INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES

IJPAES

Volume-5, Issue-4, Oct-Dec-2015 Coden:IJPAJX-CAS-USA, Copyrights@2015 ISSN-2231-4490

Received: 16th Sept-2015 Revised: 9th Oct -2015 Accepted: 12th Oct-2015

Research article

CORRELATION BETWEEN HEAVY METALS IN WATER AND SOME HEALTH PARAMETERS

[1]Shamal R. Hama, [2]Nasreen M. Abdulrahman and [3]Nehad K. Wahab

[1&3]Dept. of Animal Resource / Collage of Agriculture/ University of Tikrit /Iraq
[2]Dept. of Animal production/ Faculty of Agricultural sciences/ University of Sulaimani/Iraq
nasreen.abdulrahman@univsul.edu.iq

ABSTRACT: This work was conducted at Raniya Lakelet /Dukan, the study includes heavy metal concentration in water, sediment and fish organs. The experiment was conducted in the fish laboratory of Biology Department, Faculty of Science at University of Raparin, Sulaimani, Kurdistan Region - Iraq. The trials for the sampling species lasted for three months. 68 common carp taken as a sample, then divided in to four length groups (10-20; 20-30; 30-40; 40-50 cm). Heavy metals contents analysed in water, sediment and fish organs, including Cadmium (Cd), Zinc (Zn), Nickel (Ni), Chromium (Cr), Copper (Cu) and Lead (Pb). The results showed that heavy metals had no effect on some health aspect parameter such as CF and HSI but effect on GSI was observed. Also there is significant correlation between heavy metals and some health aspect parameter like HSI and GSI, while in generally there is no significant correlation between heavy metals and the other like CF.

Key words: Water, heavy metals, health parameters

INTRODUCTION

Globally, there is an increasing awareness that water will be one of the most critical natural resources in future, water is an essential requirement of human and industrial development and it's the most delicate part of the environment [1]. Increasing industrialization and urbanization activities made the serious problems of pollution in water; particularly heavy metals pollution [2]. As heavy metals cannot be degraded, they are deposited, assimilated or incorporated in water, sediment and aquatic animals and thus, causing heavy metal pollution in water bodies [3]. Fulton's condition factor links weight and length to an indicator of the "condition" [4], "well-being" or "fitness" of fish, the larger the factor, the better the condition. Apart from the condition factor, lipid content is used as an indicator for fish condition or fish energy [5]. A lack of food supply can cause decreasing lipid contents [6]. The decreased CF in fish due to pollution might be a consequence of the direct metabolic impacts on fish or the impoverishment of food chain, leading to a depletion of energy resources such as stored glycogen or body fat and subsequently resulting in a reduction in fish growth and overall condition [7]. Van den Heuvel *et al.,* [8] suggested that a detectable change in the physiological endpoints such as CF might take at least two years in order to reflect the altered energy intakes in fish due to the effect of pollution. The variation in fish CF could be attributed to factors other than pollution, such as habitat quality and food availability [9]. The liver plays a major role in the metabolism of xenobiotic compounds with biochemical alterations occurring under some toxic conditions; likewise, the liver is a primary detoxification organ in fish, Organ-level biomarkers, particularly the hepatosomatic index (HSI), also have been used as biomarkers of contaminant exposure [10], because the liver is so important in detoxification. Exposure to contaminants can lead to an increase in liver size from hypertrophy (an increase in size), hyperplasia (an increase in number) of hepatocytes, or both. Studies evaluating the relative liver size of fishes from contaminated and reference sites often utilize the HSI, which expresses liver size as a percentage of total body weight [10]. Alberto *et al.,* 2005 [11] revealed a negative relation between CF and HSI with GSI, but this relation was observed only in *G. atripinnis*.

Furthermore, low HSI values prior to and during reproduction may result from the transfer of liver energy reserves toward gonadal maturation and the reproductive event, with consequent depletion of these reserves and a decrease in HSI values [12], CF and HSI trends may reflect physiological conditions in *Astyanax aeneus* that enable oocyte maturation and release, suggesting that oocyte production relies on energy stored in the liver and not on energy stored in the musculature.

Most commonly used bioindicators are corporal indices such as condition factor (CF), gonadosomatic index (GSI) and hepatosomatic index (HI). This could be due to different fishing factors related to seasons and schooling in feeding and spawning grounds [13]. GSI is an indicator of the state of gonadal development and maturity. It has been used to assess gonadal changes in response to seasonal changes or contaminant exposure, there is well established evidence that exposure to various environmental toxicants can result in gonadal changes such as decreased GSI, morphological alterations or both [14].

MATERIAL AND METHODS

The lakelet of Ranya is aquatic area and is a part of Little Zap which is located east of Ranya district (8.49km) and western north of Sulaimanya governorate (83.97km) on 36°11'58.2°N 44°56'50.7°E). The depth of water can be determined by the high of a hill in the region which built between 1956-1958 on high region and its 36m high, recently this hill was sunken and it's called Basmusian.

Water samples were collected between 10:00 am to 2:00 pm. was collected from the depth of 30 cm from the river. One liter polyethylene bottles were used, each was pre-washed by river water. After that filtrating through qualitative filter paper diameter 9 cm.After samples collection, all the fish samples were scarified and soon the abdominal cavity was opened to remove, gonads and liver to be weighed at once. Condition factor CF was calculated using the cube law, and were calculated as follow:

Gonadosomato index (GSI) % = Gonads weight (g)/ Body weight (g) x 100 [15].

Hepatosomato index % = liver weight (g)/body weight (g) x 100 [15].

$K = W \times 100 / L^3$,

Where CF = condition factor, W = fresh weight of fish in grams and L = total length of fish in cm.

RESULTS AND DISCUSSION

According to the results illustrated in table (1) no significance differences observed in condition factor of all length range group, as it is an indicator of the overall fish condition and it reflects fish shape and energy reserves, it is often used to evaluate fish stress [16]. It has been stated previously that the condition factor can fluctuate with physiological development, sexual maturation, season and geographic location. Eastwood and Couture [16] reported that a decreased condition factor of metal-contaminated fish could be explained either by direct effects on juveniles (metabolic impacts) or by an impoverishment of the food chain, both events leading to decreases in fish growth and overall condition.

Table 1. Some health aspect parameters of captured fish according to fish length

Length ranges	CF	GSI	HSI
Group 1	1.385[a]	7.845[b]	1.710[a]
Group 2	1.363[a]	10.170[b]	1.497[a]
Group 3	1.422[a]	11.492[b]	1.630[a]
Group 4	1.425[a]	20.928[a]	1.869[a]

*A different letter means: there is significant at ($p<0.05$).

Since condition factor is greatly influenced by both biotic and abiotic environmental conditions, it is useful in assessing the status of the aquatic ecosystem in which fish live [17]. In studies of population dynamics high condition factor values indicates favorable environmental conditions (such as: habitat and prey availability) and low values indicate less favorable environmental conditions [17]. Condition factor [18] is used by several authors to compare condition of fish species. In the study of *Carassius carassius* (1.75±0.06) had best performance while CF value in *Esoxlucius* (0.74±0.10) was lowest across caught species.

Correlation analysis resulted in negative correlation of all trace metal concentrations and fish condition factor CF as shown in table (2) except Ni with high significant correlation in second length group (20-30 cm) that shown in table (3), on the other hand, it was found that the correlations between the trace metal concentrations of muscles and the condition factor CF of fish samples varied with characteristic opposite trends compared to those related to, length, weight and age [19].

Table 2. Correlation between Heavy metals in water and some health parameters (CF, GSI and HSI).

Heavy metals in water	CF	GSI	HSI
Cd	0.617	0.768	1.000*
Zn	-0.898	-0.786	-0.235
Ni	0.988	0.998*	0.750
Cr	0.808	0.913	0.969
Cu	0.613	0.434	-0.217
Pb	0.411	0.592	0.964
*. Correlation is significant at 0.05 level (2-tailed).			

The negative relationship between the trace metal concentration and the condition factor of fish suggests the relative dilution effect of the lipid content of tissues [20], these variations may explain also the opposite correlations observed in present study between heavy metals-size and heavy metals-condition factors of fish. Similar observations, i.e., a decrease in CF due to metal pollution in highly degraded natural ecosystems, have been made by, for healthy fish populations, the condition factor is usually situated around 1; a superior value indicates a better condition, while an inferior value indicates a poorer one [21]. Smaller fish will normally have lower condition factors compared with larger fish of the same populations [16] As numerically observed in our results, the smaller fish with (10-20cm) and (20-30cm) were less in CF. as compared with larger fish (30-40cm) and (40-50cm); in spite of that they all not significant with each other, and Couture and Rajotte [21], and this relation observed in the recent study as illustrated in table (3), in which length groups ranges from (20-30cm) and (30-40cm) have lower value than other length groups which ranged from (40-50cm) and (over 50cm).

Table 3. Correlation between CF and mean concentration of heavy metals

Pearson Correlation	F. length	Cd	Zn	Ni	Cr	Cu	Pb
CF	Group 1	0.204	0.426	-0.234	-0.438	-0.336	0.014
	Group 2	0.397	-0.143	0.753**	-0.142	0.566	0.351
	Group 3	0.171	-0.718	0.027	0.390	0.598	0.184
	Group 4	0.844	-0.607	0.930	-0.639	-0.888	0.976
*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).							

REFERENCES

[1] Balasim, H. M, Al-azzawi, M. N, and Rabee, A. M. 2013. Assessment of pollution with some heavy metals in water, sediments and Barbus xanthopterus fish of the Tigris River, Iraq, (4)54: 822–813.

[2] Zheng Na, Qichao Wang, Zhongzhu Liang and Dongmei Zheng, 2008. Characterization of heavy metal concentrations in the sediments of three freshwater rivers in Huludao City, Northeast China. Journal of Environmental Pollution, 154(1): 135-142.

[3] Malik N, Biswas AK, Qureshi TA, Borana K, Virha R 2010. “Bioaccumulation of heavy metals in fish tissues of a freshwater lake of Bhopal”. Environ. Monit. Assess. 160: 267-267.

[4] Nash RDM, Valencia AH, Audrey JG 2006. The origin of Fulton’s condition factor - setting the record straight. Fisheries 31(5):236–238.

[5] McMillan JR, Dunham JB, Reeves GH, Mills JS, Jordan CE 2012. Individual condition and stream temperature influence early maturation of rainbow and steelhead trout, Oncorhynchus mykiss. Environ Biol Fish 93(3):343–355.

[6] Naesje TF, Thorstad EB, Forseth T, Aursand M, Saksgard R, Finstad AG 2006. Lipid class content as an indicator of critical periods for survival in juvenile Atlantic salmon (Salmosalar). EcolFreshw Fish 15(4):572–577.

[7] Hinck, J.E., Blazer, V.S, Denslow, N.D, Myers, M.S, Gross, T.S. and Tillitt, D.E. 2007. Biomarkers of contaminant exposure in northern pike (*Esoxlucius*) from the Yukon River Basin, Alaska, Arch Environ ContamToxicol.,52(4): 549–562.

[8] Van den Heuvel, M.R, Landman, M.J, Finley, M.A, West, D.W. 2008. "Altered physiology of rainbow trout in response to modified energy intake combined with pulp and paper effluent exposure". Ecotoxicol. Environ. Safe 69, 187–198.

[9] Bervoets, L, Campenhout, K.V, Reynders, H, Knapen, D, Covaci, A. and Blust, R. 2009. Bioaccumulation of micropollutants and biomarker responses in cagedcarp (*Cyprinus carpio*), Ecotoxicol. Environ. Safe. 72: 720–728.

[10] Facey, D.E., Blazer, V.S., Gasper, M.M. and Turcotte, C.L. 2005. Using fish biomarkers to monitor improvements in environmental quality, J. Aquat. Anim. Health, 17: 263–266.

[11] Alberto, A, Camargo, A,Verani, J.R., Costa. O.F.T. and Fernándes, M.N. 2005. Health variables and gill morphology in the tropical fish (*Astyanax fasciatus*) from a sewage-contaminated river, Ecotoxicol. Environ., 61: 247-255.

[12] Dethloff MG, Christopher J, Schmitt JC. 2000. "Condition factor and organosomatic indices, in: Schmitt CJ, Dethloff MG (ed) Biomonitoring of Environmental Status and Trends (BEST) Program: selected methods for monitoring chemical contaminants and their effects in aquatic ecosystems". U.S. Geological Survey, Biological Resources Division, Columbia, (MO): Information and Technology Report USGS/BRD-2000--2005. pp13-18.

[13] Abou-Seedo, F, Otieno, M. J. and Dadzie, S. 2004. "Length-weight relationship, condition factor and gonadosomatic index of lizaklunzingeri (day, 1888) in kuwait bay: Comparison of data from 1980s and 1990s". Zoology in the Middle East. 25: 37-47.

[14] Pieterse, G. M. 2004. "Histopathological changes in the testis of Oreochromis mossambicus (Cichlidae) as a biomarker of heavy metal pollution". Doctoral thesis, Faculty of Science, Rand Afrikaans University, Johannesburg.

[15] Lagler, K.F. 1956. Enumeration of fish eggs. In Freshwater Fishery Biology, edited by (2nd ed.) W.M.C. Brown Co. Dubque. pp. 106-110.

[16] Eastwood, S., Couture, P. 2002. Seasonal variations in condition and liver metal concentrations of yellow perch (*Percaflavescens*) from a metal-contaminated environment, Aquat.Toxicol, 58: 43–56.

[17] Anene, A. 2005. Condition Factors of four Cichlid Species of a Man-Made Lake in Imo State, Southeast, Nigeria, Turk. J. Fish. Aquat. Sci. 5: 43-47.

[18] Mansouri, N. Khorasani, N. Karbassi, A. R. Riazi, B. and Panahandeh, M. 2013. Assesing Human Risk of Contaminants in Anzali Wetland Fishes, 2(11), 119–126.

[19] Kasimoglu, C. 2014. The Effect of Fish Size, Age and Condition Factor on the Contents of Seven Essential Elements in Anguilla anguilla from Tersakan Stream Mugla (Turkey), Journal of Pollution Effects and Control., 02(2): 1–6.

[20] Authman, M.M.N. 2008. Oreochromis Niloticus as a Biomonitor of Heavy Metal Pollution with Emphasis on Potential Risk and Relation to Some Biological Aspects, Global Veterinaria, 2: 104-109.

[21] Couture, P, Rajotte, J.W. 2003. "Morphometric and metabolic indicators of metal stress in wild yellow perch (Percaflavescens) from Sudbury, Ontario: a review". J. Environ. Monit. 5, 216–221.

INTERNATIONAL JOURNAL OF
PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES

ISSN 2231-4490

International Journal of Plant, Animal and Environmental Sciences