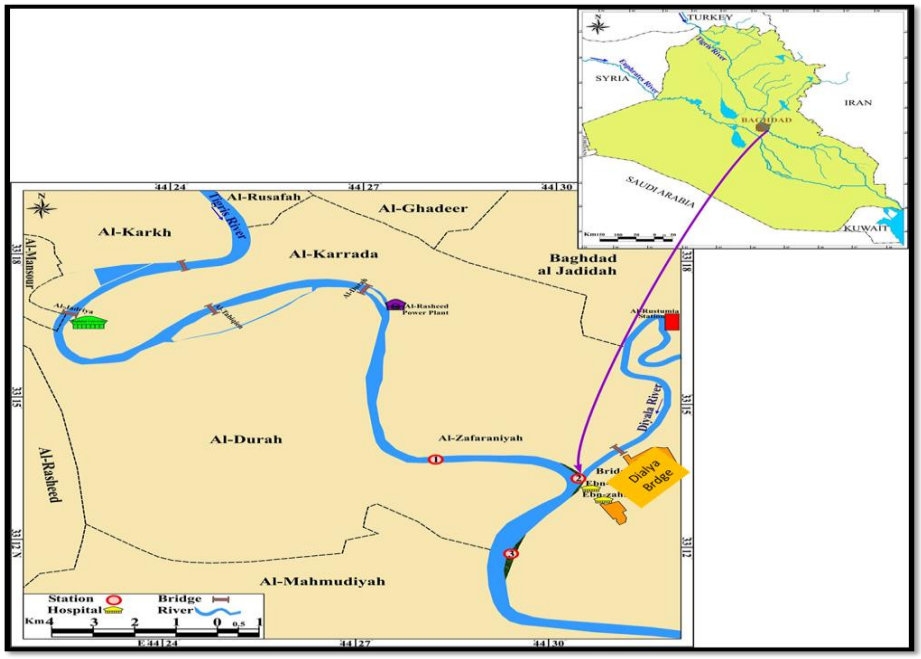

Figure 1: Map of the study area in the Tigris River showing three study sites

FISH SAMPLING

A total of 85 specimens of *L. xanthopterus* were collected monthly from three sites that were chosen on Tigris River during the period of November 2015 to April 2016, ranged between 7-33cm in length were divided into four length groups,using gill and casting nets with mesh dimensions 5*5 mm.

EXTRACTION OF HEAVY METALS FROM FILTERED WATER

One liter of water sample was filtered using millipore filter papers (0.45µm). These filter papers were washed with5% hydrochloric acid, followed by de-ionized water and dried at 60°C for 24h; the filtered water was transferred to a beaker then acidified with 5ml of concentrated nitric acid. The sample allowed to cool and transferred to 50 ml volumetric flask, The solution was kept in clean polyethylene flasks. Finally, the solution was ready for reading Pb and Cd metals by flame atomic absorption spectrophotometer (11).

ESTIMATION OF PB AND CD IN THE TISSUES

Fish samples were dissected; gills , muscle, liver and kidney were removed , washed with distilled water and placed in slides, Tissues were measured for their weight and then digested with 10 ml nitric acid. When the fish tissues were dissolved completely, the sample was placed on a water bath and gradually heated to 70 ^{o}C until the vapor and the acid fluid inside the flask turned clear, the flask was heated to 70 ^{o}C to evaporate the excess acid till the remaining digested fluid became 1 ml. then kept at room temperature, and 1ml. nitric acid was used to wash and the filtrate was digested. Finally, the digests were diluted to 25 ml in a volumetric flask. The digested sample was filtered through 0.45µm millipore membrane filter. The heavy metals Pb and Cd in the filtrates were determined directly by a Shimadzu AA-6601,Atomic Absorption Spectrometer. The measured concentrations are expressed in µg/g unit.

STATISTICAL ANALYSIS

One-way and two-way analysis of variance (ANOVA) was used to determine whether Pb and Cd concentrations varied significantly among tissues and water, with values less than 0.05 ($p \leq 0.05$) considered statistically significant. The statistical calculations were done using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA) statistical package.

RESULTS AND DISCUSSION

CONCENTRATION OF DISSOLVED PB IN WATER

The results of present study showed that the concentration of Pb in water was varied in the three studied sites, which increased particularly in Nov.2015 compared with the other months and reached 6.50µ/l. at site 3 (Tab. 1), followed by site 2 (4.50µ/l) and site 1 (2.50µg/l). The lowest value (0.01µg/l) recorded at site 1 in Feb. and Mar. 2016 , also in Jan., Fab and Mar. at site 2. The statistical analysis showed no significant differences ($p>0.05$) in dissolved Pb concentration among all sites. The concentration of dissolved Pb found in the present study considered relatively high compared with the findings of Al-Lami and Al-Jaberi (5) on Tigris River, While the study of Al-Mayah (6) on the Al-Garaf River showed that the mean concentration of lead was higher than the results of the present study. Pb could be attributed to the huge amounts of sewage and industrial wastewater discharged into the river (1).

Table l : Monthly variations of dissolved Pb µ/l in water (mean ± SE.) for all sites

Month / Site	Nov. 2015	Dec.	Jan. 2016	Feb.	Mar.	Apr.	Mean
1	2.50	2.14	0.06	0.01	0.01	0.35	0.84±0.47
2	4.50	1.21	0.01	0.01	0.01	0.51	1.04±0.71
3	6.50	0.57	0.02	0.04	0.04	0.34	1.25±1.05

All differences are not significant at ($p>0.05$)

CONCENTRATION OF PB IN TISSUES

The results are summarized in Tab. (2) shows the mean concentrations of Pb in the various organs viz., gills, muscle, liver and kidney of *L. xanthopterus* from site 1, ranged from13.54 µg/g in gills recorded in largest group to 60.00µg/g in liver and kidney which recorded in 11-20cm and 21-30cm length groups respectively, while the level of Pb from site 2 has ranged from 19.01 µg/g to 76.33 µg/g in gills and liver in 21-30 cm and 1-10 cm respectively. Tab. 2 is referring to site 3 shows that the lower mean concentration of Pb were observed in muscle which recorded 14.63 µg/g in largest group, the highest value found in kidney recorded 65.44µg/g in 11- 20cm length group. In total the mean accumulation of Pb is varied among lowest value recorded in gills from site 1 to highest value recorded in liver from site 2. The results of statistical analysis showed no significant differences ($p>0.05$) in Pb concentration among different length groups for each site, or among all sites during studied period. Among the four organs the levels of lead level followed the sequence: liver > kidney > muscle > gills from site 1 and 2, while the orders of concentration of lead in organs are as : kidney > liver > muscle > gills from site 3.

Table 2 : Concentrations of Pb µg/g(mean ±SE.)in different organs of *L. xanthopterus* according to length groups for all sites

Site	Length group (cm)	Gills	Muscle	Liver	Kidney
1	1-10	17.20±1.80	30.00± 13.00	57.48± 2.55	47.31± 12.12
	11-20	17.55± 2.01	33.68± 10.10	60.00± 2.89	40.40± 12.76
	21-30	22.40± 12.33	44.73± 12.34	38.45± 1.11	60.00± 11.89
	31- 40	13.54± 1.90	44.74±1 4.55	48.95±13.56	49.40± 13.23
2	1-10	29.12± 11.24	44.25± 13.34	76.33± 16.67	41.32± 14.24
	11-20	23.20± 1.56	35.53± 12.12	37.67 ±11.26	49.80± 12.67
	21-30	19.01± 1.99	58.93± 12.45	68.88± 15.45	58.00± 13.14
	31- 40	17.20± 1.74	22.71± 2.45	55.49± 13.63	62.20± 24.60
3	1-10	22.40± 12.58	58.51± 20.36	60.56± 15.61	51.95± 13.26
	11-20	14.82± 1.18	44.33± 13.72	36.97± 14.58	65.44± 16.72
	21-30	20.77± 13.52	38.02± 12.58	58.12± 16.51	46.35± 14.48
	31- 40	21.88± 13.59	14.63± 1.26	38.27± 13.69	53.33± 15.73

All differences are not significant at (p>0.05)

CONCENTRATION OF DISSOLVED CD IN WATER

Tab. (3) illustrated the variations of the dissolved Cd concentration in water at all sites, which was ranged between 0.00 µg/l at site 1 in Nov. 2015 ,Feb. and Mar. 2016 at site 1 as well as in Dec.2015 at site 2 and Nov. 2015 at site 3 to 0.09 µg/l found in Jan. 2016 at site 2. The statistical analysis showed no significant differences (p>0.05) in dissolved Cd concentration among all sites. Cd may be attributed to the huge amounts of raw sewage and agricultural wastewater discharged into the river (1). The obbained results were in agreement with the previous studies (4, 20 &28).

Table 3 : Monthly variations of dissolved Cd µ/l in water (mean ± SE.) for all sites

Month / Site	Nov. 2015	Dec.	Jan. 2016	Feb.	Mar.	Apr.	Mean
1	0.00	0.02	0.04	0.01	0.01	0.08	0.02±0.01
2	0.08	0.01	0.09	0.07	0.07	0.04	0.06±0.01
3	0.006	0.03	0.08	0.06	0.04	0.03	0.04±0.01

All differences are not significant at (p≤0.05)

CONCENTRATION OF CD IN TISSUES

According to length group of *L. xanthopterus* which illustrated in Table 4. Cd was accumulated with least concentration (0.03 µg/g) in muscle in first length group from site 1, whereas it was accumulated at the highest level (2.46 µg/g) in liver in 11-20cm length group from the same site .The level of Cd was ranged between 0.15µg/g in muscle in 11-20 cm length group to 1.41µg/g in kidney in 31-40cm length group from site 2, on the other hand site 3 characterized with concentration of Pb differed among fish organs and ranged from 0.20 µg/g noticed in gills in fourth length group to 2.94 µg/g recorded in 11-20cm length group. The results of statistical analysis showed no significant differences (p>0.05) in Cd accumulation among different length groups for each site, or among all sites during studied period. Among the four organs the levels of Cd level followed the sequence: liver > kidney> gills > muscle from site 1 and 3 , while the orders of concentration level of Cd in organs are as follows : kidney > liver > gills > muscle from site 2.

Table 4 : Concentrations of Cd µg/g (mean ±SE.)in different organs of *L. xanthopterus* according to length groups for all sites

Site	Length group (cm)	Gills	Muscle	Liver	Kidney
1	1-10	0.97± 0.07	0.03 ± 0.01	1.69± 0.05	1.27± 0.06
	11-20	1.04± 0.07	0.66± 0.04	2.46± 0.96	0.24± 0.09
	21-30	0.56± 0.03	2.01± 0.06	0.90± 0.04	1.04± 0.04
	31-40	0.62± 0.07	0.03± 0.00	1.31± 0.05	1.41± 0.05
2	1-10	0.51± 0.05	0.74± 0.05	0.67± 0.09	0.88± 0.02
	11-20	0.59± 0.02	0.15± 0.07	0.87± 0.04	0.80± 0.02
	21-30	0.76± 0.01	0.95± 0.02	0.80± 0.02	0.71± 0.02
	31-40	0.74± 0.05	0.66± 0.03	0.90± 0.03	1.41± 0.04
3	1-10	1.04± 0.05	2.13± 0.08	0.40 ±0.03	0.24± 0.03
	11-20	0.31± 0.05	1.05± 0.06	2.94± 0.06	2.75± 0.07
	21-30	2.78± 0.07	0.54± 0.02	0.38± 0.02	1.19± 0.07
	31-40	0.20± 0.01	0.58± 0.06	1.87± 0.07	0.31± 0.01

All differences are not significant at (P≤0.05)

Lead and cadmium are highly toxic to aquatic organisms (particularly fish) at low concentration because fishes are not able to regulate their levels in tissues, under conditions of low Cd-concentrations and prolonged exposure, the concentration of Cd in liver and kidney is shown to gradually increase (3). The present results demonstrate that the concentration of Pb and Cd in fish liver and kidney had the highest value than that in gills and muscle. Cadmium is accumulated primarily in the kidney and liver. Pb and Cd were showed very high affinity to kidney, therefore the kidney may be considered a good indicator of pollution (27). The kidney is the main organ involved in the maintenance of body fluid homeostasis, its role to detoxify metals has also accumulated significant amounts of heavy metals (17). The high accumulation of theses metals in the liver could be related to the fact that the liver played an important role in accumulation and detoxification (27) . The current results pointed out that the mean concentration of Pb is higher than Cd in all examined organs, this result are in agreement with Ambedkar and Muniyan (10) of Kollidam River, India and Al-Samawi (8) on Tigris River. Accumulation of metals in the organs of fish is a function of uptake and elimination rates, and metal concentrations in various organs may change during and after exposure, according to various patterns (3). Similar observations were reported by many studies carried out with various fish species (16, 22& 24). Cinier *et al.* (14) found out that the loss of accumulated Cd was rapid and immediate in muscle and no loss of Cd was observed in kidney and liver, it can therefore be stated that levels of heavy metals Pb and Cd in fish is not active tissue for bioaccumulation of heavy metals as reported seem to be a transitory tissue in the pathway of metal uptake and in metal storage, thus muscle are not always a good indicator of the whole fish body contamination (12). Saleh(23) reported that the amount of pollutants in the fish liver is directly proportional to the degree of pollution in the aquatic environment by heavy metals. Similar to the present study, lowest Pb concentrations in muscle were found in *Oreochromis niloticus* from Lake Awassaand and Lake Ziway (18). The same observation was made concerning different freshwater fish species in Lake Kolleru , India , and in Chenab River, Pakistan (2 &21). In the present work the studied sites are highly contaminated with Pb and Cd due to the large disposal of sewage and local industrial waste from water sewage of the the Karkh Directorate, Alrustumia water sewage (Diyala River) Ibn–Khateeb Hospital. The statistical analysis pointed out no significant differences (P>0.05) in the accumulation pattern of metals in various tissues according to length groups in each site or among all sites in *L. xanthopterus*, thus the

difference in accumulation pattern of metals in different tissues was presumably due to the differences in their physiological roles in maintaining homeostasis and regulatory ability of each organ in the fish (8).Some metal do not increase in concentrations with length are thought to be under homeostatic control (19). Al-Yousuf *et al.* (9) found out that the concentration of Cd in *Lethrinus lentjan* has a positive correlation with fish length. In contrary, Several researchers have shown negative relationships among fish length and the metal accumulation (8,13& 15) , according to this study the pollution in Tigris River South of Baghdad could be increase for the next years due to increased human activities.

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تركيز الرصاص والكادميوم في الماء وأعضاء محددة من سمكة القطان *Lucibarbus xanthopterus* من نهر دجلة، جنوب بغداد، العراق

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الملخص

جمعت 85 عينة من أسماك القطان ***Lucibarbus xanthopterus*** من ثلاثة مواقع من نهر دجلة من شهر تشرين ثاني 2015 لغاية شهر نيسان 2016، قسمت أطوال ألاسماك الى أربع مجاميع . تم قياس تركيز العناصرالثقيلة الرصاص والكادميوم في الماء وفي كل من الغلاصم والعضلات والكبد والكلى لسمكة القطان. أظهر النتائج أن معدل تركيز الرصاص أكثر من الكادميوم في كل من المياه والأسماك ، إذ سجلت تراكيز الرصاص والكادميوم في الكبد والكلى قيماً أعلى من الغلاصم والعضلات. جاء تسلسل تركيز الرصاص كما ياتي: الكبد> الكلى> العضلات> الغلاصم في الموقعين 1 و 2 ، في حين كان تركيزه في أعضاء ألاسماك في الموقع 3 كما ياتي : الكلى > الكبد > الغلاصم > العضلات. أما تركيز الكادميوم في أعضاء السمكة فكانت كما يأتي : الكبد > الكلى > الغلاصم > العضلات في الموقعين 1 و3، بينما سجل تركيزه الكادميوم في الموقع 2 حسب التسلسل التالي : الكلى > الكبد > الغلاصم > العضلات.

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