https://ijrps.com/

ISSN: 0975-7538
Research Article

Bio chemical alterations due to the impact of lead nitrate in sublethal levels on muscle and liver tissues of an economically important marine fish *Mystus gulio* (Hamilton)

Palani Kumar S*[1], Marimuthu S[2], Sharahdamma A.S[3]

[1]M.S. Horticulture, Kurngulam east, Thanjavur 613007, Tamil Nadu, India
[2]Department of Surgery, Thanjavur Medical College, Thanjavur, Tamil Nadu, India
[3]Govt PHC, Sillathur, Thanjavur District, Tamil Nadu, India

ABSTRACT

In this study, the Marine fish Mystus gulio subjected to lead nitrate toxicity under three sublethal concentrations (09.60 mg/L, 15.50 mg/L and 26.50 mg/L)for 24 hrs, 48 hrs 72 hrs and 96 hrs . The vital organs Muscle and Liver were dissected from *M.gulio* and processed for biochemical assay. The result of Lead nitrate treated fish tissue shows a decrease in the level of Protein, Carbohydrate and Lipid comparing to the control fish. The depletion results of Protein in Muscle from 69.10 to 56.48 in male and 69.55 to 55.60 percent in female, Carbohydrate from 16.52 to 13.65 Percent in male and 16.81 to 13.34 percent in female and Lipid from17.70 to 12.00 percent in male and 18.21 to 13.50 percentage in female, similarly the liver tissue shows depletion of protein from 50.15 to 41.12 percent in male and 52.00 to 43.05 percent in female, Carbohydrate from 25.15 to 20.48 percent in male and 25.44 to 19.60 percent in female Lipid shows from 21.78 to 17.86 percent in male and 20.06 to 17.00 percent in female. This shows depletion of three biochemical components due to the impact of Lead nitrate toxicity. Impact of Lead nitrate leads to active depletion of biochemical components of protein carbohydrate and Lipid resulting in accelerated metabolism.

Keywords: Biochemical studies; Muscle; Liver; Lead nitrate; *M.gulio*.

INTRODUCTION

Metals are introduced into the aquatic systems as a result of weathering of soils and rocks and from a variety of human activities like mining, smelting, processing and manufacturing of metal articles and using of substances containing metal contaminants. Most of the heavy metals are toxic to organisms as well as humans if exposed levels are sufficiently high. In aquatic ecosystems, the heavy metals have received considerable attention due to their toxicity and accumulation in biota (Javed and Hayat, 1999). The fish, as a bio indicator species, plays an increasingly important role in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment. The sudden death of fish indicates heavy pollution; the effects of exposure to sub lethal levels of pollutants can be measured in terms of biochemical, physiological or histological responses of the fish organism (Mondon *et al*., 2001). These pollutants build up in the food chain and are responsible for adverse effects and death in the aquatic organisms (Farkas *et al.*, 2002).

* Corresponding Author
Email: drspkumar71@yahoo.in
Contact: +91-9442155198
Received on: 27-03-2012
Revised on: 08-06-2012
Accepted on: 09-06-2012

The experimental teleost fish *Heteropneustes fossilis* divided in to four equal groups. Tissue brain, liver, kidney and gills removed and processed for the estimation of protein contents. It has been observed that lead nitrate cause deleterious effects in all the tissue with reference to protein contents. When chabazite added with lead nitrate, protein contents improved towards normal (Meeta Mishra and Subodh Kumar Jain, 2009).

MATERIALS AND METHODS

Experimental animal

The brackish water fish *Mystus gulio* (length around 22 cm and weight 150 g) were collected from Muthupet - Velankanni backwaters Velankanni, Latitude:10.6833, Longitude: 79.8333, Lat (DMS): 10° 40' 60N, Long (DMS): 79° 49' 60E,. The collection of fishes was done with the help of local fisherman near the private fish ponds backwaters. The collected alive fishes were transferred to 50 liters plastic barrel half filled with its native water. Then the container was aerated with oxygen cylinder. Then the fishes were transferred to Thanjavur by car and the specimens were transferred to big cement tanks of approximate capacity 500 L. fed with dried acetes (test animal fed with *ad libitum* once a day). Feeding stoped 24 hrs before experimentation as per Arora *et al.* (1974). Water temperature maintained at 30 degree C pH 7.70 ± 0.03, MOA (mg/L) 137.56 ± 0.02, PPA (mg/L) 62.0 ± 0.03, TA (mg/L) 199.52 ± 0.03, Salinity (ppt) 0.444 ± 0.01, TH (mg/L) 141.25 ± 0.05.

The biochemical analyses were carried out in both control animals and on lead nitrate treated animals. The tests were carried out in 3 different sublethal concentrations of 09.60 mg/L as SLC – 1, 15.50 mg/l as SLC –II, 26.50 mg/L as SLC – III with 24 hrs, 48 hrs, 72 hrs and 96 hrs, the results were mentioned in four different tables

Biochemical assay

Biochemical assay was carried out for the above animal tissue using the method of Lowry et al.(1951) for protein, Folch et al.(1957) for Lipid and Roe(1955) for Carbohydrate.

RESULTS

Control values of muscle and liver tissues of Estuarine fish *M.gulio*

The control value for Estuarine fish *M.gulio* the protein in muscle tissue for male 64.10% and female 64.55 %, carbohydrate in muscle for male 16.52% and female 16.81%, lipid in muscle for male 17.70% and for female 18.21%. Similarly the protein in liver for male 50.15% and female 52.00%, carbohydrate in liver for male 25.15% and female 25.44%, lipid in liver for male 21.78% and female 20.06% respectively.

The table 1 presents biochemical parameters of protein, carbohydrate and lipid in the muscle and liver of experimental fish *Mystus gulio* at three sublethal levels concentrations for 24 hrs. Muscle protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 63.66 in male and 63.80 per cent in female to 59.10 and 59.74 respectively. This shows a decrease. Similarly the Carbohydrate level in male 16.66 and female 16.72 per cent and gradually decreases to 15.18 and 15.48. This shows depletion of carbohydrate. Similarly Lipids declines from 17.18 and 18.00 to 14.55 and 16.62 per cent respectively. The liver protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 49.55 in male and 50.80 per cent in female to 45.68 and 45.90 per cent respectively this shows a decrease. Similarly the Carbohydrates level in male 24.94 and female 24.20 and gradually decreases to 22.66 and 22.82 this shows depletion of carbohydrates. Similarly lipid level declines from 21.90 and 20.89 to 19.86 and 18.45% respectively.

The table 2 presents biochemical parameters of protein, carbohydrate and lipid into the muscle and liver of experimental fish *Mystus gulio* at three sublethal levels concentrations for 48 hrs. The muscle protein concentration in lead nitrate treated fish SLC-I, SLC-II and SLC-III are 62.50 in male and 62.68% in female to

Table 1: Biochemical parameters of protein, carbohydrates and lipid in to the muscle, liver and gonad of experimental fish, Mystus gulio at three sublethal levels of concentrations for 24 hrs

Body organ	Treatment with lead nitrate	Exposure period (24 hrs)					
		Protein (%)		Carbohydrate (%)		Lipid (%)	
		Male	Female	Male	Female	Male	Female
Muscle	Control	64.10	64.55	16.52	16.81	17.70	18.21
	Conc.09.60 mg/L SLC-I	63.66	63.80	16.66	16.72	17.18	18.00
	Conc.15.50 mg/L SLC-II	62.78	62.90	16.18	16.52	16.42	17.38
	Conc.26.50 mg/L SLC-III	59.10	59.10	15.18	15.48	14.55	16.62
Liver	Control	50.15	52.00	25.15	25.44	21.78	20.06
	Conc.09.60 mg/L SLC-I	49.55	50.80	24.94	24.20	21.90	20.89
	Conc.15.50 mg/L SLC-II	48.00	48.55	23.00	23.18	20.32	19.72
	Conc.26.50 mg/L SLC-III	45.68	45.90	22.66	22.82	19.86	18.45

Table 2: Biochemical parameters of protein, carbohydrates and lipid into the muscle, liver and gonad of experimental fish, Mystus gulio at three sublethal level of concentrations for 48 hrs

Body organ	Treatment with lead nitrate	Exposure period (48 hrs)					
		Protein (%)		Carbohydrate (%)		Lipid (%)	
		Male	Female	Male	Female	Male	Female
Muscle	Control	64.10	64.55	16.52	16.81	17.70	18.21
	Conc.09.60 mg/L SLC-I	62.50	62.68	16.66	16.72	16.82	17.95
	Conc.15.50 mg/L SLC-II	61.50	61.65	16.18	16.52	15.70	16.78
	Conc.26.50 mg/L SLC-III	58.00	58.80	15.18	15.48	13.88	15.80
Liver	Control	50.15	52.00	25.15	25.44	21.78	20.06
	Conc.09.60 mg/L SLC-I	49.05	49.75	23.47	23.65	20.90	19.65
	Conc.15.50 mg/L SLC-II	47.42	47.95	22.22	22.56	19.50	19.26
	Conc.26.50 mg/L SLC-III	45.10	45.62	21.05	21.00	19.1	18.00

Table 3: Biochemical parameters of protein, carbohydrates and lipid in to the muscle, liver and gonad of experimental fish, Mystus gulio at three sublethal level of concentrations for 72 hrs

Body organ	Treatment with lead nitrate	Exposure period (72 hrs)					
		Protein (%)		Carbohydrate (%)		Lipid (%)	
		Male	Female	Male	Female	Male	Female
Muscle	Control	64.10	64.55	16.52	16.81	17.70	18.21
	Conc.09.60 mg/L SLC-I	60.30	60.62	16.16	16.12	16.04	17.1
	Conc.15.50 mg/L SLC-II	58.22	59.06	15.42	15.75	15.33	16.22
	Conc.26.50 mg/L SLC-III	56.65	56.82	14.05	14.30	12.18	14.28
Liver	Control	50.15	52.00	25.15	25.44	21.78	20.06
	Conc.09.60 mg/L SLC-I	48.30	50.00	23.10	23.27	20.10	18.75
	Conc.15.50 mg/L SLC-II	46.86	47.16	21.80	22.10	19.07	18.60
	Conc.26.50 mg/L SLC-III	44.86	45.48	21.00	20.22	18.84	17.90

Table 4: Biochemical parameters of protein, carbohydrates and lipid in to the muscle, liver and gonad of experimental fish, Mystus gulio at three sublethal concentrations for 96 hrs

Body organ	Treatment with lead nitrate	Exposure period (96 hrs)					
		Protein (%)		Carbohydrate (%)		Lipid (%)	
		Male	Female	Male	Female	Male	Female
Muscle	Control	64.10	64.55	16.52	16.81	17.70	18.21
	Conc.09.60 mg/L SLC-I	59.60	60.00	16.05	16.00	15.48	16.40
	Conc.15.50 mg/L SLC-II	57.50	58.22	15.10	15.32	15.05	15.68
	Conc.26.50 mg/L SLC-III	56.48	55.60	13.65	13.34	12.00	13.50
Liver	Control	50.15	52.00	25.15	25.44	21.78	20.06
	Conc.09.60 mg/L SLC-I	47.60	48.10	22.80	22.95	19.30	18.20
	Conc.15.50 mg/L SLC-II	46.10	47.00	21.30	21.50	18.60	18.15
	Conc.26.50 mg/L SLC-III	41.12	43.05	20.48	19.60	17.86	17.00

58.00 and 58.80 respectively this shows a decrease. Similarly the carbohydrate level in male 16.66 and female 16.72 and gradually decreases to 15.18 and 15.48 and 15.80% respectively. The liver protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 49.05 in male and 49.75% in female to 45.10 and 45.62 respectively this shows a decrease. Similarly the carbohydrate level in male 23.47 and female 23.65 and gradually decreases to 21.05 and 21.00 this shows depletion of carbohydrate. Similarly lipid level declines from 20.90 and 19.65 to 19.1 and 18.00% respectively.

The table 3 presents biochemical parameters of protein, carbohydrate and lipid into the muscle and liver of experimental fish *Mystus gulio* at three sublethal levels concentrations for 72 hrs. The muscle protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 60.39 in male and 60.62% in female to 56.65 and 56.82 respectively this shows a decrease. Similarly the carbohydrate level in male 16.16 and female 16.12 and gradually decreases to 14.05 and 14.30 this shows depletion of carbohydrate. Similarly lipids declines from 16.04 and 17.1 to 12.18 and 14.28% respectively. The same table 13 liver protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 48.30 in male and 50.00% in female to 44.86 and 45.48 respectively this shows a decrease. Similarly the carbohydrate level in male 23.10 and female 23.27 and gradually decreases to 21.00 and 20.22 this shows depletion of carbohydrate. Similarly lipid level declines from 20.10 and 18.75 to 18.84 and 17.90% respectively.

The table 4 presents biochemical parameters of protein, carbohydrate and lipid into the muscle and liver of experimental fish *Mystus gulio* at three sublethal levels concentrations for 96 hrs. The muscle protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 59.60 in male and 60.00% in female to 56.48 and 55.60 respectively this shows a decrease. Similarly the carbohydrate level in male 16.05 and female 16.00 and gradually decreases to 13.65 and 13.34 this shows depletion of carbohydrate. Similarly lipids declines from 15.48 and 16.40 to 12.00 and 13.50% respectively. The same table 14 liver protein concentration in lead nitrate treated fishes SLC-I, SLC-II and SLC-III are 47.60 in male and 48.10% in female to 41.12 and 43.05 respectively this shows a decrease. Similarly the carbohydrate level in male 22.80 and female 22.95 and gradually decreases to 20.48 and 19.60 this shows depletion of carbohydrate. Similarly lipid level declines from 19.30 and 18.20 to 17.86 and 17.00% respectively.

DISCUSSION

A decreasing trend of protein, carbohydrate and lipid concentration observed in the present study as the toxicity of fluoride (F) to 16 cm long freshwater male catfish (*Clarias batrachus* Linn.) was evaluated after their exposure to two sublethal concentrations of NaF

(35 mg F ion/L and 70 mgF ion/L) for 90 days. Changes in biochemical parameters in muscle, liver and testis tissues were recorded. Significant depletion of total protein and lipids in these tissues occurred at both the lower and higher F concentrations. A significant reduction of glycogen content was found in muscle and testis at the lower concentration, but it increased in all three tissues at the higher concentration. Moreover, an increase in the level of cholesterol in muscle, liver, and testis occurred at both concentrations, but it was significantly higher ($P < 0.05$) only at the higher concentration (Anand Kumar *et al.*, 2007).

The PL was exposed to a sublethal concentration of lead (1.44 ppm) for 30 days. The major biochemical constituents, including total carbohydrates, proteins, lipids and ninhydrin-positive substances (TNPS) were estimated using standard methods. Lead exposure resulted in retardation of growth with a significant decrease in length and weight occurring at day 10 and onwards. Of all the biochemical constituents, total protein showed the maximum decrease (79.3%) followed by total lipids (68.1%) and then by total carbohydrates (51.4%) in lead-exposed PL. The data suggest lead exposure causes reduced growth and the depletion of biochemical constituents. This may be due to metal interactions and inhibition of metabolic pathways responsible for synthesis of biochemical constituents or to greater utilization of these constituents under metal stress conditions (Chinni and Yallapragada, 2000). Similar observations were observed in the present study on estuarine fish *Mystus gulio* and in shrimp *Penaeus monodon*. The protein, carbohydrate and lipid level in the body tissues of these animals treated with lead nitrate show a decreasing trend comparing to the control animals (fish and prawn).

The fish, as a bioindicator species, plays an increasingly important role in the monitoring of water pollution because it responds with great sensitivity to changes in the aquatic environment. The sudden death of fish indicates heavy pollution; the effects of exposure to sublethal levels of pollutants can be measured in terms of biochemical, physiological or histological responses of the fish organism (Mondon *et al.*, 2001).

SUMMARY

The observations from the present study shows that, The Lead nitrate at sublethal concentrations altered the biochemical composition (protein, Carbohydrate and lipid) of the various organs of test animal. The biochemical studies on estuarine fish show a maximum decrease in the protein, carbohydrate and lipid content in muscle and Liver due to accelerated metabolism enhanced by the presence of heavy metal Lead nitrate.

REFERENCES

Anand Kumar, Nalini Tripathi, and Madhu Tripathi, 2007. Fluoride-induced biochemical changes in freshwater catfish (*Clarias batrachus* (LINN). *Fluoride*, 40(1): 37-41.

Arora, H.C., Routh, J., Chattopadhya, S.N. and Sharma, U.P., 1974. Survey of the sugar mill effluent disposal. Part II. A comparative study of sugar mill effluent characteristics. *Indian J. Environ. Helth.*, 16(3): 233-246.

Chinni, S. and Yallapragada, P.R., 2000. Lead toxicity on growth and biochemical constituents in postlarvae of *Penaeus indicus*, *Mar. Environ. Res.*, 50(1-5): 103-104.

Farkas, A., Salanki, J. and Speoziar, A., 2002. Relation between growth and the heavy metal concentration in organs of bream, *Abramis brama* L. populating lake Balaton. *Arch. Environ. Contam. Toxicol.*, 43: 236-243.

Folch, J., Lee, M. and Sloani-Stanley, G.H., 1957. A simple method for isolation and purification of total lipids from animal tissue. *J. Biol. Chem.*, 226: 497-509.

Javed, M. and Hayat, S., 1999. Heavy metal toxicity of river Ravi aquatic ecosystem. *Pakistan J. Agric. Sci.*, 36: 1-9.

Lowry, O.H., Rosebrough, N.J., Fair. A.L. and Randall, R.J., 1951. Protein measurement with the folin phenol reagent. *J. Biol. Chem.*, 193: 265-275.

Meeta Mishra and Subodh Kumar Jain, 2009. Effect of Natural Ion exchanger chabazite for emediation of lead toxicity: An experimental study in teleost fish *Heteropneustes fossilis*. *Asian J. Exp. Sci.*, 23(1): 39-44.

Mondon, J.A., Duda, S. and Nowak, B.F., 2001. Histological, growth and 7 ethoxyresorufin O-deethylase (EROD) activity responses of greenback flounder *Rhombosolea tapirina* to contaminated marine sediment and diet. *Aquat. Toxicol.*, 54: 231-247.

Roe, J.R., 1955. The determination of sugar in blood and spinal fluid with anthrone reagent. *J. Biol. Chen.*, 212: 335-343.