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LEVELS OF HEAVY METALS (CADMIUM, COPPER AND ZINC) IN THE TISSUES OF FOUR FISH SPECIES OF THE EUPHRATESRIVER; THIQAR, IRAQ

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ABSTRACT

Concentration of three heavy metals (cadmium , copper and zinc) in the gills, skin, scales, liver, bones and muscles of four fish species (Himri, carp, tilapia and khishni) collected from the Euphrates River in the area between the town of Batha and the city of Nasiriyah were investigated. Samples were collected in July 2015. The study revealed that the concentrations of heavy metals changewith different tissue and with species of fish. The lowest level of cadmium was shown by Hamri (38.88 mg / kg dry weight) , and the highest (107.4 mg / kg dry weight) was recorded in the liver followed by scales . Carp and tilapia did not differ significantly among themselves and showed significant differences ($p < 0.05$) fromKhishni.The lowest level of copper was measured in the muscle tissue (21.93 mg / kg dry weight) and highest in the liver (2088.07 mg / kg dry weight) . Hamri showed more accumulation of copper. The highest rates of zinc was in the gills (279.79 mg / kg dry weight) and the lowest accumulation was in the muscles. The study indicate that all concentrations of heavy metals in the tissues of fish was high as classified by FAO. The effect of cadmium on the different fish species differ significantly ($P < 0.05$). Transactions in the texture of the skin and bone tissue did not differ from each other, but significantly rose ($p < 0.05$) compared with the treatments of scales and muscle tissue.

KEYWORDS: Cadmium, Copper and Zinc

INTRODUCTION

Rivers are polluted with heavy elements from various sources such as domestic discharge, agricultural activities like fertilizers and pesticides, which affect the water balance in the ecosystem (Gallardet*et. al*., 2004; Karak*et al*., 2010). Fishes are widely taken to assess the health of ecosystems, due to the transfer of heavy elements within the food which is responsible for the harmful effects in ecosystems (Farkas*et al*., 2000). Study of the bioaccumulation of heavy elements in different organs of Fish is important to know the extent of their exposure during their life to pollutants, and use vital evidence to determine the extent of water pollution of the environment in which we live as well as on the impact of heavy elements on its nutritional value , growth and reproduction (Mchim and Benoit 1971;Al-Sarraj, *et. al.*, 2004) Cadmium is toxic if it exceeds the concentration 0.01 mg / L in irrigation water and drinking water (Taha, 2004). cadmium is stopped by some heavy metals such as iron, mercury biological function of humans and is likely to be toxic few concentrations (Robert,1991), and effects of acute blood pressure and kidney damage and its effects on the building red blood cells (Gupta and Mathur, 1983). Copper is available in surface and subsurface water and increasing concentrations when using pesticides for agricultural spraying which is important in cell Metabolism but cause anemia and disorder in the bone and tissue when increasing concentrations. zinc is necessary for the body as a copper and cobalt for both humans and animals and the lack of zinc leads to obstruction of growth, loss of appetite and lack of semen. (NAS-NRC, 1974) .

Four species of economically valued fish were selected from the Euphrates River. They areheavily consumed in the city of Nasiriya. However, for the purpose of the study of bio-accumulation of some heavy elements in the gill , skin , scales and liver , bones and muscleswere investigated.

MATERIALS AND METHODS

Description of Study Area

Euphrates River is one of the important sources of water for human consumption and industrial purposes Figure (1).The quality of the Euphrates River is deteriorated when it comes out of Shinafiyah area in the city of Diwaniya after passing Samawah that causes the springs of subsurface areas the salinity to rise to 6.4 g / liter (Hussein,*et. al.,* 2006). the Euphrates RiverPenetrates geographical area of the city of Nasiriya from the North West Frontier Badhae city at kilometer 911.5 of the Euphrates River, the beginning of the study area to the electricity station of Nasiriya city (Long 31.042393° ,Lat 46.216016°) , River width is between (25-84 m) fishing operations are in those area located on the banks of the river, use electric fishing for collecting fish specimens that are put immediately in a small container of crushed ice to continue Fish processing in the laboratory.

Samples of four species of fish spread in Euphrates in the area from Badhae region to the city of Nasiriya are gathered in July 2015 to study the bioaccumulation of heavy metals i.e. Cadmium , Copper and Zinc in the tissues of fish, which are used as a good reference for contamination of the environment with heavy elements (Salman *et. al,.* 2007) .investigated species have specific features , length between 15-20 cm and O-group age

1- Fish Species

- Himri:*Barbusluteus*
- Common carp: *Cyprinuscarpio*
- Khishni: *Liza abu*
- *TilapiaOreochromisaureus*

Fish were collected with plastic container which havecrashed ice.Gill , skin peels ,liver, bones and muscles of each type of fishhave been isolated by specific method (Lucky, 1977) in the anatomy of the fish.

2. tissue of fish areseparated , cut into small pieces , mixed well and then dried at a temperature of 105 C for 24 hours and then milled and digested according to Canliandkalay(1998) and measured by atomic absorption apparatus (FAO,1983) ,expressed it (mg / kg dry weight) and used the random tests in assessing global CRD Transactions 3 × 6 × 4 for four different fish and six different tissues and three replicates and analyzed by SPSS to show ANOVA (schedule of analysis of variance AL-Rawi(1992).

Figure 1: Map Showing the Sampling Location in the Euphrates River at Thi Qar Province

RESULTS AND DISCUSSIONS

Cadmium

When studyingtransactions the tissue of Fish and their effect by pollution cadmium values for transactions of tissue ,gill, skin, scales,liver , bones and muscles are 38.82 and 34.88 and 54.87 and 74.96 and 42.56 and 37.68 mg / L dry weight, respectively. There were different tissues transactions among themselves morally p <0.05 transactions are in the liver tissue is the biggest pollution from the rest of the transactions and then transaction of scales 54.87 mg / L dry weight. The study agrees with (Klarecamp*et. al*., 1984) that the liver and kidney are main organs formetabolic operations , Detoxification, and accumulation in the liver of heavy elements are higher than the rest of the tissue due to its important position from the body as it is the liver is blood circulation center (Adefhemi*et. al* ., 2008). The impact of cadmium on fish species ,Fish four differ from each other morally and the level of p <0.05 and cadmium values pout (*Liza abu*) is the highest 62.33 mg / L dry weight while the lowest rates are for cadmium is a *Barbus luteus* 38.88 mg / L dry weight either carp and Tilapia are not morally different among themselves in cadmium rates but they are different significantly p <0.05 from *Liza abu* and *Barbus luteus*. As (Hussein and Fahad, 2012) mentioned , increasing the accumulation of cadmium in *Liza abu*inGharraf River, and study (Weher, 2002), in his study on the Jordan River Fish in the valley of the Arabs. The reason may be due to that fish vary in their ability on the accumulation of heavy elements (Salman, *et. al. , 2007*) reported that as of *Barbus luteus*has a great ability to the accumulation of heavy elements ,in his study on the concentrations of nine heavy elements of four types of fish in the Euphrates River.

The influence of the overlap between the types of fish and transactions tissue shown in Table 1 that the highest values obtained for the overlap is carp and liver tissue and the treatment of *Liza abu* scales and *Liza abu*and liver, values 107.04 and 106.49 and 105.98 mg / liter dry weight and the values of this overlap are morallydifferent p <0.05 from all Other transactions overlapping but it is not significantly different from each other, the lowest values obtained for cadmium are 26.87 carp in the skin. The values are less polluted is the treatment of skin 34.88 mg / L dry weight. It agrees the study of (Dehami, 2010) of the Euphrates River, as the study showed that common carp accumulate cadmium higher than other fish.Figure (2-3).

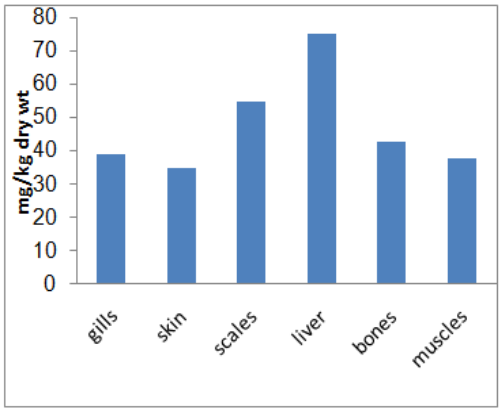

Figure 2: Cd Level in Tissue of Fish Collected from Euphrates River

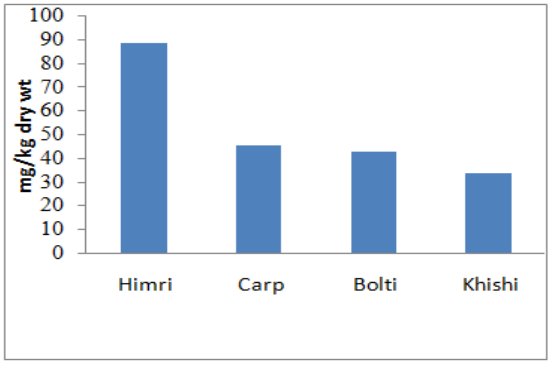

Figure 3: ConcentrationCd in Fish Collected from Euphrates River

Copper

Table 2 shows the copper rates of accumulation in sections ,gill ,skin scales ,liver, bones and muscles are 30.67 and 39.81 and 43.87 and 142.06 and 31.80 and 26.3 .significant differences ($P<0.05$) among transactions. However, the liver reveals the highest accumulation level of copper (157.42g/ kg dry wt) ,while the lowest was found in the muscles (26.31 mg / kg dry weight). The present work shows that copper accumulate in the liver more than other tissues. This coincide with Mount and Stephan (1967) as indicated by the exposure of fish to pollutants and a decrease in muscle due to acceleration of metabolism.Schulz and Martins (2001) declare that accumulation of copper in *Barbus luteus*is more than in *Liza abu* and carp that may be dueto the mechanism of feeding. This alsolead to increase concentration of copper in *TilapiaOreochromisaureus*liverFigure (4-5)

Accumulation of Copper in *Barbusluteus* , *Cyprinuscarpio* , *Tilapia Oreochromisaureus* and *Liza abu*is forming 51.81 and 36.55 and 66.23 and 86.23 and 35.08**g/ kg dry wt**, respectively, the sections have been different of the type of fish in copper accumulation among themselves and the highest concentration of copper in *Barbusluteus*section while the lowest was at *Liza abu*section and they don't not vary significantly in carp section .while the overlapping between types of fish ,designated parts and their influence by copper ,the section of tilapia in liver is the highest value of copper and there are no moral dissimilarities among them but they get low from other overlapped sections.

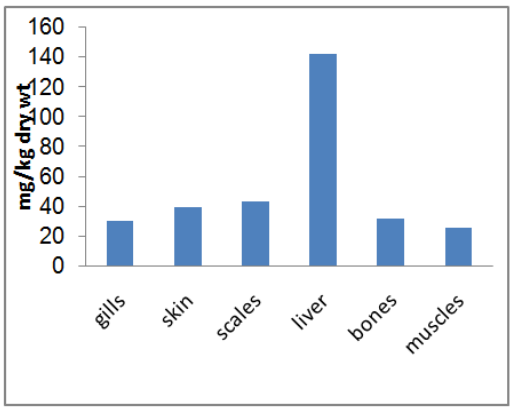

Figure 4: Cu Concentration in Fish Tissues Collected from Euphrates River

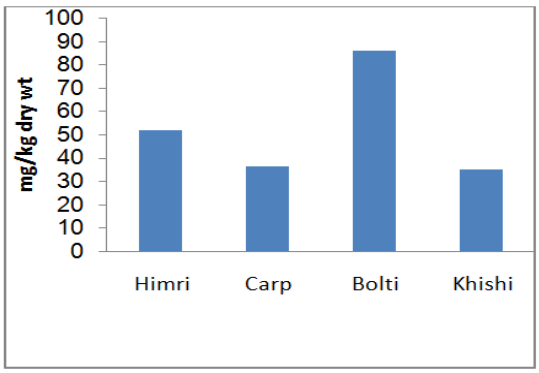

Figure 5: Cu Concentration in Fish Collected from Euphrates River

Zinc

The effect of zinc in various tissues sections where zinc levels reach in sections gill , skin scales , liver , bones and muscles of 149.63 , 114.49 , 106.04 ,126.20 , 115.05 and 83.15 mg / kg weight dry The sections show significant differencesp<0.05 among themselves and the zinc rates, fabric gills are the highest and then the section of liver tissue while sectionsin skin texture and fabric of the bones don't differ from each other, but normally rise P<0.05 from section of scalesand muscle tissue, while in zinc muscle tissue rates are less polluted of 83.15 mg / kg dry weight. The impact of zinc in the types of fish makes it clear in the table 3 It turns out that the *Barbus luteus*and carp and tilapia and *Liza abu*zinc rates of 121.79 and 150.43 and 111.55 and 79.28, respectively, and shows significant differences zinc rates p<0.05 among themselves and the highest value of the zinc rates is to carp fish and least polluted is *Liza abu*fish.Table 3 High concentrations of the zincrates is noted as (Hussein and Fahad, 2012) states in his study of the fish *Liza abu*in River Gharraf and study of (Weher, 2008), shows that the muscles are less tissue accumulation of heavy elements (Legorburn*et. al*., 1988)the reason may be it is not an active organ of the accumulation of heavy elements (Karadede and Unlo, 2000). The impact of the overlap of fish species sectionsand various tissues sections and their influence on zinc rates have been shown that the highest value of the zinc is a carp and texture gills 277.12 mg / kg dry weight excel morally all overlapped Transactions , they are less overlap in the zinc rates of *Liza abu* fish , tissue muscles and less moral 65.89 mg / kg dry weight. The current study shows that high levels of heavy elements in the liver and gills compared to some of it's organs back to the source of the accumulated elements is an industrial source because the elements from this source have a

tendency to accumulate in these organs compared to other organ (Obasohan, 2007). (Yilmaz, 2005; Kargin,1996) states that the liver, kidney, gills and lymph tissue are more accumulation of heavy elements and the muscle is not the organ which accumulates elements (Yilmaz, 2005; Kargin; 1996; Legorbura*et. al*., 1988). And heavy elements contaminationis resulting from the development of industry and agriculture. (Suhendan*et. al*., 2010) in his study on the Ataturk Dam in Turkey, that the high concentrations of zinc may be due to agricultural waste and continuous scrap (Weher,2008).Figure (6-7)

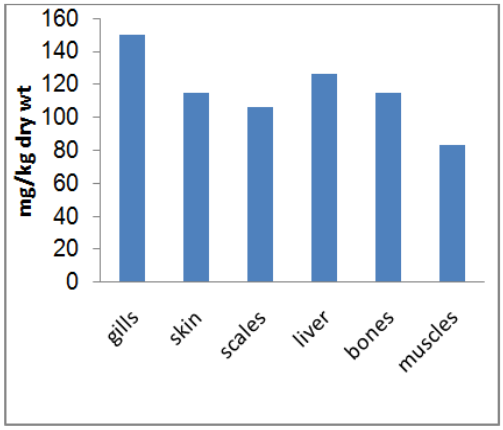

Figure 6: Concentration Zn in Tissue of Fish Collected from Euphrates River

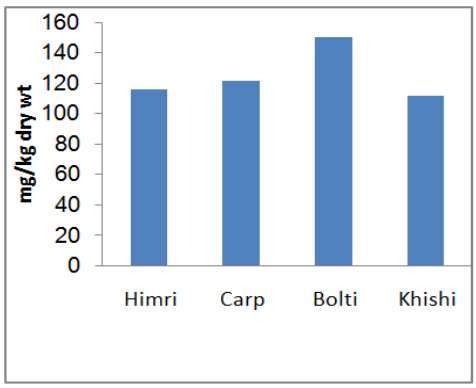

Figure 7: Concentration Zn in Fish Collected from Euphrates River

The difference in the distribution of heavy elements in four species of fish is the result of several factors, including nutrition,fish habitat , environmental needs , metabolism , biology and physiology (Arellano *et. al*., 1999). And environmental factors such as temperature (Heath, 1987) and the nature of its life. Carp`s food is on seabed only while tilapia is on seabed and on plants and Zoo benthos which accumulates heavy elements. Studies indicated that the crustaceans and satinlikes have a high accumulation of these elements (Ali and Fishar, 2005). The Euphrates River is exposed to various pollutants, including heavy elements, which tend to accumulate in theliving bodies(Salman, 2006). The studies show cadmium can enter the gills tissues, bones, scales(Van Aardt and Endmann, 2004; Mwash, 2003). Bioaccumulation of heavy elements in fish and otherphysical organs hasan alert great importance to the health of the fish and human consumption, we should place as a continuous monitoring of the concentrations of heavy elementsbecause of their acute effects. (Gupta and Mather, 1983)

Table 1: Cadmium Levels (G/ Kg Dry Wt. of Various Tissues for four Fish Species in the Euphrates

Average	Khishni	Tilapia	Carp	Himri	Fish / Tissue
38.82	42.17	45.23	33.49	34.39	**gills**
43.88	36.55	37.57	26.85	38.58	**skin**
54.87	105.98	33.57	35.72	44.21	**scales**
74.96	106.49	41.66	107.04	44.65	**liver**
42.56	44.15	56.46	36.04	33.61	**bones**
37.68	38.69	42.23	31.96	37.84	**bones**
47.29	62.33	42.78	45.18	38.88	**Average**

Table 2: Copper Levels (G/ Kg Dry Wt. of Various Tissues for Four Fish Species in the Euphrates

Average	Khishni	Tilapia	Carp	Himri	Fish / Tissue
30.67	35.09	30.58	26.32	30.72	**gills**
39.81	21.93	93.45	21.93	21.93	**skin**
43.87	26.32	43.86	52.70	52.63	**scales**
142.06	52.63	288.07	70.13	157.42	**liver**
31.80	52.63	30.72	21.93	21.93	**bones**
26.31	21.91	30.72	26.32	26.32	**bones**
	35.08	86.23	36.55	51.82	**Average**

Table 3: Zinc Levels (G/ Kg Dry Wt. of Various Tissues for Four Fish Species in the Euphrates

Average	Khishni	Tilapia	Carp	Himri	Fish / Tissue
149.63	93.67	107.18	277.12	120.55	**gills**
114.49	101.92	143.20	97.42	115.43	**skin**
106.04	45.63	89.16	146.20	143.20	**scales**
126.20	85.41	123.68	158.52	137.22	**liver**
115.05	83.16	127.44	105.67	143.95	**bones**
83.15	65.89	78.66	117.68	70.39	**bones**
115.76	79.28	111.55	150.43	121.79	**Average**

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REFERENCES

1. Adefemi, S. O. ; Asaola, S. S. ; Olaofe, O. 2008. Determination of heavy metals in *Tilapia mossambicuis* fish , Associated water and sediment from Ureje Dam in south western Nigeria . Res . J. Environ. Sci., 2(2), 151-155.
2. Al-Dehami, M. H. 2010.Trace element in Common carp (*Cyprinus carpio*) collected from Euphrates river J. Alforat Sci. Agri : 119-110 : 2(2).

3. AL-Rawi, K. M.(1992).Introduction of Statistics .N. Univ.p. p.467.

4. Arellano, J. M.; Ortiz, J. B, ; Capeta, D. ; Silva, D. ; Gonzalez de Canales ML,Sarasquete C and Blasco J. 1999. Levels of copper, zinc, manganese and iron in two fish species from salt marshes of Cadiz Bay (south west Ibrian Peninsula) Bol. Inst. Oceonogr., 15/1-4: 485-488.

5. Ali, M. and Fishar. M. 2005. Accumulation of trace metals in some benthic invertebrate and fish species relevant to their concentration in water and sediment of lake Qarun, Egypt. Egypt. J. Aq. Res., 31/1 : 289-301.

6. Canli M Ay O and Kalay M. 1998. Levels of heavy metals (Cd, Pb, Cu, Cr and Ni) in tissues of *Cyprinuscarpio*, *Barbuscapito and Chonodrostomaregium*from the Seyhan river, Turky. Turk. J. of Zool. 22 : 149-157.

7. Al-Sarraj E. S.; Janker, M H.and Al-Rawi S. M.(2014).Bioaccumulation Study of some Heavy Metals in Tissues and Organs of Three Collected Fish Species in Tigris River within Mosul City.Mesopotamia Sci. Vo.25 N.2 p. 43-55.

8. Farkas, A. ; Salanki, J., Varanka, I(2000). Heavy metal concentration in fish of lake ablation, Lakes and Reservior. Research and Management, 5(4) , 271-279 .

9. Food and Agricultural organization (FAO) 1983. Compilation of legal limits for hazardous substances in fish and fishery products . Fisheries circular No.764.FAo, Rome.

10. Gupta, B. N. and Mathur, A. K. 1983. Toxicity of heavy metals. Ind. J. Med. Sci. 37 : 236-240.

11. Gallardet, J. ; Viers, J. ; Duper, B. (2004). Trace element in river water. Treaties on Geochem., 5, 225-272.

12. Heath AG. 1987. Water pollution and Fish physiology. CRC press, press, Florida, USA, 245 pp.

13. Hussein S. A.andFahad K. K. 2012. Seasonal variation in concentration of Trace Elements in Muscles of Kishni (*Liza abu*) from Al-Garaf River, ThiQar Province, Iraq. Basrah J. Agrie Sci., 25 (Special Issue 2).

14. Karak, J.; Anaser, O. ; Shehab, Th. 2010. Accumulation of some heavy metals in HimryBarbusluteus and common Carp cyprinuscarpio fish Euphrates river. Syria, J. Animal and Poultry Prod. Mansasoura Univ., 1(12), 669-675.

15. Karadede H and Unlu E. 2000. Concentration of some heavy metals in water, sediment and fish species from the Ataturk dam lake (Euphrates), Turkey. Chemosphere, 41: 1371-1376.

16. Kargin F. 1996. Seasonal changes in levels of heavy metals in tissues of *Mullusbarbatus*and*Sparusaurata*collected from Iskanderun gulf (Turky). Water, Air Soil Pollut.90: 557-562.

17. Klavercamp, J. E.; MeDonald, W. A. ; Dunca, D. A. and Wangenann, R. 1984. Metallothionein and acclimation to heavy metals in fish, are view. In contaminant effects on fisheries (cairns, V. W.; Hodson, P. V.; Nriagu, J. O.; Eds). Wiley, New York, pp: 99-113.

18. Lagler, K. F. 1956. Fresh water Fishery Biology. 2nd edn. W. M. Brown Co. public, Dubqu, 545, p.

19. Legorburu I, Canton L, Millan E and Casado A. 1988. Trace metal levels in fish from Unda river (Spain) Anguillidae, Mugllidae and Salmonidae. Environ. Technol. Lett., 9: 1373-1378.

20. Lucky, Z. 1977. Methods for the Diagnosis of fish Disease. Amerindpuple., New Delhi, 140p.

21. Mchim, J. M.; Benoit, D. A. 1971. Effect of long-term exposures to copper on survival,growth and reproduction of brook trout *Salvelinusfontinalis.* J. fish Res. Bd. Can., 28(5), 655-662.

22. Mount, D. I. and Stephan, C. E. 1967. Amethod for Detecting Cadmium poisoning in fish. J. of Wildlife Management 31: 1.

23. Mwashot BM. 2003. Levels of Cadmium and lead in water, sediments selected fish species in Mombasa, Kenya Western Indian Ocean. J. Mar. Sci.2/1 : 25-34.

24. National Academy of Sciences-National Research council (NAS-NRC). 1974. Food and Nutrition Board. Recommended Dietary allowances. Washington DC : National Academic press.

25. Obasohan, E. E. 2007. Heavy metals concentrations in the offal, gill, muscle and liver of a fresh water mudfish (Parachannaobscura) from ogba river, Benin City, Nigeria. African J. of Bio. Vol. 6(22): 2620-2627.

26. Robert G. 1991. Toxic effects of metals In: Casarett and Doull's toxicology. Pergamum Press, pp 662-672.

27. Salman, G.M.; Hasan F. M. and Salh M. M. 2007. Concentrations of nine heavy metals in muscles of fish *Barbus lutes* Heckel ; *Aspiusvorax*Heckel : *Barbusgrybus*Heckeland*Hypophthalmicthyesmolotrix*Richardson collected from Euphrates river. J. Aquatic environmental research Vo.10 (1). P. 5-19.

28. Salman, G.M. 2006. Environmental study of possible pollutants in Euphrates river between Hindia barrage and Al-Kufa-Iraq. Ph. D. Thesis, Coll. Of Science, Babylon university-Iraq.

29. Schulz, U. H. and Martins-Junior, H. 2001. Astynafaseiatus As Bioindicator of water pollution of Rio Dos Sinos, Brazil Braz. J. Biol, 61(4): 615-622.

30. Suhendan, M. and Ozkan, O. and Oymak, S. A. 2010. Trace Metal contents in fish species from Ataturk Dam Lake (Euphrates Turkey) Turkis J. of fisheries and Aqua. Sci. 10: 209-213.

31. Taha, A. A. 2004. Pollution Sources and Related Environmental Impacts in the New Communities, Southeast Nile Delta, Egypt. Emirate. J. Eng. Res. 19/1: 44.

32. Van Aardt WJ and Erdman R. 2004. Heavy metals (Cd, Pb, Cu, Zn,) in mudfish and sediments from three hard-water dams of the Mooi river catchment, South Africa. Water. 30: 211-218.

33. Weher S. M. 2008. Levels of Heavy metal Cd, Cu and Zn in three fish species collected from the Northern Jordn Valley, Jordan. Vo. 1 N.1 1995-6673 p.41-46.

34. Yilmas AB. 2005. Comparison of heavy metal levels of Grey Mullet (*Mugilcephalus L.*) and sea bream (*Sparusaurata L.*) caught in Iskendrun Bay (Turkey). Turk. J. Vet. Anim. Sci., 29: 257-262.