Journal of Environmental Sciences, 2015; Vol. 44, No. 3 : 575-587

ACCUMULATION OF SOME HEAVY METALS IN WATER AND AQUATIC MACROPHYTES OF EUPHRATES RIVER

Jasim M. Salman[1*] Yasser A. El-Amier[2] Shaimaa J. Hadi[3]

[*1]*Department of Biology, College of Science, University of Babylon, Iraq*

[2]*Botany Department, Faculty of Science, University of Mansoura, Egypt*

[3]*Department of Biology, Faculty of Science, University of Kufa, Iraq*

**Corresponding author: jasimsalman@uobabylon.edu.iq; yasran@mans.edu.eg*

ABSTRACT

Some heavy metals including; Co, Cu, Cd, Pb and Fe were measured in water and roots, shoots and leaves of three aquatic macrophyte species namely; Phragmytes australis, Potomogeton pectinatus and Ceratophyllum demersum to evaluate the degree of pollution in Euphrates River during Mar. 2012 to Feb.2013. Concentration of the studied heavy metals in dissolved and particulate phases ranged between (76-137.75 µg/l & 582-749.5 µg/g) for Fe, (0.91-2.21 µg/l & 12.02-17.33 µg/g) for Cu, (1.54-4.30 µg/l&9.74-12.6 µg/g) for Cd, (0.85-2.66 µg/l & 0.00-0.41 µg/g) for Co and (4.83 – 7.92 µg/l & 0.41-0.7 µg/g) for Pb, respectively. The highest concentration of heavy metals was detected in submerged and leaves of aquatic macrophytes. The results showed that the heavy metals concentration in Euphrates River were within the permissible limits with significant local heavy metal pollution, and the heavy metals concentration in macrophytes were remarkably high but varied among plants species.

Keyword: *: Heavy metals, Water, Aquatic macrophytes, Bioaccumulation, Euphrates River.*

INTRODUCTION

Heavy metals have become the first source of environmental pollution, and these heavy metals are difficult to remediate and accumulated in toxic concentrations (Malar *et al.*, 2014).

Heavy metals might be produced from rocks, soils and sediments as natural sources, but mainly originated from industrial activities (El-Bouraie *et al.*, 2010). The existence of heavy metals in aquatic environments causes serious negative impacts on plant and animal life (Akpor *et al.*, 2014; El-Amier *et al.*, 2015).

Aquatic macrophytes play main role in equilibrium in water body and in maintaining the aquatic system. The aquatic plants maintain high tolerance to high levels of heavy metals and accumulated them in very high concentration (Begum and Krishna, 2010; Zurayk *et al.*, 2001; Cardwell *et al.*, 2002). Many studies deal with the concentration and accumulation of heavy metals in water and aquatic macrophyta and used these plants as bioindicator of heavy metals pollution (Kara, 2005; El-Bouraie *et al.*, 2010; Voica *et al.*, 2012;

Malar *et al.,* 2014; Hassan *et al.,* 2010 ; Salman *et al.,* 2010; Salman and Hussain, 2012; Salman *et al.,* 2015).

The aim of this study is to determinate the spatial and temporal variation of some heavy metals and accumulation of them in water and some aquatic macrophytes in Euphrates River (Al-Abasyia branch), middle of Iraq.

MATERIALS AND METHODS

The studied area was about 32 km represented by four sites along Euphrates River (Al-Abbasyia branch) during Mar. 2012 to Feb. 2013. Samples of water and aquatic plants were collected from study sites. Heavy metals were analysed in two phase of water (dissolved & particulate), dissolved heavy metals was measured according to APHA (2003) and particulate phase according to Sturgeon *et al.* (1982). Heavy metals in water measured by using Flame Atomic Absorption Spectrophotometer FAAS (model SHIMADZO, AA-7000, Japan).

Aquatic plants samples were collected from the same site and kept in polyethylene bags and transported to lab. All samples dried and digested according to Orson *et al.* (1992). Finally, heavy metals measured by FAAS (model SHIMADZO, AA-7000. Japan).

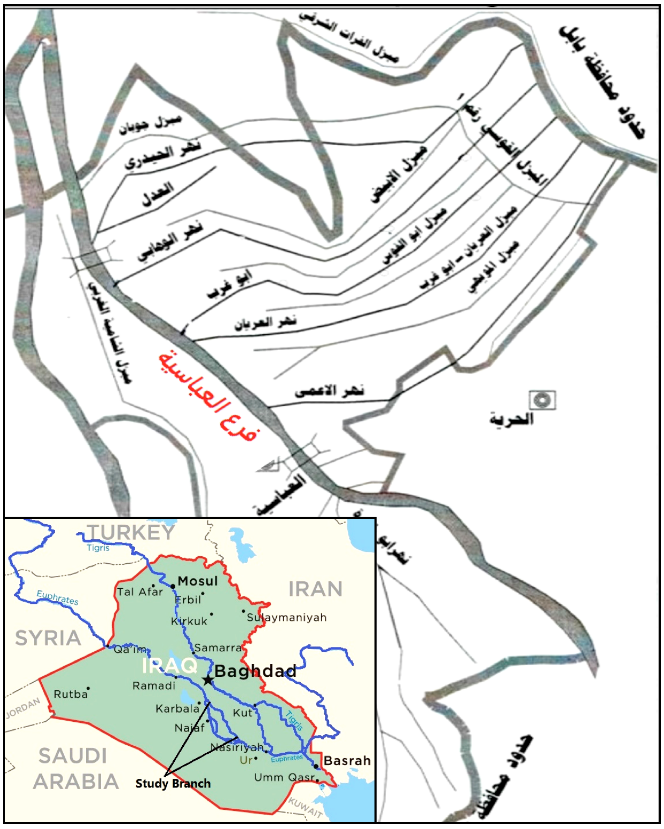

Fig. (1) : Map of Iraq showing Euphrates River and Al-Abasyia branch

RESULTS AND DISCUSSION

The concentrations of heavy metals are illustrated in Figure (2). The highest concentration of heavy metals Fe (137.75 µg/l), Cu (2.21 µg/l), Co (2.66 µg/l) and Pb (7.96 µg/l) were recorded in February 2013, whereas Cd expressed the highest value (4.30 µg/l) in July 2012. On the other hand, the lowest value was recorded in March (76.0 and 1.54 µg/l) for Fe and Cd, in April (0.85 and 4.83 µg/l) for Co and Pb, but Cu (0.91 µg/l) in September 2012, respectively. The results showed a significant variation among different months, this variation may be due to many factors such as water flow, waste water discharge, temperature run off pesticides and pollutants from adjecte area (Abdel-Baki, 2011; Salman and Hussain, 2012). This study recorded high concentration of heavy metals during winter while they recorded low concentration during summer may be due to a variations in many properties of water such as temperature, pH (Li *et al.,* 2013) or to amount of particulates (Faragallah *et al.,* 2009) and the density of phytoplankton (Atici *et al.,* 2008).

The concentrations of particulate heavy metals are shown in Figure (3). The highest concentration of particulate phase Fe (749.50 µg/g) and Pb (0.70 µg/g) were recorded in January 2013, whereas the lowest value (582.0 and 0.41 µg/g) were analyzed in July 2012. Cu and Cd expressed the highest value (17.33 and 12.78 µg/g) in February 2013, while, the lowest value (12.02 and 9.74 µg/g) were obtained in May and September 2012, respectively. On the other hand, Co expressed the highest value (0.41 µg/g) in November 2012, while the lowest value (0.01 µg/g) was recorded in May and September 2012.

The result showed the concentration of heavy metals in particulate phase was higher than their concentration in the dissolved phase may be due to the increase of particulate matter which include living and non-living components (El Bouraie *et al.,* 2010) or to drifting of particulate matter from catchment area , effluent of sewage and industrial and agriculture wastes (kara, 2005). Heavy metals in particulate phase effected by many physical and chemical properties of water such as temperature, pH, salinity, organic matters and water velocity (Karaer *et al.,* 2013).

Aquatic systems are more sensitive to pollution by heavy metals than terrestrial ones (Malar *et al.,* 2014), Aquatic macrophytes are well known in concentrating and accumulating heavy metal in aquatic system (Kara, 2005). The concentration of heavy metals in different parts of three species of aquatic plants are listed in Tables (1- 5).

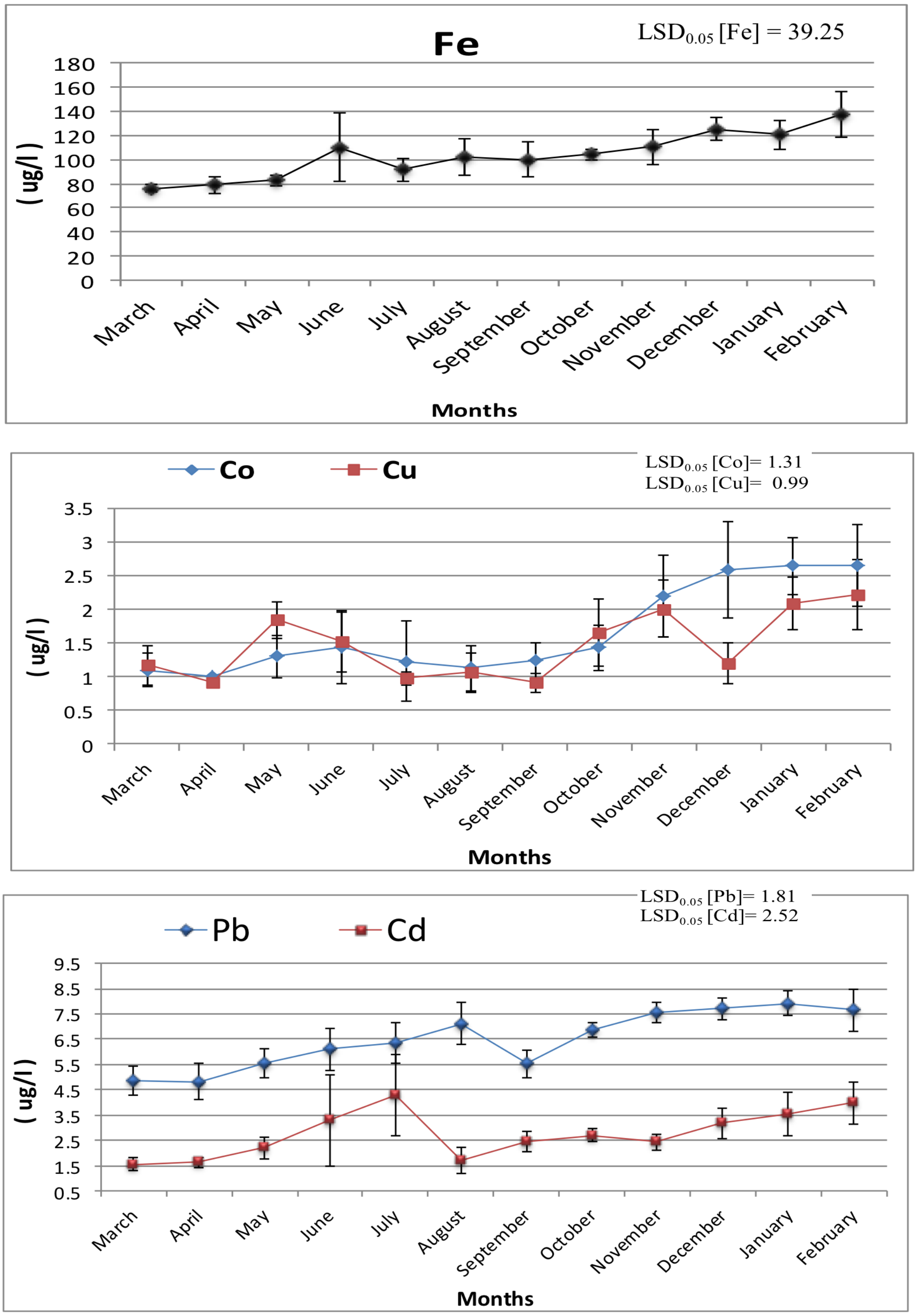

Fig. (2) : Concentration of some heavy metals in dissolved phase of water in study sites during Mar. 2012 – Feb. 2013.

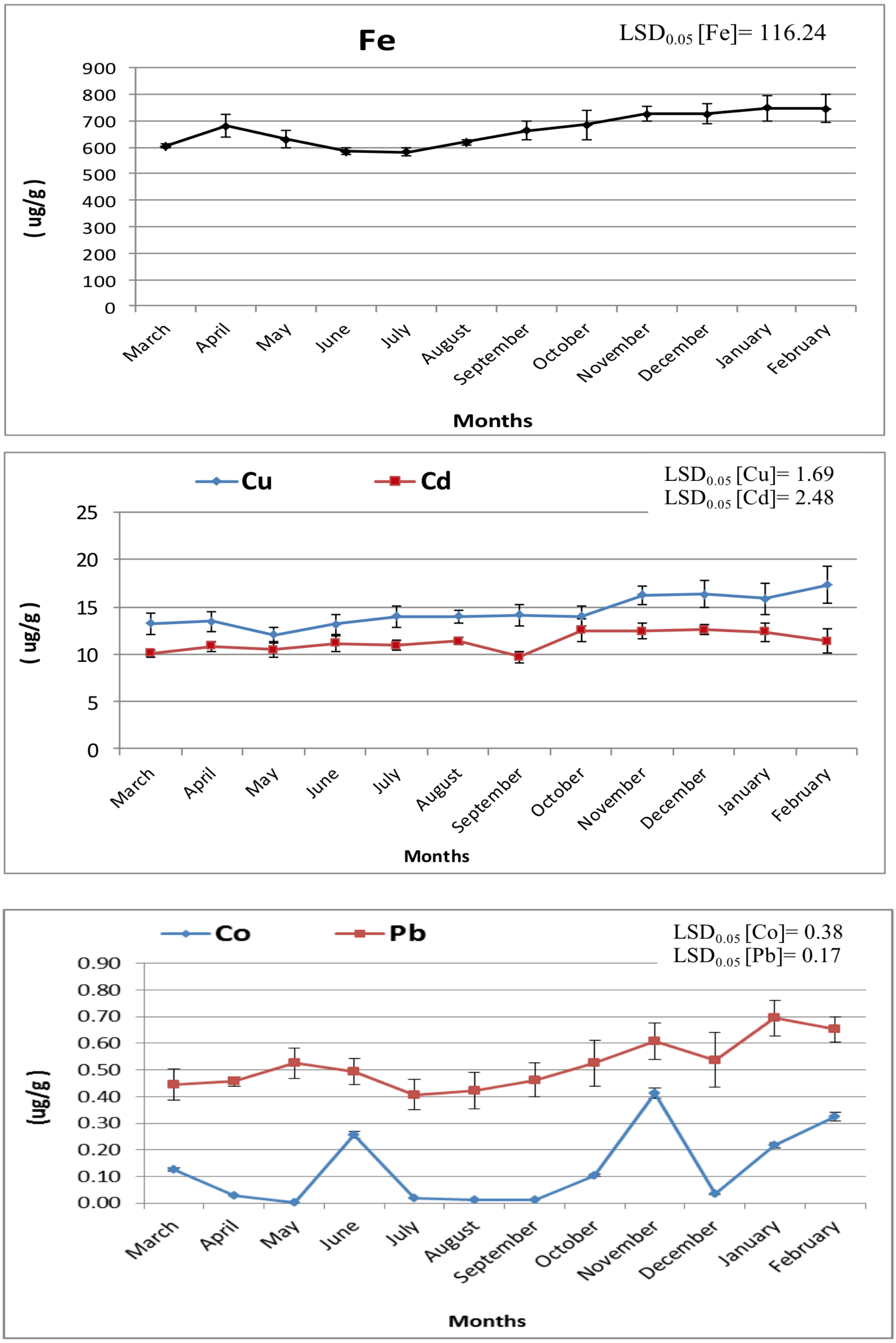

Fig. (3) : Concentration of some heavy metals in particulate phase of water in study sites during Mar. 2012 – Feb. 2013.

The highest Cu concentration (16.55 and 16.5 µg/g) was recorded in rhizome and stem of *Phragmitus australis*, respectively in September, April, 2012, whereas the leaves expressed the highest value (15.5µg/g) in February. 2013. In case of Potamogeton pectinatus the highest value (28.75, 20.65 and 24.5 µg/g) for root, stem and leaves were observed in June, August and March, respectively. However, *Ceratophyllum demersum* expressed the highest concentrations (15.55µg/g) for leaves in January. 2013. But the stem showed the highest content (20µg/g) in May and November, 2012 (Table 1).

Table (1) : Cu (µg/g) concentration in the parts plant during study 2012-2013 in four sites.

Month	Year	Aquatic Macrophyta							
		Phragmites australis (Cav.) Trin. ex. Steud.			*Potamogeton pectinatus* L.			*Ceratophyllum demersum* L.	
		Rhizome	Stem	Leaves	Root	Stem	Leaves	Stem	Leaves
March	2012	11.63±0.72	13.48±1.39	15.38±0.52	9.88±0.52	10.50±2.29	24.50±6.06	13.50±0.87	15.00±0.01
April		13.23±0.35	16.50±2.18	11.65±3.15	10.50±0.50	10.50±0.29	17.75±1.30	16.50±2.02	10.00±2.89
May		7.78±2.99	7.90±3.06	12.60±1.29	20.25±5.63	11.10±0.64	12.75±0.14	20.00±0.00	10.50±3.18
June		13.53±0.53	11.70±0.44	11.30±0.90	28.75±10.61	12.35±0.95	12.00±1.15	8.00±0.01	8.10±3.23
July		13.90±0.35	8.28±3.16	9.05±1.71	10.13±0.13	15.00±2.89	13.25±0.43	7.88±0.13	9.33±3.85
August		11.65±2.26	8.78±3.45	10.20±1.65	15.00±2.89	20.65±5.40	13.25±0.43	8.00±0.01	9.68±4.23
September		16.55±1.08	9.90±2.43	10.18±3.63	15.75±2.53	16.40±2.08	14.50±0.29	16.00±0.02	10.60±3.12
October		13.78±1.58	12.63±2.49	9.84±4.60	14.55±2.65	10.93±0.92	12.25±2.74	16.00±0.01	11.65±3.67
November		12.85±2.40	13.1±2.54	14.80±1.68	15.85±2.41	12.00±1.15	15.00±0.58	20.00±0.01	11.90±2.78
December		10.38±2.66	11.95±0.69	11.20±2.89	11.93±1.44	10.00±0.00	15.00±0.58	12.00±0.02	11.25±3.61
January	2013	14.53±0.73	10.78±3.15	12.78±2.59	11.50±0.74	12.30±2.57	14.50±0.29	12.00±0.02	15.55±1.33
February		11.18±2.94	11.70±0.44	15.50±1.74	11.25±1.25	10.50±0.50	14.40±0.23	12.00±0.01	15.00±3.37
Annual mean		12.58	11.39	12.04	14.61	12.69	14.93	13.49	11.55
F-value		1.49	1.08	0.75	1.99	2.30	2.84	46.1	0.6
P-value		0.18	0.4	0.69	0.06	0.03*	0.009**	0.000***	0.82
$LSD_{0.05}$		5.29	6.79	7.13	11	5.99	5.77	1.83	9.02

* The values are the mean of those recorded in the 4 sites .

The highest Pb concentration (0.77µg/g) was recorded in rhizome and stem of *Phragmitus australis,* respectively in September, July, 2012, whereas the leaves expressed the highest value (7.64µg/g) in January. 2013. In case of Potamogeton pectinatus the highest value (13.20 and 17.78 µg/g) for root and leaves in May, 2012 whereas stem expressed the highest value (15.66 µg/g) in February, 2013, *Ceratophyllum demersum* expressed the highest concentrations (3.32, 3.95 µg/g) for stem and leaves in January, 2013 (Table 2).

The highest Cd concentration (33.45 and 34.8 µg/g) was recorded in rhizome and stem of Phragmitus australis, respectively in February, 2013 whereas the leaves expressed the highest value (37.98µg/g) in November, 2012 (Table 3). In case of *Potamogeton pectinatus* the highest value (48.375, 38.375 and 38.05 µg/g) for root, stem and leaves were observed in September, November, 2012 and January 2013, respectively. However, Ceratophyllum demersum expressed the highest concentrations (38.375 and 47.625 µg/g) for stem and leaves in January. 2013.

The highest Co concentration (15.06 and 7.72 µg/g) was recorded in rhizome and stem of *Phragmitus australis*, respectively in October, 2012, whereas the leaves expressed the highest value (7.57µg/g) in November, 2012. In case of *Potamogeton pectinatus* the highest value (7.63, 7.45 and 7.96 µg/g) for root, stem and leaves were observed in October, March, 2012 and January 2013, respectively. However, *Ceratophyllum demersum* expressed the highest concentrations (7.30µg/g) for stem in June, 2012. But the leaves showed the highest content (7.92µg/g) in August, 2012 (Table 4).

Table (2) : Pb (µg/g) concentration in the parts plant during study 2012-2013 in four sites.

Month	Year	Aquatic Macrophyta							
		Phragmites australis (Cav.) Trin. ex. Steud			*Potamogeton pectinatus* L.			*Ceratophyllum demersum* L.	
		Rhizome	Stem	Leaves	Root	Stem	Leaves	Stem	Leaves
March	2012	0.55±0.14	0.61±0.08	0.73±0.07	0.45±0.17	0.72±0.06	0.57±0.14	1.66±0.28	2.04±0.54
April		0.66±0.08	0.66±0.04	0.75±0.06	0.62±0.07	0.66±0.05	0.63±0.11	1.42±0.32	2.38±0.93
May		0.66±0.01	0.75±0.03	0.75±0.08	13.20±12.43	15.62±14.86	17.78±16.91	1.86±0.54	2.52±0.71
June		0.65±0.04	0.67±0.03	0.66±0.05	0.65±0.07	0.70±0.07	0.58±0.09	1.99±0.63	2.69±1.33
July		0.74±0.06	0.77±0.03	0.65±0.08	0.43±0.15	0.48±0.18	0.63±0.08	1.43±0.37	2.79±1.32
August		0.68±0.08	0.73±0.03	0.44±0.18	0.50±0.15	0.57±0.17	0.45±0.20	1.63±0.29	2.71±1.48
September		0.77±0.06	0.70±0.04	0.53±0.11	0.62±0.20	0.54±0.18	0.41±0.10	1.67±0.30	2.75±1.53
October		0.33±0.16	0.75±0.06	0.48±0.17	0.77±0.12	0.67±0.02	0.71±0.04	1.69±0.75	1.86±0.87
November		0.69±0.04	0.72±0.03	0.71±0.03	0.74±0.08	0.61±0.19	0.64±0.09	2.26±0.90	3.15±1.55
December		0.62±0.03	0.77±0.07	0.60±0.11	0.79±0.08	0.58±0.17	0.77±0.04	2.24±0.61	2.82±1.18
January	2013	0.57±0.14	0.76±0.02	7.64±6.85	0.65±0.12	0.53±0.16	0.50±0.09	3.32±0.25	3.95±1.85
February		0.56±0.07	0.75±0.02	0.63±0.12	0.47±0.17	15.66±14.85	0.64±0.16	2.65±1.07	3.57±1.50
Annual mean		0.62	0.72	1.21	1.66	3.11	2.02	1.98	2.77
F-value		1.69	1.2	1.05	1.03	0.93	1.04	0.47	0.24
P-value		0.12	0.32	0.43	0.45	0.52	0.44	0.91	0.99
$LSD_{0.05}$		0.25	0.13	5.68	10.3	17.4	14	1.76	3.67

* The values are the mean of those recorded in the 4 sites.

Table (3) : Cd (µg/g) concentration in the parts plant during study 2012-2013 in four sites.

Month	Year	Aquatic Macrophyta							
		Phragmites australis (Cav.) Trin. ex. Steud.			*Potamogeton pectinatus* L.			*Ceratophyllum demersum* L.	
		Rhizome	Stem	Leaves	Root	Stem	Leaves	Stem	Leaves
March	2012	29.08±6.07	24.78±3.66	31.65±6.81	27.40±8.15	35.20±13.37	29.85±6.91	30.70±5.47	46.63±12.80
April		29.13±7.39	29.45±4.31	32.70±7.65	28.20±8.34	36.28±16.47	30.98±7.91	35.65±5.44	42.90±7.34
May		28.33±6.48	28.95±8.93	34.13±7.13	25.70±9.71	33.23±17.30	27.80±5.87	32.85±5.22	46.50±12.60
June		28.80±7.75	31.80±10.92	31.18±4.92	30.25±9.86	31.68±11.22	27.95±5.90	34.13±6.18	44.78±12.87
July		32.38±10.15	25.15±4.54	30.58±5.32	29.60±9.88	33.53±17.04	25.68±1.29	36.13±8.79	37.73±5.80
August		24.80±4.13	31.75±10.80	35.95±10.26	35.33±11.89	36.78±15.59	34.10±10.94	30.20±2.10	40.75±8.24
September		28.48±7.72	31.18±11.25	30.13±5.57	48.38±12.35	26.50±12.80	31.28±7.73	34.83±6.21	46.58±13.22
October		33.15±10.04	24.68±4.74	32.78±4.34	28.55±10.28	34.68±16.61	32.05±4.97	35.00±6.42	47.58±12.53
November		25.75±3.65	31.85±10.73	37.98±9.63	33.88±12.44	38.39±15.02	29.05±5.73	35.25±8.32	42.78±7.58
December		28.90±4.58	29.78±8.55	35.33±3.33	28.00±10.63	32.70±7.41	31.85±4.68	35.18±8.06	45.30±13.07
January	2013	30.80±8.36	30.55±9.78	35.10±5.11	28.03±7.96	33.15±11.12	38.05±9.74	38.38±10.90	47.63±11.90
February		33.45±10.53	34.80±11.69	31.10±4.76	31.23±7.81	33.70±10.87	31.03±4.99	37.55±7.43	39.15±5.28
Annual mean		29.42	29.56	33.22	31.21	33.81	30.80	34.65	44.02
F-value		0.05	0.06	0.07	0.16	0.03	0.08	0.04	0.05
P-value		1	1	1	0.1	1	1	1	1
$LSD_{0.05}$		35.69	39.19	32.79	43.1	54.41	33.32	34.11	44.63

* The values are the mean of those recorded in the 4 sites .

Table (4) : Co (µg/g) concentration in the parts plant during study 2012-2013 in four sites.

Month	Year	Aquatic Macrophyta							
		***Phragmites australis* (Cav.) Trin. ex. Steud.**			***Potamogeton pectinatus* L.**			***Ceratophyllum demersum* L.**	
		Rhizome	**Stem**	**Leaves**	**Root**	**Stem**	**Leaves**	**Stem**	**Leaves**
March	2012	0.45±0.16	0.26±0.09	0.39±0.16	0.43±0.19	7.45±7.32	7.36±7.08	6.79±6.57	7.08±6.81
April		1.40±1.20	0.32±0.12	0.13±0.06	0.18±0.09	0.16±0.08	0.26±0.16	0.14±0.08	7.89±7.54
May		0.36±0.12	0.14±0.09	0.20±0.06	7.66±7.32	0.19±0.06	0.35±0.19	0.29±0.11	0.28±0.09
June		0.29±0.09	0.28±0.09	0.34±0.13	0.27±0.10	0.21±0.07	0.29±0.10	7.30±7.03	0.52±0.20
July		6.83±6.46	0.36±0.07	7.85±7.58	7.09±6.51	0.29±0.10	7.18±7.01	7.26±6.95	0.43±0.15
August		0.42±0.13	0.31±0.16	0.36±0.15	0.22±0.09	0.47±0.21	0.41±0.18	0.28±0.01	7.92±7.46
September		0.43±0.16	0.27±0.08	0.48±0.15	0.50±0.15	0.31±0.14	0.24±0.08	0.20±0.05	0.26±0.06
October		15.06±9.44	7.72±7.49	6.81±6.46	7.62±7.39	7.21±7.03	7.76±7.15	6.78±6.51	0.41±8.55
November		0.25±0.08	7.32±7.06	7.57±7.31	0.22±0.08	0.43±0.16	0.29±0.11	0.27±0.08	0.41±0.18
December		0.40±0.21	0.23±0.11	0.31±0.16	0.22±0.11	0.15±0.07	0.28±0.14	0.32±0.16	0.46±0.17
January	2013	0.31±0.09	6.66±6.21	0.55±0.12	0.16±0.07	0.13±0.06	7.96±7.58	0.29±0.09	0.46±0.18
February		0.25±0.09	0.15±0.05	0.22±0.07	0.27±0.10	0.39±0.18	0.28±0.09	0.49±0.21	0.42±0.17
Annual mean		2.20	2.00	2.10	2.07	1.45	2.72	2.53	2.37
F-value		1.8	0.83	0.81	0.84	0.83	0.72	0.72	0.71
P-value		0.09	0.61	0.63	0.6	0.57	0.71	0.71	0.72
$LSD_{0.05}$		9.35	9.96	10.24	10.16	8.41	12.1	11.21	12.12

* The values are the mean of those recorded in the 4 sites .

Table (5) : Fe (µg/g) concentration in the parts plant during study 2012-2013 in four sites.

Month	Year	Aquatic Macrophyta							
		***Phragmites australis* (Cav.) Trin. ex. Steud.**			***Potamogeton pectinatus* L.**			***Ceratophyllum demersum* L.**	
		Rhizome	**Stem**	**Leaves**	**Root**	**Stem**	**Leaves**	**Stem**	**Leaves**
March	2012	872.5±82.70	790.0±33.42	942.5±36.03	734.75±33.05	932.75±29.20	840.0±58.17	1032.5±68.24	1016±75.18
April		909.75±70.48	817.5±40.08	1102.5±40.68	884.0±105.73	844.75±43.23	839.75±41.33	1073.5±48.83	942.75±103.01
May		852.5±100.03	768.33±93.22	1097.25±78.24	846.75±106.21	800.75±87.16	964.25±55.91	1021.75±26.51	992.0±92.24
June		884.5±35.22	925.0±105.32	969.75±113.34	890.0±91.01	967.5±51.38	992.5±41.10	1097.25±39.49	965.12±24.86
July		765.0±47.87	865.0±95.26	982.0±44.20	862.0±53.05	1167.0±143.41	964.5±64.29	1062.0±82.75	962.0±24.10
August		857.5±12.50	877.5±75.98	927.25±62.79	767.5±43.28	1182.5±266.50	907.5±77.82	1057.5±74.20	992.5±73.07
September		760.0±14.58	860.0±59.72	877.5±47.50	807.5±33.01	1155±248.41	862.5±120.23	1287.5±232.86	1060.0±82.16
October		785.0±80.57	967.5±78.67	964.75±117.48	827.5±39.45	972.5±51.05	950.0±28.28	1047.5±36.14	1277.25±196.89
November		815.0±34.03	887.25±78.97	987.25±102.40	872.5±40.08	967.25±52.43	960.0±20.00	1089.75±41.05	3617.5±2528.76
December		865.0±30.69	820.0±106.69	959.0±60.92	862.5±17.50	990.0±39.79	905.0±5.00	984.5±86.18	1277.0±257.98
January	2013	872.5±46.97	919.5±40.13	885.75±83.04	938.75±16.31	926.75±47.31	1051.75±51.38	1012.25±118.30	1105.0±76.36
February		824.75±24.85	908.75±15.60	947.25±102.14	895.0±5.00	957.5±82.60	1070±50.50	977.5±63.43	1177.26±57.21
Annual mean		838.67	867.19	970.23	849.06	988.69	942.31	1061.96	1310.84
F-value		0.76	0.61	0.74	0.95	0.97	1.65	0.75	1.02
P-value		0.67	0.81	0.69	0.51	0.49	0.13	0.69	0.45
$LSD_{0.05}$		159.54	244.93	231.35	168.41	353.47	167.59	267.42	2118.54

* * The values are the mean of those recorded in the 4 sit .

The highest Fe concentration (909.75 and 1102.5µg/g) was recorded in rhizome and leaves of *Phragmitus australis*, respectively in April 2012, whereas the stem expressed the highest value (967.5µg/g) in October 2012. In case of *Potamogeton pectinatus* the highest value (938.75, 1167.0 and 1070 µg/g) for root, stem and leaves were observed in January 2013, July 2012 and February 2013, respectively. However, *Ceratophyllum demersum* expressed the highest concentrations (1287.5µg/g) for stem in September, 2012. But the leaves showed the highest content (3617.5µg/g) in November, 2012 (Table 5).

The result showed a higher concentration of heavy metals in submerged species C. demersum, followed by *P. pectinatus* and then emergent species *P. australis* may be due to the submerged species have been found to accumulate relatively high heavy metal concentration when compared with emergent species in the same area (Kara, 2005).

Heavy metals showed relatively higher concentration in leaves of aquatic plants in all species under study because absorption of heavy metals directly from water or due to the ability of plants to accumulate the toxic heavy metals in vacuoles on leaves of plants. Heavy metals are toxic to aquatic macrophytes if their accumulation levels exceed the detoxification capacity of the plant tissues (Zhang *et al.,* 2007). Co heavy metal was recorded the lowest value (0.13 µg/g) compared with other heavy metals under study in leaves of *P. australis* during April. 2012.

The aquatic macrophytes vary widely in their ability to accumulate the heavy metals due to many factors affected on them such as biomass, morphology , growth form , water quality, etc. (Mishra *et al.,* 2007). The results showed that macrophyte species *C. demersum* have the ability to accumulate the heavy metals more than other species. Hyper accumulator plants represent a resource for Phytoremediation of metal polluted sites, as they can tolerate uptake high levels of certain heavy metals that would be toxic to most organisms (Meagher and Heaton, 2005).

CONCLUSION

The results showed that the heavy metals concentration in Euphrates river (Al- Abasyia) were mainly within the permissible limits according to criteria EPA , 1995 and WHO, 1995, However , significant local heavy metals pollution problems were recorded. The heavy metal concentrations in the river's macrophytes were remarkably high, but varied among plants species. Our results suggest that use some species of macrophytes as bioindicator to monitoring the heavy metals pollution in Euphrates River.

ACKNOWLEDGMENTS

The authors would like to thank the Environmental Research Center, University of Babylon and Department of Biology, College of Science, University of Kufa, Iraq and Botany Department, Faculty of Science, University of Mansoura, Egypt for their cooperation and support of this work.

REFERENCES

Abdel-Baki, A. S.; Dkil, M. A. and Al-Quraishy, S. (2011): Bioaccumulation of some heavy metals in *Tilapia* fish relevant to their concentration in water and sediment of

Wadi Hanifah, Saudi Arabia. African J. Biotech., 10 (13): 2541 – 2547.

Akpor, O. B.; Ohiobor, G. O.; Olaolu T. D. (2014): Heavy Metal Pollutants in Wastewater Effluents: Sources, Effects and Remediation. Advances in Bioscience and Bioengineering. 2(4): 37-43.

APHA (American Public Health Association) (2003): Standard Methods For The Examination of Water and Wastewater. 20^{th} edition. Washington. DC. USA.

Atici,T.; Ahiska, S.; Altindag, A. and Aydin, (2008): Ecological effects of some heavy metals (Cd, Pb, Hg, Cr) Pollution of Phytoplanktonic algae and Zooplanktonic organisms in Sariyar Dam Reservoir in Turkey. African Journal of Biotechnology, 7 (12): 1972 – 1977.

Begum, A. and Krishna, H. S. (2010): Bioaccumulation of Trace Metals by Aquatic Plants. Inte. J. chem. Tech. Research, 2(1): 250 – 254.

Cardwell, A. J., D. W. Hawker and M. Greenway, (2002): Metal accumulation in aquatic macrophytes from southeast Queensland, Australia. Chemosphere, 48: 653-663.

El-Amier, Y. A.; Zahran, M. A. and Al-Mamoori, S. O. (2015) : Plant diversity of the Damietta branch, River Nile, Egypt: An Ecological Insight. Mesopotamia Environmental Journal, 1(2): 109-129.

El- Bouraie, M. M.; El-Barbary, A. A.; Yehia, M. M and Motawea, E. (2010): Heavy metal concentrations in Surface River water and bed sediments at Nile Delta in Egypt. Suoseura – Finnish Peatland Society, 61 (1):1-12.

EPA (Environmental Protection Agency) (2005): EPA Guidelines for carcinogen risk assessment. EPA/630/P-03/001F, March 2005 Risk Assessment Forum, United States Environmental Protection Agency, Washington DC (2005) Available from: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=116283.

Faragallah, H. M.; Askar, A. L.; Okbah, M. A. and Moustaf, H. M. (2009): Physico-Chemical Characteristics of the Open Mediterranean Sea Water Far about 60 Km from Damietta habor, Egypt. Journal of Ecology and the Natural Environment, 1(5): 106 – 119.

Hassan, F. M.; Saleh, M. M. and Salman, J. M. (2010): A study of Physicochemical Parameters and Nine Heavy metals in Euphrates River, Iraq. E - Journal of Chemistry, 7(3): 685 - 692.

Kara, Y. (2005): Bioaccumulation of Cu, Zn and Ni from the Waste Water by Treated Nasturtium officinal. Int. J. Environ. Sci. Tech., 2(1): 63 – 67.

Karaer, F.; Katip, A.; Ileri, S.; Sarmasik, S. and Aydogan, N. (2013): Dissolved and Particulate trace elements configuration: Case Study from a shallow Lake. International Journal of Physical Sciences, 8 (24): 1319 - 1333.

Li, H.; Shi, A.; Li, M. and Zhang, X. (2013): Effect of PH, Temperature and Flow Rate of Overlying Water on Heavy Metals Release from Storm Sewer Sediments. Journal of Chemistry. Article ID 434012, 11pages.

Malar, S.; Vikram, S. S.; Favas, P. J. C. and Perumal, V. (2014): Lead heavy metal toxicity induced hangs on growth and antioxidative enzymes level in water hyacinths (*Eichhornia crassips* (mart)). Botonical studies, 55, 54 .

Meagher, R. B. and Heaton, A. C. P. (2005): Strategies for the engineered phytoremediation of toxic element Pollution; Mercury and arsenic. J. Indus. Micro Biotech. 32: 502 – 513.

Mishra, K. K.; Rai, U. N. and Prakash, O. (2007): Bioconcentration and Phytotoxicity of Cd in *Eichhornia crassipes*. Environ. Monit. Assess. 130: 237 – 243.

Orson, R. A.; Simpson, R. L. and Good, R. E. (1992): The paleoecological development of a late Holocene, tidal freshwater marsh of the upper Delaware River estuary. Estuaries 15: 130–146.

Salman, J. M.; Hassan, F. M. and Abdul-Ameer, S. H. (2015): A Study on the Fate of Some Heavy Metals in Water and Sediments in Lotic Ecosystems. International Journal of Chemical and Physical Science (IJCPS), 4 (2):36-45.

Salman, J. M. and Hussain, H. A. (2012): Water Quality and Some Heavy Metals in Water and Sediments of Euphrates River , Iraq . Journal of Environmental Science and Engineering: 1088 – 1095.

Salman, J. M.; Hassan, F. M. and Saleeh, M. M. (2010): Environmental Study to Used the Aquatic Organisms as Bioindicators to Euphrates River Pollution by Heavy Metals. Iraq Journal of Market Researches & Costumer Production, 2(3): 145-196.

Sturgeon, R.E.; Desaulincrs, J.A.; Berman, S.S. and Russell, D.S. (1982): Determination of trace metals in estuarine sediment by graphite fernace atomic absorption spectrophotometry. Anal. Chem. Acta., 134: 288-291.

Voica , C.; kovacs, M.H.; Dehelean, A.; Ristoiu, D. and Iordache, A. (2012): Icp – Ms Determinations of Heavy Metale in Surface Waters Form Transylvania. Rom. J. Phys., 57 (7-8): 1184 – 1193.

WHO (World Health Organization), (1995): Heavy metals. Environmental Health Criteria, Geneva. Vol. 165.

Zhang, F. Q., Wany, Y. S.; Lou, Z. P.; Dong, J. D. (2007): Effect of Heavy Metal Stress on antioxidative enzymes and Lipid Peroxidation in Leaves and Roots of Two Mangrove Plant Seedlings (*Kandelia candel and Bruguiera gymnorhizo*). Chemosphere, 67: 44 – 50.

Zurayk, R; Sukkariyah, B; Baalbaki, R (2001): Common hydrophytes as bioindicators of nickel, chromium and cadmium pollution. Water, Air and Soil Pollution 127:373-288.

Received on 15/ 2/ 2015

الملخص العربى

تراكم بعض المعادن الثقيلة فى الماء والنباتات المائية فى نهر الفرات

جاسم محمد سليمان[1] ياسر أحمد الأمير[2]
شيماء جبار هادى[3]

[1]قسم بيولوجى – كلية العلوم – جامعة بابل – العراق

[2]قسم النبات – كلية العلوم – جامعة المنصورة – مصر

[3]قسم بيولوجى – كلية العلوم – جامعة الكوفة – العراق

تم قياس بعض المعادن الثقيلة وتشمل الكوبلت والنحاس والكادميوم والرصاص والحديد في الماء وكذلك فى الجذور و السيقان والأوراق لثلاثة أنواع من النباتات المائية وهي: البوص *Phragmytes australis* ، علاق *Potomogeton pectinatus* ونخشوش الحوت *Ceratophyllum demersum* لتقييم درجة التلوث في نهر الفرات من مارس 2012 إلى فبراير 2013. تم تقدير تركيز المعادن الثقيلة الذائبة والغير ذائبة حيث تراوحت بين (137.75 - 76 ميكروجرام / لتر و 749.5 – 582 ميكروجرام / جرام) للحديد، (0.91- 2.21 ميكروجرام / لتر و 17.33 – 12.02 ميكروجرام / جرام) للنحاس، (1.54-4.30 ميكروجرام / لتر و 12.6 – 9.74 ميكروجرام / جرام) للكادميوم ، (2.66 - 0.85 ميكروجرام / لتر و 0.41 – 0.00 ميكروجرام / جرام) للكوبلت و (7.92 – 4.83 ميكروجرام / لتر و 0.7 - 0.41 ميكروجرام / جرام) للرصاص، على التوالي. تم تعين أعلى تركيز للمعادن الثقيلة في أوراق النباتات المائية المغمورة. وأظهرت النتائج أيضا أن تركيز المعادن الثقيلة في نهر الفرات كانت ضمن الحدود المسموح بها محليا، هذا بالاضافة الى أن تركيز المعادن الثقيلة في النباتات المائية عالى بشكل ملحوظ ولكن يختلف بين الأنواع النباتية.

JOESE 5

ACCUMULATION OF SOME HEAVY METALS IN WATER AND AQUATIC MACROPHYTES OF EUPHRATES RIVER

Jasim M. Salman[1*] Yasser A. El-Amier[2] Shaimaa J. Hadi[3]

*[*1]Department of Biology, College of Science, University of Babylon, Iraq*

[2]Botany Department, Faculty of Science, University of Mansoura, Egypt

[3]Department of Biology, Faculty of Science, University of Kufa, Iraq

**Corresponding author: jasimsalman@uobabylon.edu.iq; yasran@mans.edu.eg*

Reprint

from

Journal of Environmental Sciences, 2015; Vol. 44, No. 3 : 575-587

http://eulc.edu.eg/jes **P-ISSN 1110-192X**
e-ISSN 2090-9233