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Detection of inorganic contaminants (Hg, Cd, Pb and Co) in Iraqi fish

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Abstract

Concentrations of heavy metals (mercury, cadmium, lead and cobalt) determined in gills and muscles of different four kinds of Iraqi common fish, they were carp (*Cyprinus carpio*), Alktan fish (*Barbus xanthopterus*), shaboot fish (*Barbus gryps*) and shilluk (Chick fine linen) (*Aspius vorax*), which they fished from fish farms in Tigris River at different locals in Baghdad city. An obtained results viewed that the concentrations of elements in gills are higher than standard parameters in previous studies of World Health Organization (WHO) and Federal Environment Protection (FEP) except muscles that concentrations where almost same, the other parts of fish muscles inappropriate and dangerous to human consumption, results indicate that contamination of river water and sources of taken water to fish aquacultures by toxic heavy elements, mainly from industrial sources do not pose a threat to fish consumption rivers and fish aquaculture so far, but in the future will be a real problem must be avoided, as the results showed that there are a significant differences among the elements in different parts of fish body (muscles and gills) in terms concentration.

Keywords: Toxic heavy metals, Atomic absorption spectrometer, Iraqi fish.

Introduction

Waters systems contamination with heavy metals, become an important problems due to the cumulative usability even with low concentrations (Vanden Broek *et al.,* 2002), as they are non-biodegradable and cause acute and chronic diseases to humans (Gulfraz *et al.,* 2001), also can be exposed rivers and fish aquaculture contaminated with heavy metals from various sources of domestic waste, industrial, mining activities and events as an addition of agricultural fertilizers and pesticides, which they affect the ecological balance of the ecosystem especially water system (Canliand Kalay, 1998). Fish represents as a top of food consumers in the aquatic environment, as it has the ability to assemble these elements in higher concentrations in their bodies than in the water and sediment due feeding on algae and microorganism in addition to organic materials which found in aquatic environments (Olaifa *et al.,* 2004). An intervention of heavy elements to aquatic food chains, especially fish, either directly through food obscure indirectly through gills (Blackmore, 2000), is influenced by the accumulation of these elements in fish bodies of different factors such as pH and water hardness and the level of pollution in the surrounding water in addition to the age and condition physiological fish also contain industrial and household waste on the heavy elements and materials Hydrocarbon accumulate in aquatic food chains possible cause acute and chronic damage in fish reductive communities usability on the growth and reproduction (Schulz and Martins-junior, 2001) and effective of Tigris River in central Iraq for various pollutants such as heavy metals, which tend accumulation at the bodies of the microorganisms such as plants and shellfish developed microorganism, especially fish defensive system against the dangerous effects of heavy elements of core and non-core and some other exotic antibiotics, which produces changes at the body as cases oxidative (Abou El-Naga *et al.,* 2005). This system was linked to a form of active oxygen, including the induction of the enzyme super oxide dismutase (SOD), which removes the high oxidative stress roots ions and which inhibits the enzyme alkalis hydrogen peroxides (Metwally and Fouad, 2008). Lysosomes also play a role in the removal of these contaminants through the detention of heavy elements within them, and I have studies that have shown persistence in vertebrates is reduced with increasing pollution, hence the prolonged exposure to heavy metals could spur increase the

effectiveness of an enzyme catalase at liver and peroxides glutathion at the brain where increasing oxidation products initial fat (Volodymyr *et al.,* 2001). Four types of fish that resides in Iraqi waters are selected for the purpose of examining concentrations of some toxic heavy metals in the muscles and gills due to negative effects on human health, in another hand because it is one of the accumulative pollutants and that as a result of accumulation is working to injury a lot of tumors and diseases, cancer and malignant also be used as an evidence vital to pollution the river and fish farms.

Materials and Methods

Sampling: A long study period from 01.01.2014 to 01.09.2014, four types of fish samples are collected separately from Tigris River, at different areas in Baghdad city, Fish existing farms located at outskirts of Baghdad (Yusufiya, Doura, Abu Ghraib, Taji, Husseinia, Deiyala Bridge, Salheya, Utaifiyya, Al-Shawakah and Tigris arm) collection of samples depended on lengths and weights for Fish types.

Metals and toxic heavy metals determination: Separated muscles, gills tails of fish cuts into small pieces and mixed well, then each sample divided into two samples in order to estimate mercury (Hg) element according to (Haswell, 1988), and estimating lead element (pb), cadmium (Cd) and cobalt (Co) in a manner of other reference due to the different methods of digestion for these elements.

Determination of mercury (Hg) in samples: The element (Hg) determined by using atomic absorption spectrum (unit cold steam generation technology for mercury vaporizer unit (MVU) type SHIMADZU model AA7000, Japan according to Haswell, 1988. Weight of 2g of sample was applied and put in Becker and added to 10ml of nitric acid concentrated (HNO_3) with 5ml of concentrated sulfuric acid (H_2SO_4) is gradually, then placed on a water bath at a temperature of 70^{o}C then covered the provisions until digest the entire model cool model and nominate nomination Whattman 541 paper in a volumetric bottle volume of 50ml with distilled water complements the size to limit mark. A standard curve of (Hg) concentrations prepared to four standard solutions (Standard solutions) different concentrations of 2.5, 5, 10 and 20ppb after the addition of 5ml of solution stannous chloride ($SnCl_2$) to each sample separately, which works as a reducing agent to form mercury.

Determination of elements Lead (Pb), Cadmium (Cd), Cobalt (Co): The Determination of elements lead (Pb), cadmium (Cd), cobalt (Co) using atomic absorption spectrum device (Graphite Furnace Atomizer Technology (GFA) type model of Japanese origin SHIMADZU AA7000 (Haswell, 1988), by taking a weight of 2g from sample and put it in a Becker, then added a volume of 10ml from concentrated nitric acid HNO_3, then a bottle covered with glass watch for 24hrs after heated on a heater till arriving to 100°C until a presence of vapors, later sample left to cool, later filtered with whattman 541 filter paper and placed in a volumetric vial capacity of 50ml then volume completed with distilled water to the limited mark.

The standard curve of elements (Pb), (Cd) and (Co), standard solutions of different concentrations of each element prepared separately as in follow (2.5, 5, 10 and 20), (2, 10 and 20), (2, 4, 6, 8 and 10) ppb respectively form (2, 3 and 4). And use the following law to calculate the concentrations of the elements through the reading device and the weight of each sample and the amount of dilution of each model are as follows (Cooksey and Barne, 1979): Final concentration (ppb) = Reading device × Dilution factor / Weight of sample (gm).

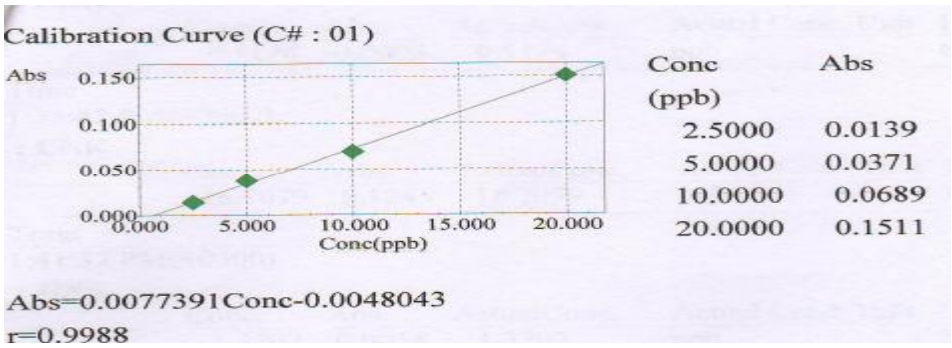

Figure (1): Standard curve for mercury

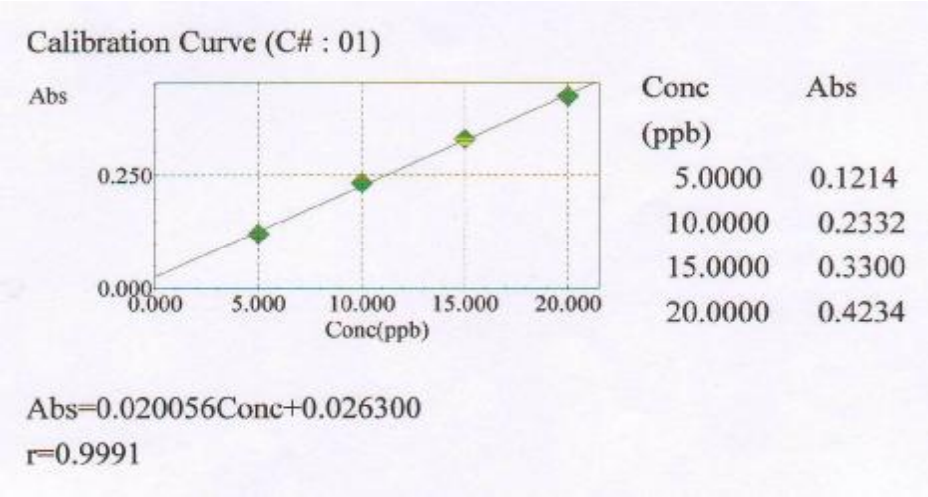

Figure (2): Standard curve for lead (Pb)

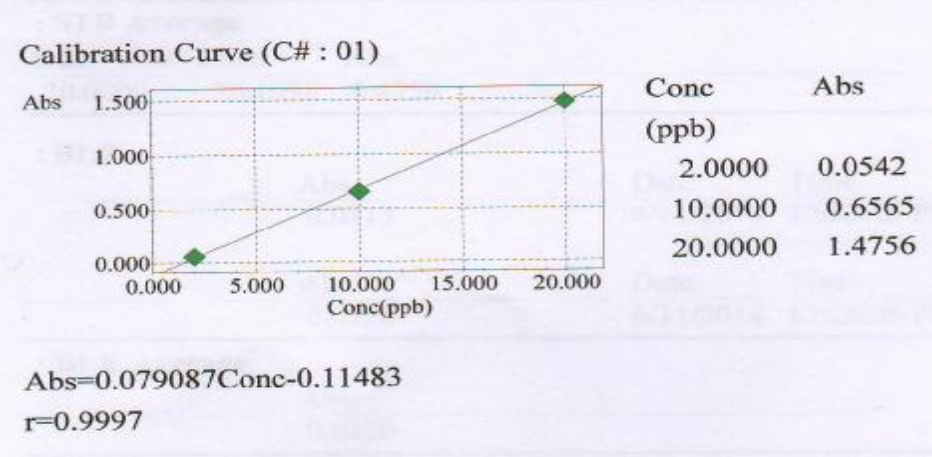

Figure (3): Standard curve for cadmium (Cd)

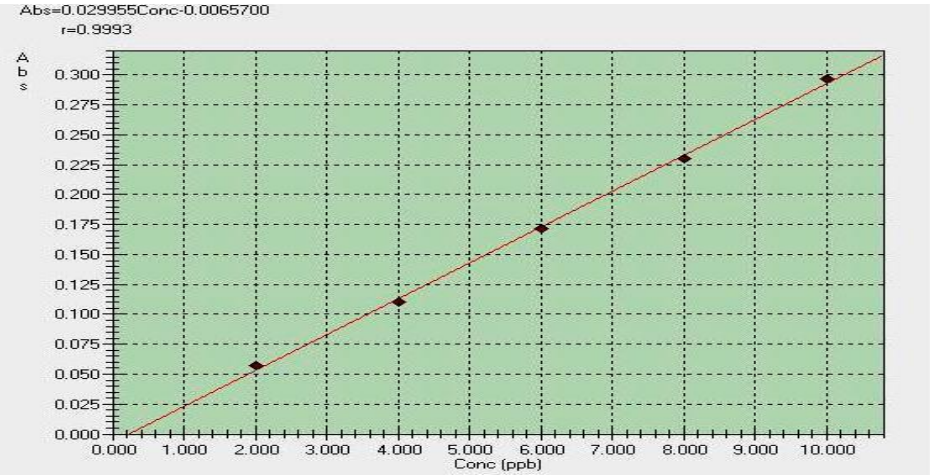

Figure (4): standard curve for cobalt (Co)

Results and Discussion

The final results were obtained and calculated for each element concentration in units of part per billion (ppb), as shown in Table (1). Results showed an increasing of (Hg) concentrations in gills more than the muscles in fish samples, generally, this lead to contamination of water with Hg due to urban activities such as industrial, agricultural wastes and wastewaters, gills are first Important location to inter heavy metals which impact gills and muscles (Bols *et al.,* 2001). Were results for determination of Hg negative in muscles but gills contain a contamination by Hg reached to 200.67ppm. This results is higher than allowed limits of contamination by Hg which were 82-166ppm. According to United State of America Food and Drugs of Administration (FDA, 2000). Hg impact protein structure therefore effects all functions related with producing protein. Hg is able strongly to link with sulfhydryl group, amine and phosphoryl group also with carboxyl group. Where it works to interception effect activity of many enzymes also impact cell membranes. Also Hg affect neural system and it may interferes with selenium Se, therefore Hg can cause Immune depression (Grath and smith, 2009). While other results showed in the lead element values as shown in the Table (2).

Table (1): Concentration of mercury element in fish samples part per billion (ppb)

Regions	Shilluk (Chick fine linen) *Aspius vorax*		Shaboot fish *Barbus gryps*		Alktan fish *Barbus xanthopterus*		Common carp *Cyprinus carpio*	
	Gills	Muscles	Gills	Muscles	Gills	Muscles	Gills	Muscles
Yusufiya	67.66	19.67	169.56	13.33	33.72	23.89	35.80	25.86
Doura	33.45	13.88	77.89	56.77	45.77	34.66	67.88	44.89
Abu Ghraib	166.67	88.87	88.90	67.67	56.89	50.87	77.34	67.22
Taji	87.99	67.77	45.22	34.66	77.98	65.89	43.67	22.55
Husseinia	46.67	34.56	23.45	12.23	56.89	44.21	45.89	24.44
Diyala bridge	147.45	78.44	137.67	77.87	166.45	59.99	180.89	77.91
Salheya	47.23	23.56	49.64	33.04	199.09	55.98	56.88	33.78
Utaifiyya	65.78	51.55	35.12	23.14	66.70	45.49	87.23	67.11
Ashawakah	56.33	33.31	177.90	29.44	39.33	19.22	200.67	13.33
Tigris arm	99.01	67.12	45.67	34.33	12.34	23.78	76.89	33.34

Table (2): Concentration of lead element in fish samples calculated part per billion (ppb)

Regions	Shilluk (Chick fine linen) *Aspius vorax*		Shaboot *Barbus gryps*		Alktan *Barbus xanthopterus*		Common carp *Cyprinus carpio*	
	Gills	Muscles	Gills	Muscles	Gills	Muscles	Gills	Muscles
Yusufiya	67.77	14.34	12.66	9.45	17.34	12.11	75.41	11.47
Doura	27.56	23.45	33.78	7.25	44.45	12.56	45.23	22.34
Abu Ghraib	39.60	UDL	17.89	9.90	12.56	2.34	23.55	12.33
Taji	12.45	UDL	6.89	UDL	54.56	34.45	23.67	14.56
Husseinia	27.67	19.34	34.67	14.55	35.89	29.55	13.45	UDL
Diyala bridge	16.89	3.67	33.90	12.67	34.45	12.13	67.56	23.45
Salheya	85.46	17.45	97.44	86.65	67.45	24.67	56.78	23.56
Utaifiyya	88.70	9.98	98.45	33.45	111.37	85.45	78.55	12.56
Ashawakah	80.90	4.78	88.90	7.89	67.78	12.67	34.45	13.34
Tigris arm	34.56	7.89	45.89	9.90	67.78	4.67	90.67	15.56

UDL: under detection limit

Results of (pb) determination showed values in Table (2). In muscles of fish samples, samples are free from (pb) except to samples were (Khetan / Utaifiyya, Carp / Salehia), this results refer to a contamination in water with (pb) due to industrial and agricultural wastes. Determinate concentrations of (pb) in samples were 85.45 and 86.65 respectively, this results are higher than acceptable Concentrations of (pb) limits in fish according to (FDA, 2000), but concentrations in gills are recorded in 17 samples from sum of 40 samples in a percentage of 42.5% more than acceptable limits are (49-16) ppm. according to (FDA, 2000). an exposure to (pb) for a long time can increase (pb) in human body and lead to cause many serious diseases such as anemia, Pale skin, abdominal pain, Nausea, Vomiting and Joints paralysis, exposer to (pb) for a long periods may cause kidney filler and reducing fertility and increasing probability of pregnant or Incidence of congenital malformations (Gatchment. 2002). What regarding about the Cobalt, the range of concentrations is 3.56-19.90ppm. according to (FDA, 2000), these results showed that concentrations are in the range of allowed limits a shown in Table (3).

The obtained results proved concentrations of (Cd) in all muscles values in the range among 3.45-70.45ppm, in Table (4) as results were in allowed limits in range among 9-88pm according to (FDA, 2000). Increasing of (Cd) refers to contamination of water by industrial contamination and industrial revolution which that have occurred in successive decades. (Cd) is considered as one of toxic elements. The accumulation of (Cd) in kidney remains there and cause hypertension renal disease (Schulz *et al.,* 2001). It's difficult to remove (Cd) by excretion, also it leads to direct damage of nerve cells because it prevents the formation of acetylcholine and activates enzyme choline esterase (Schumacher *et al.,* 1991).

Conclusions

The results showed high concentration of toxic heavy metals in fish gills in general and, in particular, non-compliance with standard specifications for food, which could pose a risk to human health due to the accumulation of these elements in the sensitive internal organs such as liver, kidneys, and brain. So we recommend tightening health control methods and ways of breeding fish caught and processed water that equips fish farms and methods of disposal of industrial waste, which has the main reason for the pollution of fish and determine the extent of the safety and validity of these fish for human consumption.

Table (3): Concentration of cobalt element in fish samples calculated part per billion (ppb)

Regions	Shilluk (Chick fine linen) *Aspius vorax*		Shaboot *Barbus gryps*		Alktan *Barbus xanthopterus*		Common carp *Cyprinus carpio*	
	Gills	Muscles	Gills	Muscles	Gills	Muscles	Gills	Muscles
Yusufiya	16.98	UDL	UDL	UDL	UDL	UDL	UDL	UDL
Doura	UDL	UDL	8.90	UDL	UDL	UDL	UDL	UDL
Abu Ghraib	19.90	UDL	6.78	UDL	UDL	UDL	UDL	UDL
Taji	UDL	UDL	UDL	UDL	UDL	UDL	UDL	UDL
Husseinia	5.90	UDL	UDL	UDL	UDL	UDL	12.34	UDL
Diyala bridge	UDL	UDL	UDL	UDL	UDL	UDL	5.23	UDL
Salheya	UDL	UDL	UDL	UDL	4.67	UDL	UDL	UDL
Utaifiyya	UDL	UDL	6.90	UDL	18.93	UDL	5.78	UDL
Ashawakah	3.56	UDL	7.89	UDL	4.69	UDL	9.09	UDL
Tigris arm	UDL	UDL	UDL	UDL	UDL	UDL	UDL	UDL

UDL: under detection limit.

Table (4): Concentration of cadmium element in fish samples calculated part per billion (ppb)

Regions	Shilluk (Chick fine linen) *Aspius vorax*		Shaboot *Barbus gryps*		Alktan *Barbus xanthopterus*		Common carp *Cyprinus carpio*	
	Gills	Muscles	Gills	Muscles	Gills	Muscles	Gills	Muscles
Yusufiya	78.00	34.87	46.78	34.56	88.92	55.56	79.01	60.08
Doura	67.56	23.45	39.67	23.45	78.56	43.56	96.09	12.45
Abu Ghraib	81.28	60.23	78.90	23.89	45.89	34.89	56.90	12.42
Taji	56.78	6.78	55.56	5.34	67.67	12.23	45.67	23.33
Husseinia	95.34	9.00	88.90	6.78	67.56	5.66	33.45	12.23
Diyala bridge	67.95	8.99	43.70	67.65	45.45	3.45	78.67	34.56
Salheya	56.78	3.67	67.82	50.24	45.67	23.45	34.45	12.34
Utaifiyya	45.90	6.90	89.90	29.08	77.80	70.45	50.00	5.67
Ashawakah	99.08	37.78	77.88	34.67	99.06	34.67	89.45	6.90
Tigris arm	86.64	16.56	34.56	18.56	45.56	12.34	78.75	34.78

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