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Heavy metal concentrations in the bivalve *Corbicula f*luminalis shells from Shatt Al-Arab River

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Abstract - This study was to investigate the contamination in the Shatt Al-Arab River by determining the heavy metals in the limnic bivalve *Corbicula fluminalis,* a sentinel species. The results showed that the values of Ba, Zn, Pb, Ni, Co, Cr, Sr, Cu, Mn and Fe in *Corbicula fluminalis* shells increased significantly from the beginning point toward the central part of Shatt Al-Arab River. This increase may be explained from the high incidence of pollution from sewage, development, and industry in the central part of Shatt Al-Arab River compared to the northern parts.

Keywords: *Corbicula fluminalis*, Shells, Pollution, Shatt Al Arab River, Heavy metals.

Introduction

The tolerance and adaptability of the bivalve molluscs have made them a preferred organism as indicator of the quality of ecosystems (Conti and Cecchetti, 2003). Trace metal contamination level in a given organism results from the net balance between the processes of metal uptake and metal loss (Goodfriend and Magaritz, 1989). Chemical analysis of hard body parts can yield vital information on the processes involved in biomineralisation and the interaction between the organism and the surrounding environment.

Trace elements are incorporated into bioic systems at significantly lower quantities (~0.1wt%) than elements in the surrounding environment (Dalbeck, 2008). Even though these elements do not form crystal phases, their presence can be used to provide a better understanding of biomineralisation processes.

Trace element composition can allow insight to the conditions in which mineralisation occurred, how these 'foreign' elements can affect growth of hard body parts, and growth of the individual, as well. Concentration of trace elements in hard body parts depends on the acceptability of the elements (Dodd, 1965; Afaj and Al-Dabbas, 1998).

In the Shatt Al-Arab River, there is high concentration of population and industries. Most of domestic sewage and industrial effluents with high organic matter are discharged untreated. This extra organic matter has caused several biogeochemical changes, both in small side streams and in the river proper, which be a source of heavy metals in these water bodies. A number of authors have studied the heavy metals in *Corbicula fluminalis* shells as a pollution indicator, such as the work of Mustafa (1989) and

Salman (2007) in the Shatt Al-Arab River, Al-Bassam (1999) in the Euphrates River, and the study of Al-Saady (2008) in the Hor Al-Chekka River. The main objective of the present study was to determine the concentration of metals in specimens of the limnic bivalve *Corbicula fluminalis* shells.

Study Area:

The study area was located on the banks of Shatt Al-Arab River north of and within the area of Basrah city, south Iraq (Fig. 1).

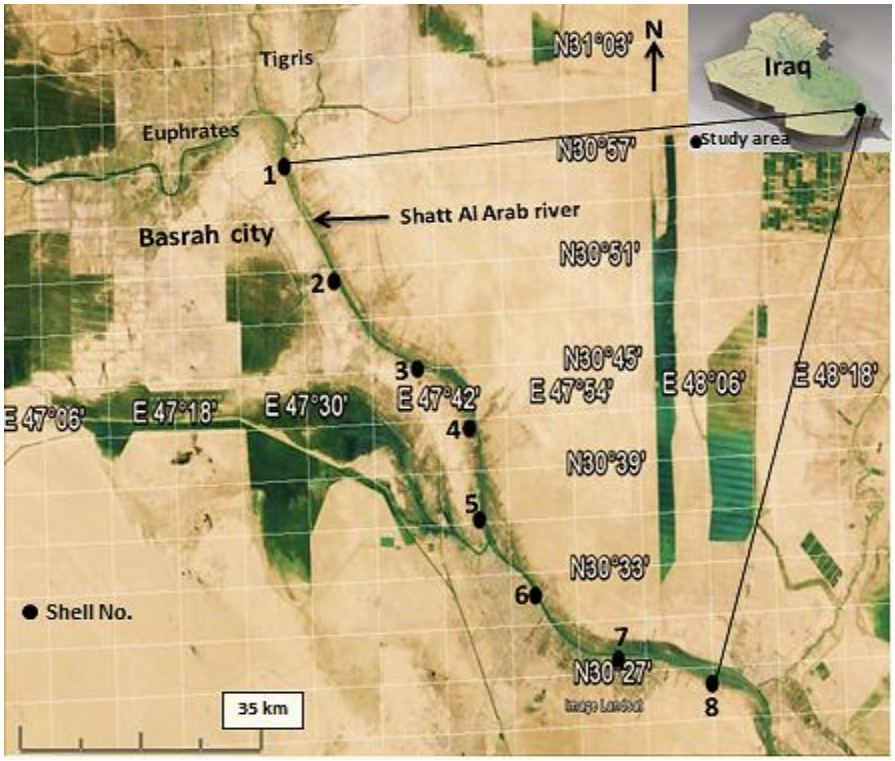

Figure 1. Study area with location of sampling sites.

Materials and Methods

Eight *Corbicula fluminalis* shells were chosen for analysis. These shells were tested by scanning electron microscope-EDAX, Inductively Coupled Plasma-Atomic emission spectrometry (ICP-AES), and Inductively Coupled Plasma-Mass spectrometry (ICP-MS).

Shell samples were first separated from living soft tissues, washed with distilled water, exposed to ultrasonic radiation for 2 h to remove possible foreign materials, and then air-dried, crushed to get particles of size less than 2 microns. Processed shells were assayed for Ca, Ba, Zn, Pb, Ni, Co, Cr, Sr, Cu, Mn and Fe elements.

Subsequently, graphite coated the bulk of shells prior to scanning electron microscope (SEM-EDAX) examination.

Results and Discussion

Bivalves were chosen for this study because they meet many of the requirements of a good biological sentinel (Phillips, 1980). They are somewhat sedentary, regionally abundant, and are long lived. They readily accumulate many metals and bioaccumulate contaminants.

Consequently, such organisms have been largely used in both salt and fresh water monitoring programs (Farrington, 1983). Chemical analyses of molluscs shells provide more information about the environment in which these organisms lived.

Ba, Zn, Pb, Ni, Co, Cr, Sr, Cu, Mn and Fe are the main trace elements in *Corbicula fluminalis* shells (Figs. 2 and 3). These elements in our target organism increased significantly towards the central parts of Shatt Al-Arab River (Table 1) as a result of untreated sewage discharge in the river from industrial facilities and hospitals that spread in the north and center part of Basrah city. This demonstrates that *C. fluminalis* may be used locally as an indicator of contamination by trace metals.

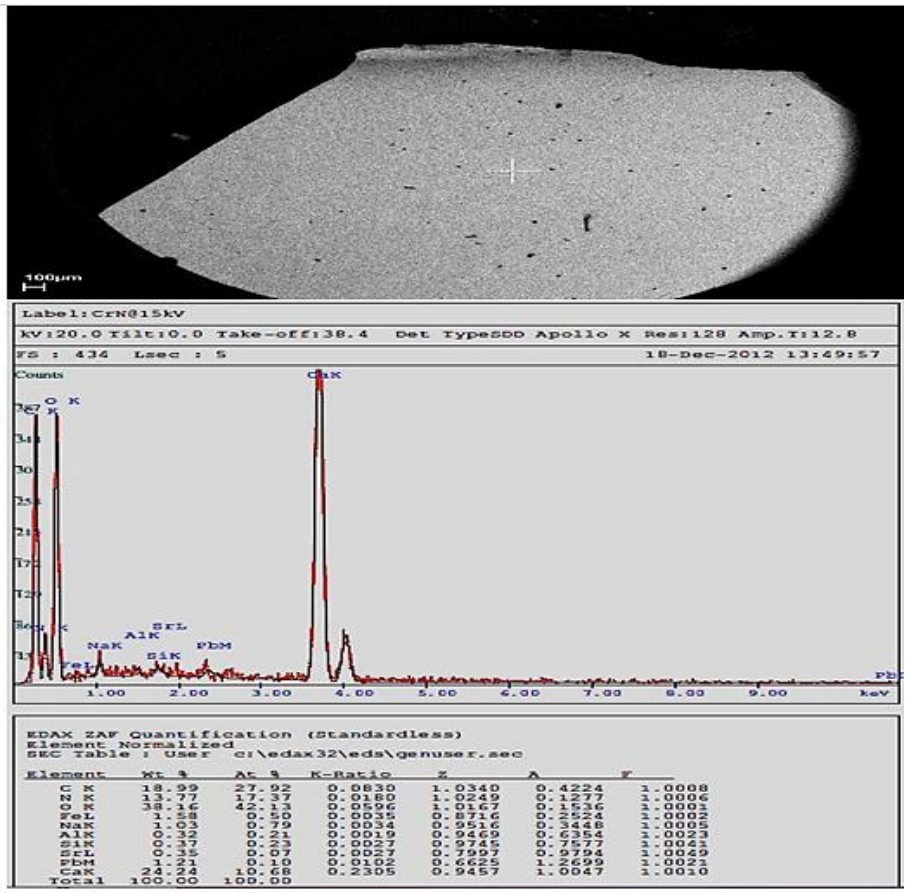

Figure 2. Picture and spectrum of *Corbicula fluminalis* shells under scaning electron microscope-EDAX, scale bar 100 µm.

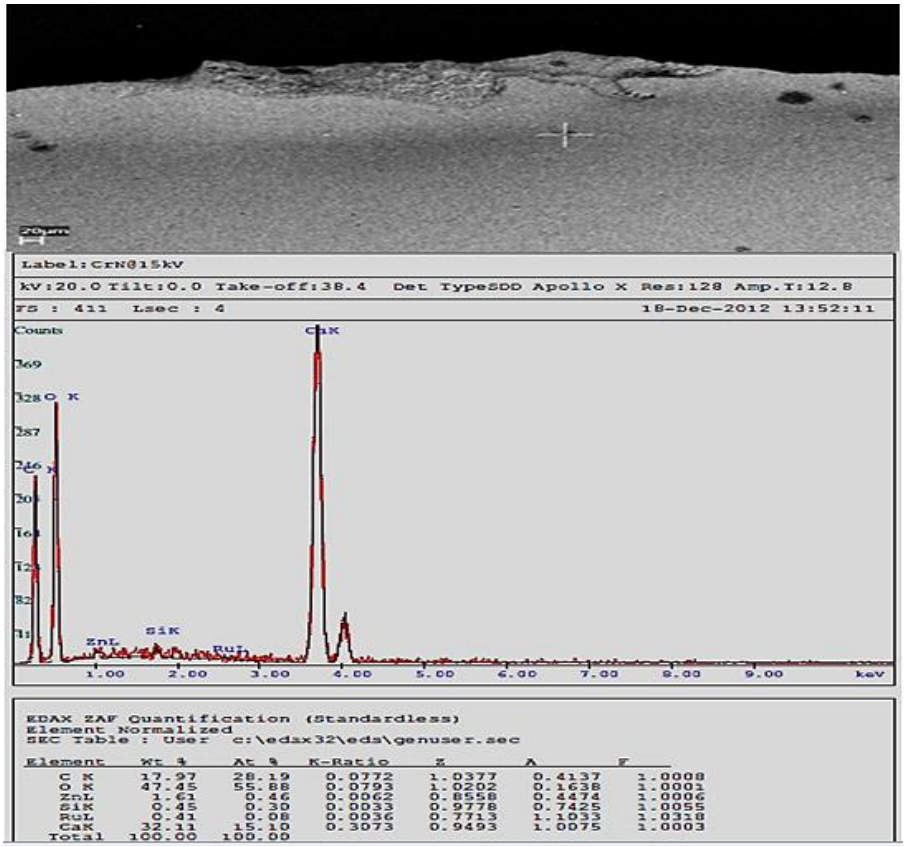

Figure 3. Picture and spectrum of Corbicula fluminalis shells under scanning electon microscopr-EDAX, scale bar 20 μm.

Table 1. Calcium the main trace elements in *Corbicula fluminalis* shells from the Shatt Al-Arab River.

Elements	Stations								Mean
	1	2	3	4	5	6	7	8	
CaO %	55.1	55	55.2	55	55.3	55.1	55	55.2	55.1
LOI %	42.3	42.7	42.6	42.8	42.5	42.7	42.8	42.6	42.6
Ba ppm	23.1	23.7	23.8	24	24.2	24.4	24.5	24.8	24
Zn ppm	110	114	116	118	118	119	120	122	117
Pb ppm	15	16	18	20	20	21	22	22	19.2
Ni ppm	9	10	10	11	13	13	14	16	12
Co ppm	4	5	7	10	10	11	13	15	9.3
Cr ppm	7	9	9	11	11	12	14	13	10.7
Sr ppm	1640	1655	1675	1677	1679	1680	1682	1685	1671.6
Cu ppm	322	326	325	237	239	238	242	243	271.5
Mn ppm	22	24	25	27	29	29	31	33	27.5
Fe ppm	90	94	98	99	101	102	105	106	99.3

Table (2) shows a comparison between heavy metals that accumulated in *C. fluminalis* shells from this study and previous studies in the Shatt Al-Arab, Euphrates, and Hor Al-Chekka rivers. Zinc, copper, chromium, iron, and manganese were higher in the present study compared with the previous studies. This indicates the contamination of the Shatt Al-Arab River is increasing during the last few years as a result of increased anthropogenic and industrial activities.

Table 2. Comparison of the mean heavy metals (ppm) in *Corbicula fluminalis* shells between the present study and previous studies.

Ref.	Zn	Pb	Ni	Co	Cu	Cr	Fe	Mn
Mustafa (1989) in Shatt Al-Arab river	31.5	0.32	3.41	-	169	-	-	2.36
Basam (1999) in Euphrates river	6.7	47	56	63	4	-	-	-
Salman (2007) in Shatt Al-Arab river	-	49	51	28	9.3	6	65	-
Al-Saady (2008) in Hor Al-Chekka	4.8	38	34	18	9.2	-	-	-
Present study	117	19.2	12	9.3	271.5	10.7	99.3	27.5

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تراكيز المعادن الثقيلة في أصداف *Corbicula fluminalis* لنهر شط العرب

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المستخلص - أجريت هذه الدراسة للتحقيق من تلوث شط العرب من خلال تحديد العناصر الثقيلة الموجودة في أصداف *C*orbicula *f*luminalis كمؤشر بايلوجي. أظهرت النتائج بأن تراكيز عناصر الباريوم والزنك والرصاص والنيكل والكوبلت والكروم والسترونتيوم والنحاس والمنغنيز والحديد في هذه الأصداف تزداد بشكل ملحوظ من بداية تكون نهر شط العرب باتجاه الأجزاء الوسطى منه. فقد تعود الزيادة إلى نسبة التلوث العالية بهذه العناصر في الأجزاء الوسطى من شط العرب مقارنة بالأجزاء الشمالية منه. هذا التلوث كان نتيجة لتصريف المياه الملوثة في شط العرب من المصانع والمستشفيات المنتشرة في وسط مدينة البصرة. بالإضافة إلى أن زيادة الفعاليات البشرية والصناعية في نهر شط العرب خصوصاً بعد عام 2003 أدت الى زيادة تركيز المعادن الثقيلة (Zn, Cu, Co, Fe, Mn) في اصداف *C*orbicula *f*luminalis في نهر شط العرب مقارنةً بالدراسات السابقة.