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Mollusca As A Bioindicator of Heavy Metals Pollution in Shatt AL-Arab Estuary

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ABSTRACT

In The present study we determined the concentrations of eight heavy metals (Lead, Nickel, Copper, Chrome, Zinc, Cobalt, Cadmium and Iron) in exchangeable and residual phase by using Flame Atomic Absorption Spectrophotometer (FAAS) for Mollusca ***(Theodoxus Jordani, Corbicula flumenia, Turberculata Melanoides and Melanopis nodosa)*** *from the sediment core samples. Melanides turberculata have high ability to accumulation Ni and Cd in their tissue and this can be used as a bioindex of Ni and Cd pollution index, Corbicula flumenia have high ability to accumulation Co in their tissue and this can be used as a bioindex of Co pollution index and Melanopsis nodosa have high ability to accumulation (Pb, Cu, Cr, Zn and Fe) in their tissue and this can be used as a bioindex of (Pb, Cu, Cr, Zn and Fe) pollution index. The degree of contamination in the Mollusca had been evaluated by using Contamination factor (CF) and Enrichment factor (EF). Based on Contamination factor (CF) this environment were moderate contamination with Pb , low contamination with (Ni, Zn, Cu, Cr and Fe) , very high contamination with Cd and low to moderate contamination with Co. Based on Enrichment factor (EF) this environment were very severe enrichment to extremely severe enrichment with Pb, severe enrichment with (Ni, Zn, Cu and Cr),extremely severe enrichment with Cd and severe enrichment to very severe enrichment with Co. An increase in average concentration of heavy metals in biomass due to increase heavy metals in water and sediment of Shatt Al Arab River.*

Key words: Mollusca, Heavy metals, Exchangeable, Residual, sediment core, Shatt AL-Arab estuary.

INTRODUCTION

Fresh water *mollusca*–snails and bivalves-have been used frequently as bioindicator organisms. Two important advantages of snail and bivalves over most other freshwater organisms for biomonitoring [1] are: (Large in size, Limited mobility in the aquatic environment, Abundant in many types of fresh water environments, Relatively easy to collected and identify).In recent years, technological advancement in various fields has led to increasing input of heavy metals into the environment, which in turn has inevitably caused water environmental pollution [2].The cycling of heavy metals in aquatic ecosystems has been the subject of much investigation as levels of environmental contamination continually increase [3]. Metals are mainly accumulated in sediments and bio accumulated in aquatic biota through food chain [4]. Biomonitors have been defined as species which accumulate trace metals in their tissues and may therefore be analysed to monitor the bio availability of such contaminants in the ecosystems [5] and [6].

Many researchers used *mollusca* as bioindicators to determine the levels of Heavy Metals in the aquatic environments [7],[8],[9] and [10]. Few workers used Invertebrates as bioindicator to determine the levels of Heavy Metals in Iraqi aquatic systems, [11] mentioned to determine the level of Heavy Metals in Shatt Al-Arab River, and investigate the possibility of using the fresh water *Corbicula fluminca* as bioindicator for Heavy Metals pollution[12] studied some Heavy Metals in *Corbicula fluminae* and *Uniotigridis* which collected from Euphrates River, and he found that there were high concentrations of Heavy Metals in their tissues.[10] study the assessment and sources of Some Heavy Metals in *Bellamya (Viviparus)bengalensis*. [6] determine the concentration of six Heavy Metals in five sites in Shatt Al-Arab river and determine the ability of *M. tuberculata* as bioindicator for pollution by some Heavy Metals.[13] estimation the concentration and distribution of five Heavy Metals (Cu,Fe,Mn,Pb and Zn) in two clam species (*Corbicula fluminea and Corbicula fluminalis*) from six stations located in Shatt Al-Arab river between Quarna and Abu Al-Khaseb.

This study used four species in sediment core of Shatt Al-Arab estuary as a bioindicator for heavy metals pollution.

MATERIALS AND METHOD

Four species of Mollusca Fig.(1) (*Theodoxus Jordani,Corbicula flumenia*, *Turberculata Melanoides* and *Melanopis nodosa*) were collected from the sediment core samples in Shatt Al-Arab (Fig.2) and grind finely using an electrical mortar and sieved through a 63 µm mesh sieve. The sample was stored in polyethylene vials till the time of analysis.

Theodoxus Jordani ***Corbicula flumenia*** ***Turberculata Melanoides*** ***Melanopis nodosa***

Fig (1): Some of the Mollusca in core sample as bioindicaters

Fig.(2) The study stations

The exchangeable heavy metals ions were extracted from sediment according to the method of [14].The residual heavy metals were extracted according to [15].Samples were measuring using Flame Atomic Absorption Spectrophotometer (FAAS).To check for contamination of the digestion procedure and sample manipulation, a blank solution was prepared and carried through each set of the analysis.

RESULT AND DISCUSSION

Result of the present study are shown in Table (1) and (2). The highest value of Heavy Metals concentrations in *Theodoxus jordani* in the exchangeable phase was (1623.21µg/g dry weight) in Iron and the lowest value was (13.24µg/g dry weight) in Cobalt, and the highest value of Heavy Metals concentrations in *Theodoxus jordani* in Residual phase was (1860.68µg/g dry weight) in Ironand the lowest value was (15.44µg/g dry weight) in Cadmium. The highest value of Heavy Metals concentrations in *Melanides turberculata* in the exchangeable phase was (1830.65µg/g dry weight) in Iron and the lowest value was (15.83µg/g dry weight) in Cadmium, and the highest value of Heavy Metals concentrations in *Melanides turberculata* in the Residual phase was (1940.70µg/g dry weight) in Iron and the lowest value was (18.68µg/g dry weight) in Cadmium. The highest value of Heavy Metals concentrations in *Corbicula flumenia* in the exchangeable phase was (2120.21µg/g dry weight) in Iron and the lowest value was (10.28µg/g dry weight) in Cadmium, and the highest value of Heavy Metals concentrations in *Corbicula flumenia* in the Residual phase was (2120.21µg/g dry weight) in Iron and the lowest value was (15.10 µg/g dry weight) in Cadmium.The highest value of Heavy Metals concentrations in *Melanopsis nodosa* in the exchangeable phase was (2128.50µg/g dry weight) in Iron and the lowest value was (11.54µg/g dry weight) in Cadmium, and the highest value of Heavy Metals concentrations in *Melanopsis nodosa* in the Residual phase was (2311.51µg/g dry weight) in Iron and the lowest value was (16.72µg/g dry weight) in Cadmium.

From these results we found that *Melanides turberculata* have high ability to accumulation Ni and Cd in their tissue and this can be used as a bioindex of Ni and Cd pollution index, *Corbicula flumenia* have high ability to accumulation Co in their tissue and this can be used as a bioindex of Co pollution index and *Melanopsis nodosa* have high ability to accumulation (Pb, Cu, Cr, Zn and Fe) in their tissue and this can be used as a bioindex of (Pb, Cu, Cr, Zn and Fe) pollution index.

Indices:

Contamination Factor (CF) :

Table (3 and 4) shown the CF and PLI value according to [16] classification the CF value of Pb in exchangeable and residual phase are ($1 \leq CF \leq 3$) indicating that this environment were moderate contamination, the CF value of (Ni, Zn, Cu, Cr and Fe) in exchangeable and residual phase are ($CF<1$) indicating that this environment were low contamination, the CF value of (Co) in exchangeable and residual phase are ($CF<1$) to ($1 \leq CF \leq 3$) indicating that this environment were low to moderate contamination, the CF value of Cd in exchangeable and residual phase are ($CF>6$) indicating that this environment were very high contamination.

Enrichment Factor (EF):

Table (5 and 6) shown the EF value according to [17] classification the EF value of Pb in exchangeable and residual phase are (EF 25-50) and (EF >50) indicating that this environment were very severe enrichment to extremely severe enrichment, the EF value of (Ni, Zn, Cu and Cr) in exchangeable and residual phase are (EF = 10-25) indicating that this environment were severe enrichment, the EF value of (Co) in exchangeable and residual phase are (EF = 10-25) to (EF 25-

50) indicating that this environment were severe enrichment to very severe enrichment, the EF value of Cd in exchangeable and residual phase are (EF >50) indicating that this environment were extremely severe enrichment .

Table (1) : Concentration of Exchangeable Heavy Metals (µg/g) dry weight in Mollusca

Species	Pb	Ni	Cu	Cr	Zn	Co	Cd	Fe
Theodoxus Jordani	**28.53**	**51.50**	**32.18**	**55.68**	**40.53**	**13.24**	**13.25**	**1623.21**
Melanides Turberculata	**25.32**	**60.23**	**40.63**	**44.21**	**38.36**	**20.52**	**15.83**	**1830.65**
Corbicula flumenia	**21.25**	**48.11**	**28.51**	**60.01**	**28.61**	**28.12**	**10.28**	**2120.21**
Melanopsis nodosa	**30.25**	**50.63**	**43.21**	**65.72**	**48.37**	**16.28**	**11.54**	**2128.50**

Table (2) : Concentration of Residual Heavy Metals (µg /g) dry weight in Mollusca

species	Pb	Ni	Cu	Cr	Zn	Co	Cd	Fe
Theodoxus Jordani	**30.68**	**56.28**	**40.52**	**58.62**	**42.12**	**16.28**	**15.44**	**1860.68**
Melanides Turberculata	**28.83**	**65.42**	**44.79**	**53.84**	**40.21**	**23.64**	**18.68**	**1940.70**
Corbicula flumenia	**26.30**	**50.81**	**33.30**	**68.10**	**32.70**	**33.68**	**15.10**	**2120.21**
Melanopsis nodosa	**38.62**	**55.81**	**45.62**	**70.11**	**50.18**	**28.51**	**16.72**	**2311.51**

Table (3) : Contamination Factor(CF) In Exchangeable Heavy Metals in Mollusca

species	CF(pb)	CF(Ni)	CF(Cu)	CF(Cr)	CF(Zn)	CF(Co)	CF(Cd)	CF(Fe)
Theodoxus Jordani	**2.04**	**0.61**	**0.54**	**0.55**	**0.58**	**0.53**	**88.33**	**0.03**
Melanides Turberculata	**1.81**	**0.72**	**0.68**	**0.43**	**0.55**	**0.82**	**105.53**	**0.03**
Corbicula flumenia	**1.52**	**0.57**	**0.48**	**0.59**	**0.41**	**1.12**	**68.53**	**0.04**
Melanopsis nodosa	**2.16**	**0.60**	**0.72**	**0.64**	**0.69**	**0.65**	**76.93**	**0.04**

Table (4) : Contamination Factor (CF) In Residual Heavy Metals in Mollusca

species	CF(pb)	CF(Ni)	CF(Cu)	CF(Cr)	CF(Zn)	CF(Co)	CF(Cd)	CF(Fe)
Theodoxus Jordani	**2.19**	**0.67**	**0.68**	**0.57**	**0.60**	**0.65**	**102.93**	**0.03**
Melanides Turberculata	**2.06**	**0.78**	**0.75**	**0.53**	**0.57**	**0.95**	**124.53**	**0.03**
Corbicula flumenia	**1.88**	**0.60**	**0.56**	**0.67**	**0.47**	**1.35**	**100.67**	**0.04**
Melanopsis nodosa	**2.76**	**0.66**	**0.76**	**0.69**	**0.72**	**1.14**	**111.47**	**0.04**

Table (5) : Enrichment Factor (EF) In Exchangeable Heavy Metals in Mollusca

species	EF(pb)	EF(Ni)	EF(Cu)	EF(Cr)	EF(Zn)	EF(Co)	EF(Cd)	EF(Fe)
Theodoxus Jordani	**70.68**	**21.26**	**18.60**	**18.93**	**20.08**	**18.37**	**3063.79**	**1.00**
Melanides Turberculata	**55.62**	**22.05**	**20.83**	**13.33**	**16.85**	**25.24**	**3245.58**	**1.00**
Corbicula flumenia	**40.31**	**15.21**	**12.62**	**15.62**	**10.85**	**29.87**	**1819.83**	**1.00**
Melanopsis nodosa	**57.15**	**15.94**	**19.05**	**17.04**	**18.28**	**17.22**	**2034.93**	**1.00**

Table (6) : Enrichment Factor (EF) In Residual Heavy Metals in Mollusca

species	EF(pb)	EF(Ni)	EF(Cu)	EF(Cr)	EF(Zn)	EF(Co)	EF(Cd)	EF(Fe)
Theodoxus Jordani	**66.31**	**20.27**	**20.43**	**17.39**	**18.21**	**19.70**	**3114.53**	**1.00**
Melanides Turberculata	**59.74**	**22.59**	**21.66**	**15.31**	**16.66**	**27.43**	**3612.73**	**1.00**
Corbicula flumenia	**49.88**	**16.06**	**14.74**	**17.73**	**12.40**	**35.77**	**2673.10**	**1.00**
Melanopsis nodosa	**67.19**	**16.18**	**18.52**	**16.74**	**17.46**	**27.78**	**2714.92**	**1.00**

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