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Assessment of the accumulation of some trace metals in whole body of fresh water shrimp *Atyaephyra desmaresti mesopotamica* from Shatt Al-Arab River, Basrah, Iraq

S.T.L. Al-Yaseri
Marine Science Centre, Basra University, Basrah-Iraq
email: alyaseri 2007 @yahoo.com

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Abstract - Concentrations of heavy metals (Pb, Mn, Ni, Fe, Cu, and Zn) were determined in shrimp *Atyaephyra desmaresti mesopotamica* collected from Shatt Al-Arab River, Basrah, Iraq. The elements content were determined in whole body biomass. The seasonal variations of the element concentrations, and the relationship between element concentrations in males and females were estimated in this study. Measurements were done to evaluate trace metals in shrimps tissues in Qurmat-Ali in Shatt Al-Arab River between summer (May- August) 2008 and spring (March and April) 2009. Samples were collected seasonally. Tissue samples were analyzed by flame atomic absorption spectrophotometry. Females accumulated the trace metals in their bodies in spring higher than other seasons. Males accumulated the trace metals in their bodies in Spring higher than other seasons, except for Pb and Mn. Regarding to concentrations; the highest values were 141.80 µg g^{-1} d.w in males and 136.79 µg g^{-1} d.w in females for Iron, while the lowest values were 2.49 µg g^{-1} d.w in males and 2.96 µg g^{-1} d.w in females for Lead. Regarding to seasons; in Summer the concentrations of trace metals were higher in males than in females, except Zn, in Autumn they were higher in males than in females, except Pb and Ni, in Winter they were higher in males than in females, except Pb and Zn, in Spring they were higher in males than in females, except Pb, Mn and Zn.

Keywords: Freshwater shrimp, Shatt Al-Arab River, metals

Introduction

Shrimps are frequently used as bio indicators in environmental monitoring due the species ability to accumulate pollutants from their ambient .Usually, the level of pollutant accumulated in such organism's tissues used for assessing the level of pollution in their habitat (AbdAllah and Moustafa, 2002).

Heavy metals enter aquatic environment from various sources. Rock and soils directly exposed to surface water are usually the largest natural source. Another major source is anthropogenic input, such as that from fossil fuel combustion, mining, smelting and solid waste incineration (Stein and Winer, 1996). Waste product like the waste from paper factory, batteries, pesticides and inorganic fertilizers enter Shatt Al-Arab River (Al-

Khafaji, 1996; Abaychi and Al-Saad, 1988). The concentration of heavy metals in natural environment depends on both natural and anthropogenic factors, which may play an important physiological role, but, also may impose a toxic effect on biosensors (Arkadiusz *et al.*, 2007). Aquatic environment contaminated by heavy metals may lead to bioaccumulation of the heavy metals in the food chain of aquatic environment. Normally, such contaminants are transported from its sources through River system and deposited down stream. Since most of pollutant could be mixed and became suspended solid and bottom sediment through sedimentation (Abdullah *et al.*, 2007).

The presence of heavy metals in aquatic environment can lead to greater environmental problem when the elements are up taken by organisms, hence consumption of such kind of organisms may form a significant pathway to metals contamination in human beings and eventually poses greater health risk because of their stability (Bieny *et al.*, 1994). Ingesting large amount of heavy metals like Lead can cause serious toxic effects, and health risks (Akinola *et al.*, 2008). The crustaceans concentrate various toxic and non toxic trace metals in their bodies with no evident danger to themselves, so they often exploited to identify pollutant in aquatic environment (Abdullah and Al-Mansoori, 2002).

During the shrimp life there is a continuous flux of element from the environment (water and food) to the shrimp tissues and vice versa. When shrimps become available as food for human and other organisms, or decompose, so the shrimps play an important role in the aquatic environment (Bieny *et al.*, 1994). Local studies were done on the concentrations of trace metals in Shatt Al-Arab River by (Abaychi and DouAbul, 1985; Abaychi and Mustafa, 1988 ; Abaychi and Al Saad, 1988). They show levels of trace metals contamination in water, sediment and organisms. The concentration of trace metals in water were with the permitted level in spite of the domestic agriculture and industrial pollutants, beside the oil pollution. Al-Higag (1997) assessed the concentration of Cd, Cu, Pb and Zn in Al Ashar and in Al-Khandak canals and have recorded high concentrations. Al-Imarah *et al.* (1997) assessed the concentration of Cd, Cu, Fe, Pb, Mn, Ni, V and Zn of two type of commonly edible shrimp *Metapenaeus affiinis* and *Penaeus semisulcatus* from Iraq and Kuwait. In the present study, dealing with six trace metals (Pb, Mn, Ni, Fe, Cu and Zn) measured in whole body of the shrimp *Atyaephyra desmaresti mesopotamica* collected from Shatt Al-Arab River, Basrah, Iraq for the period from May 2008 to April 2009. The study area "Qurmat-Ali" is located at Shatt Al-Arab and shown in the (Figure 1). It was chosen to reflect possible sources of trace metals pollution.

Aim of the research study and its Importance:

1-The main aim of this study was to evaluate the concentrations of heavy metals in the shrimp *Atyaephyra desmaresti mesopotamica*. The importance of this study is to contribute to the monitoring findings of pollution in Shatt Al-Arab River. Also, to compare the seasonal variations of heavy metals concentrations and to determining their permissible effluent discharge rates in the aquatic environment.

2- Such data are important; that organisms which accumulate trace metals are of interest due to their implication in the human health.

Materials and Methods

Shrimps were obtained manually by shrimps net between summer 2008 (May, Jun, July and August) and spring 2009 (March and April) from Qurmat-Ali (Fig. 1). They kept in polyethylene box and brought to the laboratory. The shrimps sorted into males and females according to the presence of the appendix masculine. Samples were dried in oven at 80°C for 24 hours followed by acid digestion of 2 gm of dried samples. The method used pointed by ROPME (1983) was applied. Using Flame Atomic Absorption Spectrophotometer technique for organisms. Heavy metals concentrations in shrimp whole body was expressed as microgram per gram (μg g^{-1}).

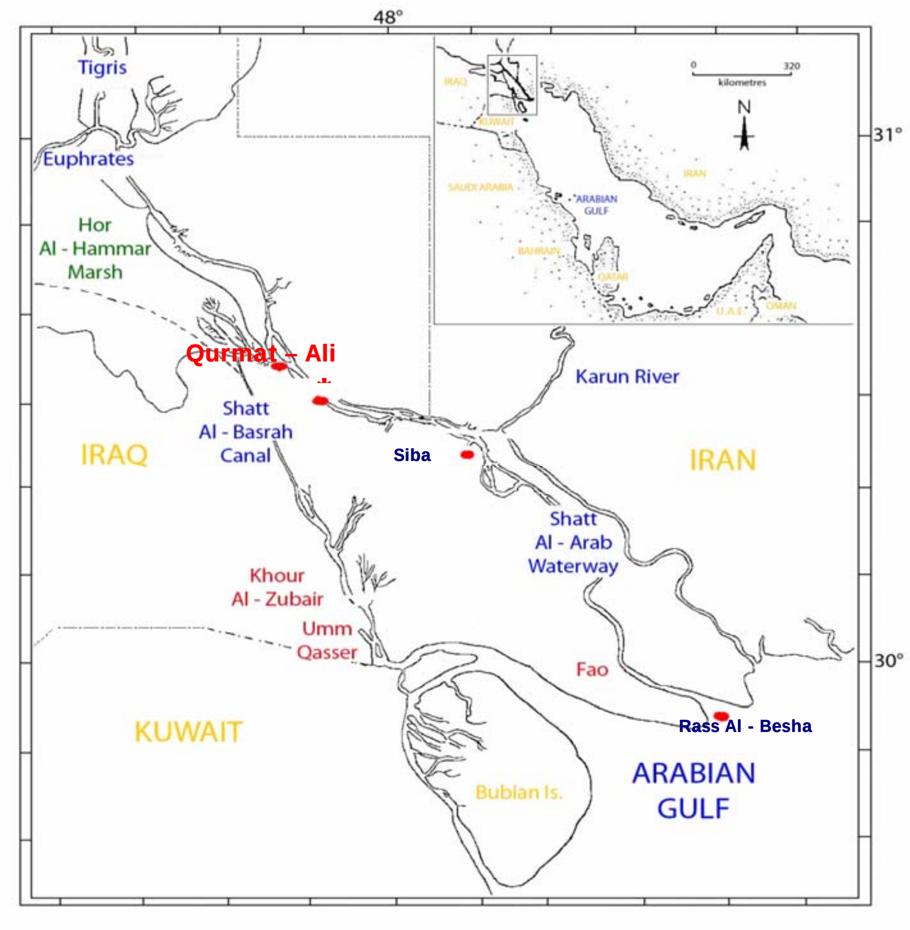

Figure 1. Study area represented by "Qurmat- Ali" located on the Shatt Al-Arab River.

Results and Discussion

In this study concentrations of heavy metals (Pb, Mn, Ni, Fe, Cu, and Zn) were determined in shrimps collected from Qurmat-Ali. The overall concentrations in this studied shrimp *A. desmaresti mesopotamica* males and females are provided in Table 1 and Table 2, and represented in µg g^{-1} dry weight. It was found that all of the metals concentrations in the tissues (whole body) of female shrimp collected from the site in spring (4.31, 7.80, 16.64, 136.79, 9.36 and 44.17) for (Pb, Mn, Ni, Fe, Cu and Zn) respectively were significantly higher ($p<0.05$) than those collected in other seasons. It indicated that the female tend to accumulate the heavy metals, the high concentration can be explained by its feeding mechanism, *A. desmaresti mesopotamica* are the species of crustaceans that live on the bottom of water bodies, as most trace metals are known to be associated with particles, especially sediment in fresh water especially the feeding increased during the Spring, and the fat accumulate in their tissues (Table 3) (Zhou *et al.*, 1996; Dalia, 1999). While in male it was noticed that the accumulation also high in Spring (16.74, 141.8, 9.91 and 43.52) for (Ni, Fe, Cu and Zn) respectively, except Pb and Mn metals were high in Summer, the reason may be due to that the bioaccumulation of metals in any organisms depend on the route of entry, that is, either from surrounding medium or in the form of food or chemical form of material available in the media, and depend mainly on their environmental levels and also depend on various factors such as amount of uptake their hold and the physical efficiency of the organism to excrete excess of metals on the other hand, various a biotic environment conditions (mainly temperature, salinity and hardness in addition to seasons location) affect accumulation of trace metals in biota (Win and Nicholus, 1997; Soundarapandian *et al.*, 2010).

Table 1. Mean concentrations of trace metals (µg g^{-1} d.w) for male shrimp *A. desmoresti mosopotamica*, stander deviation, during the studied period from 2008-2009.

Trace metals	Seasons Summer 2008	Autumn 2008	Winter 2009	Spring 2009
Lead (Pb)	3.37 ±0.52	2.89 ±0.17	2.49 ±0.63	2.98 ±0.26
Manganese (Mn)	8.60 ±2.97	6.67 ±0.32	7.15 ±1.19	6.72 ±0.30
Nickel (Ni)	15.44 ±1.22	16.26 ±0.09	16.54 ±1.28	16.74 ±0.32
Iron (Fe)	85.84 ±14.87	105.26 ±1.609	108.11 ±1.04	141.80 ±4.83
Copper (Cu)	7.05 ±1.49	8.26 ±0.90	6.91 ±0.18	9.91 ± 0.14
Zink (Zn)	25.32 ±1.48	27.51 ±1.10	26.44 ±0.81	43.52 ±1.46

Table 2. Mean concentrations of trace metals (µg g^{-1} d.w) for female shrimp *A. desmoresti mosopotamica*, stander deviation, during the studied period from 2008-2009.

Trace metals	Season			
	Summer 2008	Autumn 2008	Winter 2009	Spring 2009
Lead (Pb)	3.28 ±0.29	3.16 ± 0.04	2.96 ±0.18	4.31 ±0.15
Manganese (Mn)	5.40 ±0.36	6.08 ± 0.09	5.83 ±0.09	7.80 ±0.65
Nickel (Ni)	15.25 ±0.37	16.41 ±0.59	16.20 ±0.41	16.64 ± 0.54
Iron (Fe)	75.87 ±15.02	99.66 ±1.37	103.53 ±1.38	136.79 ±2.06
Copper (Cu)	6.59 ±0.21	6.90 ±0.03	6.41 ±0.45	9.36 ±0.30
Zink (Zn)	26.55 ±0.91	27.21 ±0.24	27.24 ±1.13	44.17 ±0.7

Table 3 . The percentage of fat for male and female shrimp *A. desmoresti mosopotamica* through the seasons, during the studied period from 2008-2009.

Season	Male	Female
Summer 2008	2.65- 5.60	1.91-2.44
Autumn 2008	3.35- 4.78	2.66-3.12
Winter 2009	2.03- 3.77	1.69- 3.00
Spring 2009	3.54-5.72	3.54- 5.72

It indicated that the river has been polluted by heavy metals which eventually lead to bioaccumulation of those pollutants in the food chain of the Qurmat-Ali and the effect of sewage and waste product as this was stated by the study of Al-Khafaji (2000), and may be due to the nature of river water (Athayle and Gokhate, 1991). Or may be that the tissue accumulation depends on water concentration, a departure from unity indicates that other factors, such as the abundance of available element forms in water and or food, can affect metal intake and accumulation (Ravera *et al.*, 2007).

Among the six metals tested for shrimps male and female, Fe concentration was the highest (141.8 µg g^{-1}d.w) in spring for male and Pb was the lowest (2.49 µg g^{-1} d.w) in winter for male. This could be explained by the role of those metals as essential or non essential element for aquatic organism. Lower Pb content in the tissue possibly due to its toxicity and are non essential metals to organism (Abdullah *et al.*, 2007).Increasing or decreasing trace metals depend on the metabolic activity when it is relatively less may be attributed to the organisms uptake and elimination rates (Ragragio *et al.*, 2009).

A. desmaresti mesopotamica male and female were found to have a large capacity for Fe. Zn, Ni, and Cu intake. Those metals are essential elements for aquatic organisms (Drexler *et al.*, 2003). Comparatively, lower Pb content was determined in the tissue. Among (Table 1 and 2) the accumulation of trace element in the tissues of males shrimp decreased in the ordered Fe >Zn > Ni > Mn > Cu > Pb, while in females was Fe > Zn > Ni > Cu > Mn > Pb. as shown in the tables. Based on the results, it showed that the magnitude of the studied trace metals accumulation in crustacean's tissue of the studied species depends on the type of trace metals, and the sex of the species. The aquatic organisms usually exhibit high degree of variability in the bioaccumulation of different metals suggest the need for detailed studies involving more species of economic importance in evaluating the general background and toxic levels for utilizing them as indices of pollution.

Conclusion

The findings of this study showed that this crustacean species has a potential to be used as a bio indicator for the contamination of trace metals. It showed that the accumulation of trace metals in the shrimp *A. desmaresti mesopotamica* depends on the type of metals and organisms sex. Shrimps live on the bottom of water bodies where they burrow in the sand or mud, and they known as in faunal deposit feeder (Han *et al.*, 1996). As a consequence, they are very much exposed to the bottom water suspension and the trace metals accumulated in sediment. This has created a major impact on the accumulation rate of trace metals in those organisms.

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قياس تراكم بعض العناصر النزرة في جسم روبيان المياه العذبة *Atyaephyra desmaresti mesopotamica* من شط العرب، البصرة، العراق

سامي طالب لفته الياسري

مركز علوم البحار، جامعة البصرة، البصرة - العراق

المستخلص - قيست تراكيز العناصر النزرة (الرصاص، المنغنيز، النيكل، الحديد، النحاس، الخارصين) في جسم روبيان المياه العذبة *Atyaephyra desmaresti mesopotamica* المستجمع من شط العرب،البصرة-العراق. قيست التغايرات الفصلية على تراكيز العناصر النزرة والعلاقة بين تراكيز العناصر في الذكور والإناث، جمعت النماذج في الفترة بين صيف 2008 (مايس وحزيران وتموز وآب) وربيع 2009 (آذار ونيسان) من منطقة كرمة علي. عينات الأنسجة حللت فصلياً بوساطة مطياف اللهب الذري. وجدت الدراسة أن الإناث تراكم العناصر النزرة في أجسامها في الربيع أكثر من الفصول الأخرى، أما الذكور فأنها تراكم العناصر النزرة في الربيع أكثر من الفصول الأخرى باستثناء الرصاص والمنغنيز، وجدت القيمة العليا لعنصر الحديد 141.80 مايكغم/غم في الذكور و136.79 مايكغم/غم في الإناث في فصل الربيع بينما القيمة الدنيا كانت 2.49 مايكغم/غم في الذكور و 2.96 مايكغم/غم في الإناث بالنسبة لعنصر الرصاص. بالنسبة للفصول: في الصيف تراكيز العناصر النزرة عالية في الذكور عنه في الإناث ماعدا عنصر الخارصين. في الخريف كانت عالية في الذكور عنه في الإناث ماعدا الرصاص والنيكل. في الشتاء كانت عالية في الذكور عنه في الإناث ماعدا الرصاص والخارصين . في الربيع كانت عالية في الذكور عنه في الإناث ماعدا الرصاص والمنغنيز والخارصين اذ كانت تراكيزها قليلة.

كلمات مفتاحية: روبيان المياه العذبة، شط العرب، العناصر النزرة.