Determination of lead concentration in water and in different organs of *Carrasobarbus luteus* and *Cyprinus carpio* in Tigris River

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Summary

The present study was carried out during the period from November 2015 to April 2016 to determine the concentration of lead in Tigris River. A total of 75 fish of Hamri *Carrasobarbus luteus* and 82 specimen of common carp *Cyprinus carpio* were sampled at three different stations. Atomic absorption spectrometry is a technique for measuring quantities of Lead present in water and fish. The results showed that the mean concentration of lead in water was more than in fish organs. Statistical analysis showed no significant differences in lead concentration between all stations. In *C. luteus* and *C. carpio* showed no significant differences in gills, muscles, liver and kidney between different length groups for each station. Length group 21- 30 cm at station 2 showed increasing differences compared with the same length group at station 1, Also *C. carpio* of Length group 31-40 cm at station 2 showed significantly increasing ($P \leq 0.05$) compared with the same length group at station 1. The highest concentration of lead was recorded in studied organs of *C. luteus* at station1as the following sequence: Gills > kidney > liver > muscles, while station 2: kidney > gills > liver > muscles, station 3 characterized as following sequence: Kidney > liver > gills > muscles. The highest concentration of lead was recorded in studied organs of *C.carpio* at station1as the following sequence: Gills > liver > muscles > kidney, while station 2: Gills > kidney > liver > muscles, station 3 characterized looks like a sequence of station 1 as following: Gills > liver > muscles > kidney. In conclusion, the result of the present study approved the presence of lead in the water of Tigris River and fish living inside it. In addition, the mean concentration of lead in water was more than in fish organs. The results also reported that lead concentration was higher than the allowable WHO concentration.

Keywords: *Carrasobarbus luteus*, *Cyprinus carpio*, Heavy metals, Lead.

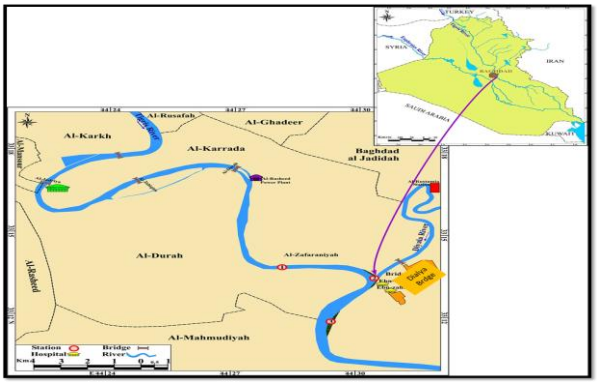
Introduction

Increase of human activities especially with the rapid agriculture and industrial development have resulted in a significant increase in levels of pollutants such as heavy metals (1). Heavy metals potentially accumulate in aquatic environment including water, sediments and fish, and subsequently are transferred to humans through the food chain. Many fish species are among the top consumers of trophic pyramids in aquatic ecosystems (2). Lead (Pb) and its products are harmful pollutants in the environment as well as being produced by manufacturing and mining action (3). The present study was performed to identify the concentrations of lead in Tigris River and determine Pb in selected organs (gills, liver, kidney and muscles) in two commercial fish species *Carrasobarbus luteus* and *Cyprinus carpio.*

Materials and Methods

The present study was carried out during the period from November 2015 to April 2016 in Tigris River near Al-Zafaraniyah, within Baghdad city. In the present study, three stations were chosen from Tigris River in Baghdad city (Fig. 1). The first station is located from the confluence on distance 1 km with the Diyala River near Animal and Fish Resources Center located in Al-Zaafarania city. The second station in Tigris River is about 3km before Diyala River joined with the Tigris River in the latitude (33°, 13′, 25″) and longitude (44°, 30′, 25″). This station is characterized by large population density and is near Hospital Ibn Zahr Al-Khatib, a hospital of isolation diseases; also it represents a drinking water source for large number of population. The River is characterized in this region by high growth of plants (Nile Flower) on both sides. While the third station is the

second substation of the Tigris located within 3 km in the latitude (33°, 11′, 55″) and longitude (44°, 29′, 25″). Also this station is characterized by agricultural fields and villages on the banks of the River. The River in this area with increased width and presence of some small stream which get the waste from around agricultural fields.



Figure, 1: Map of Tigris River showing the sampling stations.

Extraction of heavy metals from filtered water was made by taking one liter of monthly water sample filtered by Millipore filter papers (0.45 µm). These filter papers were washed with hydrochloric acid (5%), followed by de-ionized water and dried at 60 °C for 24 hrs; the filtered water was transferred to a beaker then acidified with 5ml of concentrated nitric acid. The sample was allowed to cool and then transferred to 50 ml volumetric flask. The solution was kept in clean polyethylene flasks. Finally, the solution was ready for reading by flame atomic absorption spectrophotometer and the concentration of Pb was calculated according to the equation as describe by (4).

Three stations were chosen on Tigris River in Baghdad city for present study for a period from November 2015 to April 2016. A total of 75 fish were collected for Hamri *C. luteus* and 82 specimen of common carp *C. carpio* for all stations, then placed in clean boxes with ice until it reached laboratory on the same day. Fish were divided into three length groups for Hamri and four length groups of common carp with 10 cm for each length group**.**

Extraction of heavy metals from fish: Fish specimens for every station were dissected (gills, muscles, liver and kidney), about 50g of native organs were taken into crucibles and washed with distilled water and placed on clean individual marked slides and in oven at 70 °C for 24 hr. Pb analysis was determined by using flame atomic absorption spectrophotometer (FAAS), according to methods described by (5). Data were analyzed using General Linear Model (GLM) in SAS program (6). One-way and two-way ANOVA with Least significant differences (LSD), and assess significant difference among means. P≤0.05 was considered statistically significant.

Results and Discussion

The results in present study showed that the concentration of Pb in water differed in the three studied stations; concentration increased especially in Nov.2015 compared with the other months (Table, 1) The values of Pb concentration at station 3 were 6.500 µ/l in Nov. 2015, while the results pointed out that the maximum values recorded at station 1 in Nov. 2015 and Dec. 2015 reached 2.500 and 2.145 µ/l respectively, meanwhile station 2 recorded maximum value in Nov. 2015 reached 4.500. The lowest value was 0.01 µg/l at station 1 in Feb. and Mar. 2016, while the highest concentration in Nov.2015 was 6.50 µg/l at station 3. Statistical analysis showed no significant differences (P>0.05) in dissolved Pb concentration between all stations.

The concentration of dissolved Pb found in this study considered relatively high when compared with the findings of (7) on the Euphrates River and (8) in upper region of Tigris River. While, the study of (9) on the AL-Garaf River showed that the mean concentration of lead was higher than results of present study.

Table, 1: Monthly variations of dissolved Pb µ/l in water (mean ± SE.) for all stations.

Station	Month	Nov. 2015	Dec.	Jan. 2016	Fab.	Mar.	Apr.	Mean ±SE.
1	Pb	2.500	2.145	0.062	0.010	0.010	0.347	0.840±0.47
2	Pb	4.500	1.206	0.012	0.011	0.011	0.511	1.04±0.71
3	Pb	6.500	0.575	0.019	0.044	0.044	0.339	1.250±1.05
LSD					2.365			

All differences are not significant at (P>0.05).

According to length group of *C. luteus* which illustrated in (Table, 2) the concentrations of Pb in gills ranged from 40.88-42.38 µg/g in smallest and largest length groups respectively in Station 1, while it ranged between 58.79-59.51 µg/g in smallest and second length group respectively at the station 2, on the other hand station 3 characterized with concentration of Pb ranged variety from 33.67 µg/g in smallest length group to 34.18 µg/g in largest length group. Results of statistical analysis showed no significant differences (P>0.05) in Pb level in gills among different length groups for each station, or among the three stations during studied period. Station 2 recorded highest values of Pb in gills compared with the other stations in different length group (Table, 2). Concentration values of Pb in *C. luteus* are also differed in muscles according to stations, which ranged between 23.89-26.74 µg/g in length group 1-10 cm at station 1, and between 37.32-39.75 µg/g and between 31.14-32.14 µg/g in same length group at stations 2 and 3 respectively. Station 2 recorded highest values of Pb in muscles compared with the stations 1 and 3 in different length group. Results of statistical analysis showed no significant differences (P>0.05) in Pb concentration in muscles of *C. luteus* between different length groups for each station, or among all stations during studied period. The liver of *C. luteus* revealed different concentration of Pb at the three stations, the values ranged between 20.38-22.07 µg/g and between 43.21-44.74 µg/g in first and third length group respectively at stations1and 3 respectively, while station 2 recorded highest values compared with other stations which ranged between 54.90 in length group 21-30 cm to 55.24 µg/g in length group 11-20 cm (Table, 2). Results of statistical analysis showed no significant differences (P>0.05) in Pb concentration in liver of *C. luteus* among different length groups for the three stations, or among all stations during studied period. The same situation are noticed in Pb concentration in kidney of *C. luteus*, the length group 1-10 cm recorded lowest valve in all stations with 40.47, 89.78 and 70.25 µg/g at stations 1, 2 and 3 respectively, the highest value was found in length group 21-30cm reached 42.26, 93.19 and 71.40 µg/g at stations 1, 2 and 3 respectively (Table, 2). Results also showed that significant differences (P≤0.05) in Pb concentration in kidney of *C. luteus* between different length groups for each station or between all stations during studied period. The highest concentration recorded of Pb in studied organs of *C. luteus* at station 1 as the following sequence: Gills > kidney > liver > muscles, while station 2: kidney > gills > liver > muscles, station 3 characterized as following sequence: kidney > liver > gills > muscles. The results of this study were higher than those observed by (10) on Al-Masab Alamm and (11) on Shatt Al-Arab River, while coinciding with (12) on Diyala River, (13) on Shatt Al-Hilla, (14) on Euphrates River and (15) on Al-Gharraf River. Also the results of Pb in current study was lowest than the results of the international studies of (16) on Juru River and (17) on Mudi River.

Table, 2: Concentrations of Pb µg/g (mean ±SE.) in different organs of *C. luteus* according to length groups for all stations.

Station	Length group (cm)	Gills	Muscles	Liver	Kidney ±SE.
1	1-10	40.88±18.56	23.89±9.63	20.38±5.50	40.47±16.44
	11-20	42.15±19.65	26.11±10.61	20.48±5.46	40.82±16.34
	21-30	42.38±19.62	26.74±10.56	22.07±6.53	42.26±16.90
2	1-10	58.79±24.52	37.32±15.62	55.23±26.64	89.78±43.83
	11-20	59.61±25.04	38.18±15.27	55.24±26.55	91.82±44.47
	21-30	59.51±25.17	39.75±16.12	54.90±31.51	93.19±44.36
3	1-10	33.67±15.72	31.14±12.63	43.21±13.45	70.25±42.88
	11-20	34.18±16.22	31.29±11.76	43.74±22.29	70.86±43.19
	21-30	33.99±16.24	32.14±12.28	44.74±22.47	71.40±43.15
LSD		58.16	36.82	60.08	105.13

All differences are not significant at (P>0.05).

According to length group of *C. carpio* illustrated in (Table, 3) the concentrations of Pb in gills ranged from 49.07-51.02 µg/g in smallest and largest length groups respectively in Station 1, while it ranged between 55.90 in smallest length group to 65.90 µg/g in both length group 11-20 and 21-30 cm at the station 2. On the other hand, concentration of Pb in station 3 characterized with ranged variety from 45.05 µg/g length group 31-40 cm to 47.05 µg/g in length group 21-30 cm. In the same table the results showed that no significant differences (P>0.05) in Pb concentration in gills between different length groups for each station, or between all stations during studied period, (Table, 3) showed that station 2 recorded highest values of Pb in gills compared with the other stations in different length group followed by station 1. Concentration values of Pb in *C. carpio* are also differed in muscles according to stations, which ranged between 25.32, 51.02, and 34.51 µg/g in length group 1-10 cm at station 1, 2 and 3 respectively to 27.02, 56.18 and 36.93 µg/g in length group 21-30 cm. The station 2 recorded highest values of Pb in muscles compared with the stations 1 and 3 in different length group. Results of statistical analysis showed that significant differences (P>0.05) in Pb residue in muscles of *C. carpio* between different length groups for each station, or between all stations during studied period. The liver of *C. carpio* which exposed to concentration of Pb are also differed according to stations, its values ranged between 40.84-44.84 µg/gin length groups 21-30 cm and 31-40 cm respectively at station 1, and between 50.11 µg/g in length group 11.20 cm at stations 2, and between 37.59-39.50 µg/g in length group 1-10 cm and 31-40 cm respectively (Table, 3).

Results of statistical analysis showed no significant differences (P>0.05) in Pb residue in liver of *C. carpio* between different length groups for each station, or between all stations during studied period. The same situation was noticed in Pb concentration in kidney of *C. carpio*, the length group 1-10 cm recorded lowest value in all stations with 17.43, 61.65 and 32.32 µg/g at stations 1, 2 and 3 respectively, the highest value was found in length group 31-40 cm reached 23.22, 70.13 and 39.71 µg/g at stations 1, 2 and 3, respectively (Table, 3). Results of statistical analysis showed no significant differences (P>0.05) in Pb residual in kidney of *C. carpio* between different length groups for each station, or between all stations during studied period. The highest concentration recorded of Pb in studied organs of *C. carpio* at station1as the following sequence: Gills > liver > muscles > kidney, while station 2: Gills > kidney > liver > muscles, station 3 characterized looks like a sequence of station 1 as following: Gills > liver > muscles > kidney. In the present study also Pb was accumulated in the gills at higher concentration than in liver and muscles. The highest concentrations were found in the gills and liver followed by the muscles (18). According to (19) toxicant concentration, particularly heavy metals are usually lower in the muscles than in the other studied organs and the muscles are not always a good indicator of the whole fish body contamination. This can be explained by the very fast rate of decontamination in this tissue.

Table, 3: Concentrations of Pb µg/g (mean ±SE.)in different organs of *C.carpio* according to length groups for all stations

Station	Length group (cm)	Gills	Muscles	Liver	Kidney ±SE.
1	1-10	49.07±20.08	25.32±8.95	41.18±17.08	17.43±6.72
	11-20	49.46±20.27	25.33±7.99	41.39±17.04	18.45±6.76
	21-30	50.02±20.58	27.02±9.66	40.84±16.38	20.22±7.87
	31-40	51.02±22.58	26.22±9.68	44.84±15.38	23.22±7.87
2	1-10	65.82±28.06	51.02±22.87	51.58±23.04	61.65±31.24
	11-20	65.90±28.05	51.30±23.07	50.11±23.49	62.45±31.45
	21-30	65.90±27.87	56.18±24.92	51.86±24.65	66.13±33.49
	31-40	55.90±22.87	53.13±25.90	55.86±27.65	70.13±33.49
3	1-10	45.25±20.78	34.51±15.49	37.59±17.52	32.32±13.94
	11-20	46.88±21.09	34.91±15.40	37.75±17.46	32.76±13.77
	21-30	47.05±21.04	36.93±16.89	38.50±17.73	34.71±14.38
	31-40	45.05±24.04	36.63±17.85	39.50±19.73	39.71±14.38
LSD		66.53	49.28	55.92	105.13

All differences are not significant at (p>0.05)

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تقدير تركيز الرصاص في المياه والأنسجة المختلفة لسمكتي الحمري *Carrasobarbus luteus* والكارب الشائع *Cyprinus carpio* في نهر دجلة

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الخلاصة

أجريت هذه الدراسة للمدة مابين تشرين الأول 2015 ونيسان 2016 لتحديد تركيز الرصاص في نهر دجلة. اختيرت ثلاث محطات من نهر دجلة في مدينة بغداد. وجمع 75 نموذجاً من سمكة الحمري و 82 عينة من أسماك الكارب الشائع، وقد استعمل جهاز المطياف الذري لقياس تركيز الرصاص، في الماء والأسماك. وقد أظهرت الدراسة الحالية ارتفاع تركيز الرصاص في المياه مقارنة بأنسجة الأسماك. وأشارت النتائج إلى عدم وجود فروق معنوية في تركيز الرصاص المذاب بين جميع المحطات، ولم تظهر فروقات معنوية في غلاصم وعضلات وكبد وكلى سمكة الحمري لمختلف مجاميع الأطوال لكل محطة في اثناء مدة الدراسة. لوحظ وجود زيادة معنوية لتركيزالرصاص في سمكة الحمري لمجموعة الطول 21- 30 سم في المحطة الثانية مقارنة بنفس مجموعة الطول في المحطة الأولى، كما أظهرت النتائج وجود فروقات معنوية في سمكة الكارب الشائع لمجموعة الطول 31–40 سم للمحطة الثانية مقارنة بالمحطة الأولى. سجل أعلى تركيز للرصاص في أنسجة سمكة الحمري للمحطة الأولى حسب التسلسل الآتي: الغلاصم > الكلى > الكبد > العضلات، في حين سجلت المحطة الثانية التسلسل التالي: الكلى > االغلاصم > الكبد > العضلات، أما المحطة الثالثة فكانت بالتسلسل الآتي: الكلى > الكبد > الخياشيم > العضلات. أما في سمكة الكارب الشائع فكان أعلى تركيز للرصاص بالتسلسل الآتي: الغلاصم > الكبد > العضلات > الكلى للمحطة الاولى، في حين سجلت المحطة الثانية: الغلاصم > الكلى > الكبد > العضلات، اختلفت المحطة الثالثة بشكل قليل وكما يأتي: الغلاصم > الكبد > العضلات > الكلى. وفي الختام وافقت نتائج الدراسة الحالية وجود الرصاص في مياه نهر دجلة والأسماك الحية داخله. فضلاً عن كون متوسط تركيز الرصاص في المياه أكثر مما في أعضاء الأسماك. وذكرت النتائج أن تركيز الرصاص كان أعلى من تركيز منظمة الصحة العالمية المسموح به.

الكلمات المفتاحية: سمكة الحمري، أسماك الكارب الشائع، المعادن الثقيلة، الرصاص.