Some Heavy Metal Residues In *Tilapia Nilotica* And *Mugil Cephlalus* Fish

Kamal Ebrahim El-Dsoky
Central Laboratory, Fac. of Vet. Medicine, Zagazig University

ABSTRACT

A total of 50 random samples of fresh *Tilapia Nilotica*and *Mugil cephalus* (25 of each) with different sizes were collected from Abo Hammad - Sharkia Governorate.

Fish samples were placed in an ice box and immediately taken to laboratory for determination of Cd, Pb, Cu and Zn concentrations by A.A. S. The obtained results revealed that the concentrations of Cd, Pb, Cu and Zn in fish muscles were ranged from 0.035 to 0.409 with average 0.117 µg/g 0.076 to 1.833 with average 0.334 µg/g, 0.190 to 1.33 with average 0.414 µg/g and 2.54 to 10.200 with average 5.370 µg/g in *Tilapia Nilotica*, respectively while in *Mugil cephalus* were 0.029 to 0.299 µg/g which average 0.111, 0.078 tc 0.326 which average 0.252, 0.630 to 1.600 with average 1.015 and 7.950 to 13.800 with average 10.875 µg/g, respectively. 30% Cadmium and 10% Lead in *Tilapia Nilotica*while in Mugil cephalus 10% Cadmium exceeded than maximal permissible limit in examined fish samples set by FAO/WHO 1992 whereas none of the rest examined samples exceeded the maximal limit. The possible public health hazards of heavy metals as well as the suggested measures for minimizing the pollution of fish and water had been discussed.

INTRODUCTION

Fresh water fish have been used as a food in most countries over the world *(1)*. It is high desirable food due to its contribution of high quality animals protein, its richness in calcium phosphorus and its generous supply of vitamins.

Cadmium poisoning is reported to cause I'tai- I'tai, Byo disease, with symptoms largely referable to bone and muscle pain, it also causes growth retardation, testicular damage and is carcinogenic to animals *(2)*.

Acute exposure to Cu causes hypotension, haemolytic anemia and cardiovascular collapse, while chronic exposure resulted in jaundice in humans *(2)*.

Oral toxication by zinc leads to enteritis, bloody diarrhoea, intense abdominal pain, CNS depression and tremors *(2)*. The highest lead and cadmium levels were found in muscles *(3)*. The authers illustrate chronic zinc toxicity to fish.

The authers discuss processes which affect metal bioavailability and toxicity in the aquatic environment and the implications for metal rick assessment procedures. In addition to chemical processes *(4)* .

This study was decided to determine Cd, Pb, CU and Zn levels in the muscle tissues of *Tilapia Nilotica*and *Mugil cephalus* in Abo – Hammad farm in Sharkia province to evaluate the degree of the safety for human consumption.

MATERIAL AND METHODS

Collection of samples

Twenty five random samples from each of *Tilapia Nilotica*and *Mugil cephalus* of different sizes were collected from Abo-Hammad–Sharkia province at fish farms. The fish specimens were individually placed in clean polyethylene bags and immediately taken to the laboratory where they were kept frozen until preparing for digestion and analysis.

Digestion of samples

The frozen fish were defrosted then digested according to the recommended method *(5)* in which 2 grams of muscle from

each fish sample were digested with 10ml of analytical grade nitric / perchloric acid mixture (4:1) in a clean acid washed digestion flask.

Initial digestion was performed at room temperature for 3-4 hours, followed by careful heating in water bath at 40 -45°C for one hour to prevent frothing. The temperature was then raised to 70-80°C with gentle shaking until the digestion was completed (within 3 hours). The resulting digests were allowed to cool to room temperature and diluted up to 20 times with deionized water, then filtered through whatman paper No. 1. Blank and standard solutions were also prepared and anlyzed for quality control purpose.

Heavy metal analysis

Determination of heavy metal concentrations was conducted at the central laboratory, Faculty of Veterinary Medicine, Zagazig University, Egypt by using Buck Scientific Atomic Absorption Spectrophotometer 210 VGP, equipped with background corrector, auto sampler and recorded . Cd, Pb, Cu and Zn were determined by using Air 1 Acetylene flame AAS .

RESULTS AND DISCUSSION

1. Cadmium (Cd)

The biological half life of cadmium in human body is about 20-40 years and it is reported to cause skeletal disorders refered as I'tai I'tai (Ouch Ouch disease) with symptomes that resemble osteomalacia, also it cause renal damage, hypertension, teratogenic and carcinogenic effects *(6,7)*.

The achieved results in Table 1. declared that mean ± SE concentration (µg/g wet weight) of Cd in *Tilapia Nilotica* were 0.117 ± 0.011 with 0.035 as a minimum and 0.409 as a maximum in various fresh water fish, nearly similar results were recorded *(3, 8-11)*. While lower levels were reported *(12-16)* and higher levels were reported in Tilapia *(17-19)*.

Cd concentration in *Mugil cephalus* muscles sampled from Abo-Hammad farm Sharkia Governorate ranged from 0.035 to 0.229 with average 0.111 µg /g. Nearly, similar finding found *(15, 20,21)* while lower levels were reported in *Mugil cephalus (8, 22-24)* but higher level were reported *(19, 25)*.

2. Lead (Pb)

The lead level in fish muscle has been affected by seasonal variation as it increased in winter and also affected by aged due to bioaccumulation of the metal in fish muscle higher level induce plumbism in human consuming the indoxicated fish *(2)*. Table 2. showed that Pb concentration in *Tilapia Nilotica* ranged from 0.076 to 1.833 with mean 0.334 ± SE 0.028 many previously studies were carried out to injesecated the level of lead in fish muscle , similar level were recorted *(3, 8-12, 15, 16, 19,26, 27)* but other recorded higher *(14,17, 18,30)* or level *(13, 18, 28,29)* .

In *Mugil cephalus*, Pb level was ranged from 0.078 to 0.326 (average 0.252 ± SE 0.035 µg/g wet weight) . Nearly similar results were recorded *(23, 31-34)*. Meanwhile lower level *(35)* and higher values were reported in *Mugil cephalus (24, 8, 19 , 25)*.

3.Copper (Cu)

Analysis of variance revealed winter muscle samples contain higher residues of Cu in muscle and fish liver and increased with the age of the fish *(26)*.

The obtained results in Table 3. indicated that in Tilapia species, copper concentration were ranged from 0.190 to 1.33 with mean value 0.414 ± SE 0.028 µg/g wet weight. Nearly similar results obtained *(15, 27, 36)* . While higher levels were reported *(9,10, 17, 18, 26, 37)*. Meanwhile lowered finding *(4, 30 , 38)*. But in *Mugil cephelus* muscles was ranged from 0.630 to 1.600 with average 1.015 ± SE 0.071. Approximately similar to *(22 , 24)*. While lower results *(39)* meanwhile higher level was detected *(40)*.

4. Zinc (Zn)

A higher dose intake of zinc caused chronic zinc toxicity ***(4)***. The results obtained in Table 4. revealed that concentration in muscle tissues of *Tilapia Niloticawere* ranged from 2.54 to 10.200 with average 5.370 ± SE 0.277 nearly similar ***(14 , 15, 17 , 27)*** . But higher Zn level reported ***(4, 11, 13, 18, 26, 30)***. While lower concentration was reported by ***(38)***. In Mugil cephalus, Zn was ranged from 7.950 to 13.800 (average 10.875 ± 0.625 SE µg/g wet weight). Nearly similar level previously recorded ***(22, 15).*** While higher level was reported by ***(41- 43)***. Meanwhile lower level was also assayed ***(24).***

Table 1. Results to of determination of cadmium in fish muscle

Fish species	Min. (µg/g)	Max. (µg/g)	Mean (µg/g)	±SE
Tilapia Nilotica	0.035	0.409	0.117	0.0114
Mugil cephalus	0.029	0.299	0.111	0.0181

Table 2. Results of determination of lead in fish muscle

Fish species	Min. (µg/g)	Max. (µg/g)	Mean (µg/g)	±SE
Tilapia Nilotica	0.076	1.833	0.334	0.028
Mugil cephalus	0.078	0.326	0.252	0.035

Table 3. Results of determination of copper in fish muscle

Fish species	Min. (µg/g)	Max. (µg/g)	Mean (µg/g)	±SE
Tilapia Nilotica	0.190	1.33	0.414	0.028
Mugil cephalus	0.630	1.600	1.015	0.071

Table 4. Results of determination of zinc in fish muscle

Fish species	Min. (µg/g)	Max. (µg/g)	Mean (µg/g)	±SE
Tilapia Nilotica	2.54	10.200	5.370	0.277
Mugil cephalus	7.950	13.800	10.875	0.625

Table 5. Frequency distribution of heavy metals in fish compared with maximal permissible limits *Tilapia Nilotica*@.

Metal	Permissible µg/g wet weight	Within possible limit		Over possible limit	
		No.	%	No.	%
Cd	0.1	17	70	8	30
Pb	0.1	22	90	3	10
	0.5	22	90	3	10
Cu	1.2	25	100	0	0
Zn	5.0	25	100	0	0

(a) Egyptian general authry of standardization of quality central ***(44)***

Table 6. Frequency distribution of heavy metals in fish compared with maximal permissible limits Mugil cephalus

Metal	Permissible mg/g wet weight	Within possible limit		Over possible limit	
		No.	%	No.	%
Cd	0.1a	23	90	2	10
Pb	0.1	25	100	0	0
		25	100	0	0
Cu	1.20a	25	100	0	0
Zn	5.0a	25	100	0	0

(a) Egyptian general authry of standardization of quality central *(44)*

REFERENCES

1.Campton. (1981): In compton's Encyclobedia Vol. 5 pp. 601 . Publisher University of Chicago USA.

2.Gossel, T. A. and Bricker, J. D. (1990): Principles of clinical toxicology . 2nd ed. Raven Press Ltd. New York.

3.Jureasa, D. and Blanusa, M. (2003): Mercury , arsenic , lead and cadmium in fish and shellfish from the adreatic sea. Food Addit. contam 20 (3): 241-6.

4.Janssen, C. R.; Heijerick, D. G. De Schanphelaere K. A. and Allen , H. E. (2003): Environmantal assessment of metals: Tools for incorporating bioavailability . Environ. Int. 28 (8): 793-800.

5.Al-Ghais, S. M. (1995): Heavy metal concentration in the tissue of sparus sarba forskal., 1775 from the united Arab Emarates. Bull environ. Contam. Toxicol. 55 : 581.

6.Donaldson, W. E. (1980): "Trace element toxicol . Chapter 17. In Introduction to Biochemical toxiciology , Ernest Hodgson and Frank E. Guthrie, (Eds). Elsevier, New York , pp. 330.

7.Shibamoto, T. and Bjeldanes, L. F. (1993): Introduction to food toxicology aceademic press, Inc. Harcourt Brace and company New York Food Science & Technology International series.

8.El-Atabany, A. I. (1995): Cadmium and lead residues in some food animal and fish tissues at manazala, Dakahlia, Zag. Vet. J. 32: 90.

9. Abd EL-Nasser, M.; Shaaban, A. A.; Aly , S. M. and Sayed , M. M. (1996): Levels of some heavy metals in fish caught from reiver Nile at Assiut Governorate , Egypt . Assiut Vet. Med. J. 34: 68.

10.Seddek , A. S.; Salem, D. A.; EL-Sawi, N. M. and Zaky, Z. M. (1996): Cadmium , lead nickel, copper, manganese and flourine leevls in river Nile fish Assiut Vet. Med. J. 34: 95.

11.Allen- Gill, S. J. Ford, Lasorsa, B.K. Monetti, M. Vlasova and Larders, D. H. (2003): Heavy metal contamination in the taimys peninsula , siberian Arctie, Sci. total Environ. 301 (1-3 : 119-38.

12.El-Kelish, H. I. (1995): Lead and cadmium residues in some food animal and fish at Zag. City Zag. Vet. J. 23: 97.

13.El-Mowafi , A. F. A. (1995): Role of some minerals in fish nutrition. Thesis Ph. D. Vet. Med., Zag. Univ.

14.Okoye, C. O. B. (1994): Lead and other metals in dried fish from Nigerian Markets. Bull. Environ. Contam. Toxicol. 52 : 825.

15.Sallam, K. H. I. (1997): Heavy metal residues in fish and theis relation to public

health; Ph. D. of Vet. Med. Sciencs Zagazig University , Egypt.

16.***Sallam, K. H. I.; El-Sebaey, E. S. ; Morshdy , A.M. (1999):*** Mercury , cadmium and levels in Bagrus bayad fish from the river Nile Delta region, Egypt the Journal of the Egyptian public health Associated Vd IXX IV No. 1. 2.

17. ***ABo Salem, M. E.; Edrees, A. M.; El-Shawarby , R. M. and Ashob, M. M. (1992):*** Water pollution and implication in the accumulation of heavy metals in fish . Alex. J. Vet. Sci. 8 : 13.

18.***Mohamed, A. A. (1993):*** Some trace elements in tissues of some fresh water fish. Ph. D. Thesis (Meat Hygiene). Fac. Vet. Med. Assiut University.

19.***El-Safy , M. K. (1996):*** Some studies on heavy metal pollutants in fish M. Vet. Sc. Thesis (Hygiene of Animal , Poultry and Environment). Fac. Vet. Med. Zagazig University.

20. ***Fernadez- Aceytuna, C. J.; Riconzalez, J.; Hernandez, L. M. and Balya, G. (1984):*** Organochlorine and metal pollution in aquatic organisms from the paeque nacional de donana, spain. Rev. Agr. Tech. Alim. 24 : 221.

21. ***Cappon. J. (1987):*** Cadmium and lead in lake ontario salmonids . Bull . Environ. Contam. Toxicol. 38 : 695.

22.***Legroburu, I.; Canton, L.; Millan, E. and Casado, A. (1988):*** Trace metal levels in fish from Urola river (spain)- Anguillidea , Mu gillidae and salmonidae . Environ. Techn. Lett. 9 : 1373.

23.***Hernandez , H. F.; Medina, J. ; Ansuategui, J. and Conesa , M. (1990):*** Heavy metal concentrations in some marine organisms from the mediterranean sea (Castellon, Spain): Metal accumulation in different tissues. Sci. Mar. 54 : 113.

24. ***Abd El-Kader, M. A. ; Tork , I. Y. and Aref M. A. (1993):*** Heavy metal pollution in fish . Zag. Vet. J. 21 : 116.

25.***Brumbaugh , W. G.; Schmitt, C. J. and May, T. W. (2005):*** Archives of Environmental contamination and toxicology 49 (1): 76-88.

26. ***Szefer, P. M.; Domegala – Wieloszemska , J. Warzocha, A.; Garbacik – Wesolouska and Ciesielski, T. K. (2003):*** Distribution relationships of mercury, lead cadmium , copper and zinc in perch (perca fluviatilis) from the pomeramian bay and szczecin lagoon, southern baltic , food chemistry 81 (1): 73-83.

27.***Farkas, A.; Salanki, J. and Specziar, A. (2003):*** Age – and size specific patterns of heavy metals in the organs of fresh water fish Abramis brama L. Population a low – contaminated site. Water Res. 37 (5): 959-64.

28.***Parisi, E.; Forneris, G. and Giaccone, V. (1986):*** Freshwater fish as biological indicator of heavy metal pollutions. Industr Aliment 25: 214.

29.***Gluk, B. and Hahn, J. (1995):*** Contaminants in fish "Schad-stoffbelstung Von Fischen" . Fleischwirtschaft 75 : 92.

30.***Eromasels, C.O. ; Eromasels, I. C.; Muktar, S. L. M. and Birdlings, S. A. (1995):*** Metals in fish from the upper Bemue River and lakes Grriyo and Niuwa in northeastern Nigeria . Bull. Environ. Contam. Toxicol. 54 : 8.

31.***Kumagai, H. and Saeki, K. (1983):*** Heavy metal contents of wild and cultured puffes fugu rubripes. Bull. Jap. Soc. Sci. Fisheries 49 : 1235.

32.***Rincon- Leon, F.; Zurera- Cosno, G. and Pozol-Lora, R. (1988):*** Lead and cadmium concentrations in red crayfish (Procambarus clarkii G.) in the

Guadalqiyir River Marshes (Spain). Arch. Environ. Contam. Toxicol. 17 : 251.

33. ***Fast, A. W.; D'itri, F. M.; Barclay, D. K.; Katase, S. A. and Madnjian, C. (1990):*** Heavy metal content of coho oncorhynchus kisutch and cinook salmon O. tschawytscha reared in deep upweled ocean waters in Hawaii. J. World Aquacult. Soc. 21 : 271.

34. ***Delbone, G.; Campanini, G.; Dazzi, G. and Madarena, G. (1995):*** Heavy metal levels in trout from fish farms. Annali. Fac. Med. Vet. Univ. Param. 14 : 201.

35. ***Ayas, Z. and Kolankaya, D. (1996):*** Accumulation of some heavy metals in various environments and organisms at Goksu Delta, Turkiya , 1991 – 1993 . Bull . Environ. Contam. Toxicol. 56: 65.

36. ***Jaffar, M.; Ashraf, M. and Rasool, A. (1988):*** Heavy metal contents in some selected local freshwater fish and relevant waters. Pak. Sci. Indust. Res. 31 : 189.

37. ***El-Nabawi , A.; Heinzow, B. and Kruse, H. (1987):*** As, Cd, Cu, Pb, Hg and Zn in fish from the Alexandria region, Egypt. Bull. Environ. Contam. Toxicol. 39 : 889.

38. ***Saleh, M. B.; Fouda, M. M. Saleh, M. A. Abdel-Lattif, M. S. and Wilson, B. L. (1988):*** Inorganic pollution of man – made lakes of Wadi El-Riyan and its impact on aquaculture and wildlife of the surrounding Egyptian Desert. Arch. Environ. Contam. Toxicol. 17 : 391.

39. ***Oehlenschlaeger, J. (1990):*** Heavy metal contents in various parts of redfish.(Sepastes marinus) fillets (Schwermetallgehalte in verschidenen teilen von robtbarschfilet (Sepastes marinus) inform. fischwirt. 37 : 32.

40. ***Norris, R. H. and Lake, P. S. (1984):*** Trace metal concentrations in fish from the south Esk River, Northen Tasmania, Australia. Bull. Environ. Contam. Toxicol. 33 : 348.

41. ***Villareal- Trevino, C. M.; Obregon-Morales, M. E.; Lozano-Morales, J. F. and Villegas- Navarro, A. (1986):*** Bioaccumulation of lead, copper , iron and zinc by fish a transect of the santa catarina river in cadereyta jimenes , nuevo leon, Mexico. Bull. Environ. Contam. Toxicol. 37 : 395.

42. ***Munshi, J. S. D. and Singh, N. K. (1989):*** Heavy metals accumulation of fish the river subernarekha at Ghatsila . Environ. Fcol. 7 : 790.

43. ***Marcovecchio, J. E. and Moreno, V. J. (1993):*** Cadmium , Zinc and total mercury levels in the tissues of several fish species from La plate river estuary , Argentina. Environ. Assess. 25 : 119.

44. ***Egyptian General Authority of Standerization and Quality Control (1991):*** Cairo , Egypt.

الملخص العربى

بعض بقايا المعادن الثقيلة فى لحوم أسماك البلطى والبورى

كمال إبراهيم الدسوقى

المستشفى البيطرى - كلية الطب البيطرى - جامعة الزقازيق

أجرى هذا البحث على ٥٠ عينة (٢٥ من أسماك البلطى و٢٥ عينات من أسماك البورى) جمعت العينات من مزارع أبوحماد بمدينة أبوحماد بالزقازيق محافظة الشرقية وتم أخذ العينات من عضلات الاسماك لمعرفة نسب بقايا بعض المعادن الثقيلة كالكادميوم والرصاص والنحاس والخارصين

أوضحت النتائج أن متوسط بقايا الكادميوم فى أسماك البلطى ٠,١١٧ أما فى البورى متوسط ٠,١١١ ميكروجرام لكل جرام٠

أما بالنسبة للرصاص فى البلطى فكان متوسط ٠,٣٣٤ بينما البورى متوسط ٠,٢٥٢ وكان تركيز النحاس ٠,٤١٤ فى البلطى بينما ١,٠١٥ فى البورى وقد أظهرت نتائج تحليل عنصر الزنك (الخارصين) فى البلطى متوسط ٥,٣٧٠ والبورى متوسط ١٠,٨٧٥ ٠

ويتضح من هذه النتائج أن ٣٠% من أسماك البلطى المأخوذ من مزارع أبوحماد بها نسبة أعلى من الحد المسموح به فى الكادميوم و ١٠% فى الرصاص بينما نسبة النحاس والخارصية لم تتجاوز النسبة المسموح بها أما بالنسبة لتحليل أسماك البورى فكانت نسبة ١٠% فقط تجاوزت النسبة المسموح بها بينما كانت نسبة الرصاص والنحاس والخارصين لم تتعدى النسبة المسموح بها ٠