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Assessment of the accumulation of some chemical elements in whole body Of fresh water shrimp *Metapenaus affinis* from Shatt Al-Arab River Basrah, Iraq

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Abstract

This study included the determination of six chemical elements (Pb, Mn, Ni, Cd, Cu, and Co) in whole body of shrimp *Metapenaus affinis* of the Shatt Al-Arab River , Basrah , Iraq . The seasonal variations of elements concentration , and the relation ship between elements concentration in males and females estimated in pursuit of this study Field measurements were done to evaluate chemical elements in shrimp's tissues in Qurmat-Ali in Shatt Al-Arab River between summer (May -August) 2019 and spring (March and April) 2020. Samples were collected seasonally. Tissue samples were analyzed by flam atomic absorption spectrophotometry. This study shows that bio accumulation of chemical elements, females accumulated the chemical elements in their bodies in Spring higher than other seasons , males accumulated the chemical elements in their bodies in Spring higher than other seasons except Pb. Regarding to concentrations ; the highest value were 16.89 µg g^{-1} d. w in males and 16.74 µg g^{-1} d .w in females for Nickel , while the lowest value were 1.11 µg g^{-1} d. w in males and 1.27 µg g^{-1} d. w in females for Cobalt . Regarding to seasons : in Summer the concentrations of chemical elements were higher in females than in males except Pb and Ni, in Autumn they were higher in males than in females except Cd and Co, in Winter they were higher in males than in female, except Cd and Co , in Spring they were higher in females than in males , except Ni , and Cu

As a result of the slower turnover time of the concentrations of chemical elements in females than males for all the elements . It is found that the shrimp has potential to be used as bio indicator for the concentrations of this chemical elements .

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Key worlds
Fresh water shrimp , seasonal variation , elements , concentration

Introduction

Chemical elements reach an aquatic environments from various sources. Rocks 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) . Human activities , e.g. industry, urban and agricultural discharge, mine runoffdeposition (Merciai *et al*., 2014) .

The aquatic environment contaminated by chemical elements may lead to bioaccumulation in the food chain of an environment. Shrimps contain concentrations of chemical elements on consumption by human being will cause toxic effects (Akinola *et al* ., 2008) . Normally , such contaminants are transported from its sources through River system and deposited down stream . Since most of pollutants could be mixed and became suspended solid and bottom sediments through sedimentation , therefore aquatic environment e.g (Shatt Al-Arab River) is potential sink for these pollutants for a period of time (Morrisiy *et al* ., 2003) . The presence of chemical elements in aquatic environment can lead to greater environmental problems when the elements are up taken by shrimps . Hence, consumption of such kind of crustacean may form a significant pathway to elements contamination in the human being and eventually poses greater health risk because of their stability and may persist for along time in the environment (Bieny *et al* ., 1994) .Shrimp is frequently used as bio indicator in environmental monitoring due its ability to accumulate pollutants from its ambient .Usually ,the level of pollutant accumulated in such organism's tissues used for assessing the level of pollution in its habitat (AbdAllah and Moustafa 2002).

The crustaceans concentrate various toxic and non toxic chemical elements in their bodies with no evident danger to themselves so they often exploited to identify pollutant in an environment (Al-Yaseri, 2007), shrimp can play an important role in the environment where they are very abundant particularly because of their influence on food web so the bioaccumulation of elements in any organism depend upon various factors such as bio- availability, amount of uptake their hold and the physiological efficiency of the organisms to excrete excess of pollutants

Accordingly the concentration of chemical elements in the environmental media also depend upon different factors , (Arkadiusz *et*., 2007) (Athayle and Gokhates,1991).

During the shrimp's life there is a continuous flux of elements from the environment (water and food) to the tissues and vice versa , when a shrimp was eaten or dies its tissues become available as food for human and other organisms or decompose in a relatively .

In the present study ,dealing with 6 chemical elements (Pb, Mn, Ni , Cd , Cu and Co) measured in whole body of shrimp *Metapenaus affinis* collected from Shatt Al-Arab River, Basrah , Iraq for the period from May 2019 to April 2020 . The study aria Qumat-Ali is located at Shatt Al -Arab River and shown in the (figer1) It was chosen to reflect possible sources of chemical elements pollution .

Aim and purpose of the research

1-The main aim of this study was to evaluate the concentrations of chemical elements in shrimp *Metapenaus affinis* which is an important effort that contributes to the finding of method in monitoring pollution in Shatt Al-Arab River environment , compared the seasonal variations of elements concentrations, and determining the permissible effluent discharge rates in the aquatic environment and monitoring levels of contamination in streams with respect to water quality standards .

2- Such data are important that organisms which accumulate chemical elements are of interest due to their implication to the aquatic environment and the human health .

Study area

The study area Qurmat-Ali are located at Shatt Al-Arab shown in (Figure1) It was chosen to reflect possible sources of chemical elements pollution .

Qurmat-Ali has been reported to be polluted industrial effluent , agricultural effluent and domestic waste water .

Material and Methods

Shrimp were obtained manually between summer 2019 and spring 2020 from the site .Samples were collected monthly.

They kept in polyethylene box and brought to laboratory the shrimps sorted into males and females according to the presence of the appendix masculine, samples were dried in oven at 80ºc 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 .Chemical elements concentrations in shrimp whole body was expressed as microgram per gram ($\mu g\ g^{-1}$).

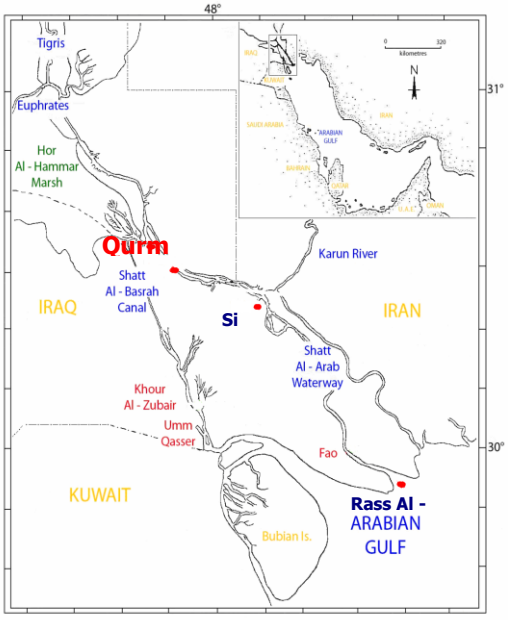

Figure 1: Study area *represented by Qurmat – Ali located on the Shatt Al-Arab River.

Result and discussion

In this study concentrations of chemical elements (Pb, Mn, Ni, Cd, Cu, and Co) were determined in shrimps collected from Qurmat-Ali . The overall concentrations in this studied shrimp *Metapenaus affinis* males and females are provided in Table 1 and Table 2 , and represented in $\mu g\ g^{-1}$ dry

weight . It was found that all of the elements concentrations in the tissues (whole body) of females shrimp collected from the site in spring (4.49 ,7.71 ,16.74 ,2.66 ,10.89 ,and 4.34) for (Pb, Mn, Ni, Cd, Cu, and, Co) respectively were significantly higher ($p<0.05$) than those collected in other seasons. It indicated that the females tend to accumulate the chemical elements , The high bioaccumulation can be explained by its feeding mechanism , *Metapenaus affinis* is the species of the crustaceans that live on the bottom of water bodies , as most chemical elements are known to be associated with particles especially sediment in fresh water especially the feeding increased during the spring and due to the quantity of fat in their tissues Table 1 and Table 2 (Zhou *et al.*,1996) . While in males it was noticed that the accumulation also high in Spring (16.89 , 13.12) for (Ni and Cu) respectively , except Pb element were high in Summer (4.09) , the reason may be due to the bioaccumulation of elements in any organism depend upon various factors such as bio- availability, amount of uptake their hold and the physical efficiency of the organism to excrete excess of elements , on the other hand , various a biotic environment conditions (mainly temperature ,salinity and hardness in addition to seasons location) affect accumulation of chemical element in biota (Win and Nicholus , 1997 ; Soundarapandian *et al*., 201) .

Table 1 mean concentration of chemical elements in $\mu g\ g^{-1}$ for males of *Metapenaus affinis* which was recorded in field ,stander deviation and the percentage of fat through the seasons

Name of elements	Summer 2019		Autumn 2019		Winter 2020		Spring 2020	
	Mean	Fat	Mean	Fat	Mean	Fat	Mean	Fat
Lead Pb	4.09 ±0.41	3.15	3.65 ±0.21	3.55	3.41 ±0.11	2.14	3.88 ±0.32	4.51
Manganese Mn	3.39 ±0.87	3.41	7.43 ±1.15	4.57	8.23 ±1.17	3.19	7.32 ±1.40	5.76
Nickel Ni	15.44 ±1.27	4.08	16.35 ±016	4.37	16.78 ±1.48	3.61	16.89 ±1.55	5.21
Cadmium Cd	1.22 ±0.14	5.31	1.55 ±0.28	4.11	1.32 ± 0.23	3.88	2.08 ±0.38	5.72
Copper Cu	6.69 ±1.59	2.65	10.22 ±1.30	4.28	6.67 ±0.49	2.87	13.12 ±1.82	5.82
Cobalt Co	1.11 ±0.12	3.34	2.88 ±0.24	4.11	2.01 ±0.08	3.57	3.02 ±0.46	5.57

Table 2 mean concentration of chemical elements in µg g^{-1} for females of *Metapenaus affinis* which was recorded in field ,stander eviation and the percentage of fat through the seasons .

Name of elements	Summer 2019		Autumn 2019		Winter 2020		Spring 2020	
	Mean	Fat	Mean	Fat	Mean	Fat	Mean	Fat
Lead Pb	3.98 ±0.32	2.51	3.18 ±0.17	2.88	2.97 ±*0.22*	1.67	4.49 ±1.26	3.51
Manganese Mn	5.55 ±0.97	2.28	6.07 ±0.32	2.93	5.79 ±0.19	2.21	7.71 ±0.30	4.62
Nickel Ni	15.35 ±1.22	2.09	16.26 ±1.09	2.75	16.54 ±1.87	2.36	16.74 ±1.32	5.33
Cadmium Cd	2.44 ±0.10	2.18	1.65 ±0.34	2.98	1.89 ± 0.23	2.77	2.66 ±0.58	5.70
Copper Cu	7.29 ±0.58	2.38	7.74 ±0.40	3.15	6.59 ±0.58	2.21	10.89 ±1.95	5.40
Cobalt Co	1.27 ±0.32	2.44	3.91 ±0.17	2.67	2.20 ±0.i6	3.01	4.34 ±0.46	5.46

indicated that the River has been polluted by chemical elements which eventually lead to bioaccumulation of those pollutants in the food chain of the Qurmat-Ali and the effect of sewage and waste product Al -. Khafaji (2000) , and may be due to the nature of River water (Athayle and Gokhate ,1991). It is likely that the entrapment of pollutants in such an area to be expected . or other factors such as the abundance of available elements forms in water and or food , can effect elements intake and accumulation (Ravera *et al*; 2007) Among the six elements tested for shrimps males and females , Ni concentration was the highest (16.89 µg g^{-1}) in Spring for male and Co was the lowest (1.11 µg g^{-1}) in Summer for males This could be explained by the role of those elements as essential or non essential elements for aquatic organisms. Lower Co content in the tissue possibly due to its toxicity and are non essential elements to organism (Abdullah *et al.*, 2007) .Increase or decrease chemical elements depend on the metabolic activity when it is relatively less may be attributed to the organism up take and elimination rates (Ragragio *et a*l., 2009) . Metapenaus affinis , males was found to have a large capacity for Pb. Mn , Ni, ,and Cu intake while female found to have a large capacity for ,Mn ,Cd ,Cu , and Co, intake . This could be explained by the role of those elements as essential elements for aquatic organisms (Drexler et al ., 2003) . Comparatively lower Co content in the tissue possibly due to its toxicity and are non essential metal to crustaceans . Among (Table 1,2) the accumulation of chemical elements in the tissues of males and females shrimp decreased in the ordered Ni > Cu > Mn > Pb > Co > Cd .

Based on those results, it showed that the magnitude of the studied chemical elements accumulation in crustaceans tissue depends on the type chemical elements and the sex of the species .

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 and the heavy metals accumulated in sediment and finally created major impact on the accumulation rate of heavy metals in those organisms The aquatic organisms usually exhibit high degree of variability in the environment of different bioaccumulation elements 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 finding of this study showed that this species of crustaceans has potential to be used as a bio indicator for the contamination of chemical elements. It showed that the accumulation of chemical elements in shrimp *Metapenaus affinis* depends on the species of chemical elements and organisms.

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