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ASIAN JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN: 0976-3376

Asian Journal of Science and Technology
Vol. 5, Issue 6, pp. 332-334, June, 2014

RESEARCH ARTICLE

ECOTOXICOLOGY: EFFECT OF ACUTE AND SUB CHRONIC EXPOSURE TO HEAVY METALS (LEAD AND NICKEL) AND ITS IMPACT ON CARBOHYDRATE METABOLISM (GLYCOGEN) IN FRESH WATER FISH SPECIES FROM SAUDI ARABIA

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ARTICLE INFO

Article History:
Received 07th March, 2014
Received in revised form
14th April, 2014
Accepted 12th May, 2014
Published online 30th June, 2014

Key words:
Environmental,
Parenthesis,
Biaccumulate,
Variations,
Parameters.

ABSTRACT

Pollution is one of the major environmental problems which deteriorate the natural environment nowadays and their characteristic features are harmful for the human life and desirable species as well. The heavy metals like Lead and Nickel are the essential elements that may biaccumulate to toxic level, especially in the fishes. These elements creates the majority toxicity symptoms in larval stage, tertogenic and other deformaties in the living beings. There is a paucity of information available on the physiological stress response so an attempt has been made to evaluate such parameters with the heavy metals like Lead and Nickel for the investigation in fresh water fish species, *O. niloticus* and *C. carpio* (Mean weight 65.5±1.00 gm and mean length 10.0 ± 1.5cm) and (Mean weight 85.5± 1.00 gm and mean length 14.7± 1.20 cm). The 96h Lc50 for both species was computed as 14.35 mg/L (*O. niloticus*) and 16.75mg/L (*C. carpio*). These fishes later treated with sub-lethal concentration of (2, 4, 6 and 8 mg/L) and (3, 6, 9 and 12 mg/L) respectively and their liver and muscle were treated for total glycogen content in which a significant ($P \leq 0.01$) depletion was recorded. All the variations in the parameters are dose dependent and are in parenthesis. The depletion was more obvious in muscle than in the liver.

INTRODUCTION

Water is one of the most important natural resources and its regular supply is very much essential for the survival of all living organisms. The suitability of water for a particular use depends on the type and amount of some specific impurities present that in some way affect the desired use. The variations impurities present in water are expressed through water quality variables which are broadly classified as Physical, Chemical and Biological. The widely used heavy metals in different industries of the modern world adversely affect the aquatic fauna and flora after discharge of the waste material into water, Al-Kahem, 1994; Al-Akel and Shamsi 1996; Al-Akel and Shamsi 2000. The enrichment coefficient of heavy metals in the food chain reached as high as several ten thousand times. Once it's consumed by the people through food chain in the form of fish, shrimp and shell fish, it would accumulate in the corresponding functional organs of the human body. The main task of the environmental toxicologist is to assess objectively the risk resulting from the presence of such substances. These substances may also alter the quality of water and thus violate the fisheries management Al-Akel and Shamsi (2000); Shamsi and Al-Akel (1986); Nath and Kumar (1988).

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Gasoline which is highly used in urban areas contain tetraethyl lead which is an antiknock agent enters in the body in the process of inhalation, circulate throughout the body with blood and causes severe anemia and also affect the kidney and liver (Lynam et.al 1981; Duffu, 1980; Al-Akel 1994. Several other investigators in the past Al-Akel, 1994; Chisolm; 1971; Goyer and Rhyne, 1973; Hodson et.al. 1978; Tiwari et.al. 1987, noticed that lead interferes with the synthesis of haem which affect the renal, haemopoietic embryonic and central nervous system. Keeping all these views, it is essential to investigate the chronic effects of these sorts of heavy metals which are very much related to the fishery management and the food chain.

MATERIALS AND METHODS

Specimen *of O.niloticus* (mean weight 65.5±1.00 gm and mean length 10.0 ± 1.5Cm) and *C. carpio* (mean weight 85.5 ± 1.00gm and mean length 14.7 ± 1.2.Cm) were acclimatized in the laboratory condition in a big container with oxygenation under a photoperiod of 12h L: 12h D for a week before starting the experiment. The medium of the aquarium was renewed every day. A stock solution of the chemical was prepared and diluted to the test water to get the required concentrations for the fishes separately. These fishes were exposed for 96 h and the dead fishes were removed immediately. Value of LC50 for 96h for both the fish species was calculated by the method of Finney, 1971 and used by Al-Akel and Shamsi (2000). For

Table 1. Variation in Glycogen content (µg/g wet weight) with percentage of depletion in two fresh water fish species (*O.niloticus* and *C. carpio*) exposed at different sub-lethal concentration of Lead and Nickel

Concentration mg/L	Muscle				Liver			
	Lead		Nickel		Lead		Nickel	
	Glycogen µg/g wet weight	% of depletion	Glycogen µg/g wet weight	% of depletion	Glycogen µg/g wet weight	% of depletion	Glycogen µg/g wet weight	% of depletion
O.niloticus								
Control	9580.00±12.37	-----	9470.00±10.37	------	16400.00±30.60	-----	16200.00±10.50	------
2.00	9125.00±18.35	4.98	8990.00±16.75	5.07	16000.00±22.68	2.43	15950.00±22.0	1.54
4.00	8670.60±16.35	5.24	8470.00±18.75	5.78	15250.00±21.75	4.69	14100.00±20.75	11.59
6.00	8165.40±16.90	6.17	7970.00±25.00	5.94	14900.00±24.50	2.34	12400.00±16.75	12.05
8.00	7528.00±14.25	8.46	7120.00±14.50	10.66	12950.00±18.75	15.06	10400.00±17.54	16.12
C.carpio								
Control	8090.00±22.15	-----------	7875.00±10.75	-------	11210.00±8.40	------	11800.25±18.75	-------
3.00	7795.00±22.75	4.55	7480.80±16.78	5.01	10250.00±15.84	8.56	11000.50±22.34	6.77
6.00	7440.00±24.50	5.24	7060.80±18.75	5.61	8090.00±21.95	21.07	10100.19±24.50	8.18
9.00	7050.00±20.80	5.53	6677.00±16.05	5.41	7875.00±16.75	2.66	9580.00±14.00	9.45
12.00	6570.00±14.80	6.80	6175.00±14.75	7.61	6890.00±22.20	12.50	8450.50±32.30	11.78

analysis of Glycogen content in Muscle and Liver of both the fishes with Lead and Nickel another two sets of experiments with 200 fishes were distributed into 12 groups. From the total stock of 200 fishes, 15 fishes were treated to different concentrations for lead and nickel separately with a control set parallel with these for comparison. These fishes were sacrificed for glycogen contents in liver (100 mg wet weight per fish) and muscle (500 mg wet weight per fish) and analyzed on U.V. Spectrophotometer (Backman, U.S.A.) using the method of Montogomery (1957).

RESULTS AND DISCUSSION

Toxicity:- Both the fishes, *O. niloticus* and *C. carpio* were exposed to different lethal concentrations (9,10,11,12 ,13,14 and 15 mg/L) and (18,19,20,21,22,23 and 24 mg/L) of Lead and Nickel toxicity respectively. The results of the acute tests were observed as

LC50 for 96h in *O. niloticus* with Lead was 11.65 mg/L and with Nickel it was 19.45 mg/L
LC50 for 96h in *C. carpio* with Lead was 13.45 mg/L and with Nickel it was 21.70 mg/L respectively.
Glycogen Content (Carbohydrate metabolism)

Glycogen contents with their percentage of depletion in Muscle and Liver with toxicity of Lead and Nickel of treated and control fishes are depicted in Table 1. The mucous secretion and some abnormal behavioral changes followed by the asphyxia were the apparent features. Glycogen content in liver and muscle decreased significantly throughout the period of investigation (Table.1). An exceptional case was registered in Liver in both the fish species at 6.0mg/L in *O. niloticus* and 9.0 mg/L in *C. carpio* where certain sudden changes occurred, it might be due to the processing for estimation. The observed value for LC50 for 96h in these fishes are quite comparable to the values given by Atchison et.al (1987). Variation in the values of LC50 might be due to the environmental factors and the species itself. This variation in values can also be attributed to the difference in susceptibility and tolerance related to its accumulation, these observations can be correlated with the work of Johnson and Toledo (1993); Al-Kahem et.al. (1998) and Al-Akel and Shamsi (2000). The changes in glycogen content in the tissues due to the structural integrity of the gills by deposition of the mucus and produced hypoxic condition, resulting in the breakdown of tissue glycogen to meet the energy demand in the muscle by abnormally faster movement (Dales, 1972; Shafi, 1980; Shamsi and Al-Akel, 1986; Nath and Kumar, 1988; Al-Akel et.al. 1988; and Al-Akel, 1995). These authors concluded that catecholamines are secreted in large amount by the fish under stressed condition which might be one of the major causes for the depletion of glycogen in fishes. These hypothesis, the author can correlate with the work of Inui and Ohshima, 1966 and Hoar et.al 1979, where these scientist have investigated the decrease in the muscular glycogen in *Anguilla japonica* during stress condition with slower rate than in the liver.

REFERENCES

A.S. Al-Akel, M.J.K. Shamsi, H.F. Al-Kahem, M.A. Chaudhary and Z. Ahmad 1988. Effect of Cadmium on the cichlid fish *Orechromis niloticus*: Behavioural and Physiological responces. J. Uni. Kuwait (Sci.) 15(2):341-346.

A.S. Al-Akel 1994. Changes in behaviour, tissue glycogen and blood chemistry of fresh water carp *Cyprinus carpio* in relation to toxicity of Lead. Zeitschrift fur Angewandte Zoologie 80: 87-96.

A.S. Al-Akel 1995. Behavioural responses and carbohydrate metabolism in *Oreochromis niloticus* due to the contamination of manganese, Egypt. J. Appl. Sci.10 (5):373-382.

A.S. Al-Akel and M.J.K. Shamsi 1996. Hexavalent chromium: Toxicity and impact on carbohydrate metabolism and haematological parameters of carp (*Cyprinus carpio* L) from Saudia Arabia , Aquatic Sci. 58:24-30.

A.S. Al-Akel and M.J.K. Shamsi 2000. A comparative study of the toxicity of Lead and its Impact on the carbohydrate metabolism and some haematological parameters of Cichlid Fish, *Oriochromis niloticus* and Catfish *Clarius gariepinus* from Saudi Arabia, Toxicological Environ. Chem. 74:19-28.

H.F.Al-Kahem 1994. Toxicity of Nickel and the effects of sublethal level on haematological parameters and behaviour of the fish, *Oreochromis niloticus*, J. Univ. Kuwait (Sci.) 21:243-252.

H.F. Al-Kahem; Z. Ahmad; A.S. Al-Akel and M.J.K. Shamsi 1998. Toxicity bioassay and changes in haematological parameters of Or*eochromis niloticus* induced by Trichlorfon, Arab Gulf J. Scient. Res. 16(3):581-593.

Chisolm, J.J. 1971. Lead Poisoning, Sci. Amer. 224:15.

Dales, L.G. 1972. The neurotoxicity of alkyl mercury compound, Am. J. Med. 53:219-232.

Duffus, J.H. 1980. Environmental Toxicology, Resources and Environmental Sciences Series, Edward Arnold (Publisher) Ltd. London, pp.1-33.

Finney, D.J. 1971. Probit Analysis, S. Chand and Company Ltd., Ram Nagar, New Delhi, India, p.333.

Goyer, R.A. and Rhyne, B.C. 1973. Pathological effect of Lead, Int. Rev. Exp. Pathol, 12:1

Hoar, W.S.; Randall, D.J. and Brett, J.R. 1979. Carbohydrate: In Fish Physiology,3,Academic Press ,New York San Francisco,London,pp.22-30.

Hodson, P.V.; Blunt, B.R. and Spry, D.J. 1978. Chronic toxicity of water-borne and dietary lead to rainbow trout (*Salmo gairdneri*) in Lake Onterio water, Water Res. 12:869-878.

Inui, Y. And Ohshima, Y. 1966. Effect of starvation on metabolism and chemical composition of eel. Bull. Jap. Soc. Scient. Fish.32:492-501.

Johnson, C.M. and Toledo, M.C.F. 1993. Acute toxicity of endosulfan of the fish *Hyphessobrycon bifasciatus* and *Brachydanion rerio*, Archiv. Environ. Contam. Toxicol, 24:151-155.

Lynam, D.; Piantamida, R. and Cole, I.F. 1981. Environmental Lead, New York London, Toronto, Sydney, San Francisco, Academic Press.P.358.

Montgomery, R.C. 1957. Determination of glycogen, Arch. Biochem.Biophys.67:378-387.

Nath, K. And Kumar, N. 1988. Hexavalent chromium: Toxicity and its impact on certain aspects of carbohydrate metabolism of the fresh water teleost (*Colisa fasciatus*) Sci. Total Environ. 72:75-81.

Shafi, S.A. 1980. Zinc inoxication in some freshwater fish, I. Variation in energy reserve. Anals. Limnol.1:91-97.

Shamsi, M.J.K. and Al-Akel, A.S. 1986. Effect of mercuric chloride on glycogen content in the various tissues of fresh water fish *Oreochromis niloticus.* Proc. Saudi Biol. Soc. 9:271-276.

Tiwari, H.; Gill, T.S. and Pant, J. 1987. Impact of chronic lead poisoning on the haematological and biochemical profile of a fish, *Barbus conchonius* (Ham.), Bull. Environ. Contam. Toxicol. 38(5): 748-752.

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