VOLUME - 11, ISSUE - 03, MARCH - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Zoology

ARSENIC INDUCED ALTERATIONS IN GLYCOGEN AND LIPID DURING TESTICULAR CYCLE OF A FRESHWATER SILUROID, *MYSTUS (M.) VITTATUS* (BL.)

Anuradha Shukla P.G. Department of Zoology SH.Kisan P.G.College, BASTI (UP).

Yogendra Kumar Payasi* Department of Zoology; IGNTU, (A Central University) Amarkantak, 484887 (M.P.) India. *Corresponding Author

J.P.Shukla Department of Zoology; IGNTU, (A Central University) Amarkantak, 484887 (M.P.) India.

ABSTRACT The increasing order in the glycogen and lipid content was observed during preparatory and spawning phase but decrease in these biochemical parameters was during post-spawning phase of testicular cycle in *Mystus (M.) vittatus*, a freshwater siluroid. Less significant alteration in glycogen and lipid was noticed after 15 days of exposure but highly significant decrease was observed after 30 days of exposure in SLC (Sublethal concentration) of trivalent arsenic as AsCl3. causes for decline in these biochemical parameters have been discussed.

KEYWORDS : *Mystus (M.) vittatus*; Preparatory phase; Spawning phase; Post-spawning phase; Trivalent arsenic; Testicular cycle.

INTRODUCTION

Heavy metal pollution at present has become a serious environmental and public health hazard. It is because, the concentration of metallic pollutants released into the different section of environment from various industrial processes. These are often concentrated because of their bio-accumulative and non-biodegradable features. Heavy metals constitute a core group of aquatic pollutants (Vutukur 2003; 2005). Their high toxicity even at low concentration may exert cumulative toxic effects in a wide variety of fish fanna and other aquatic biota (Storelli et al.,2006). The introduction of heavy metals into the environment is through a wide spectrum of natural sources such as volcanic activities, erosion, and anthropogenic ones, including industrial wastes release as well as leakage. Certain metallic pollutants such as chromium, arsenic, nickel, cadmium, mercury etc exert toxic effects on living biota even at low concentration whereas zinc, manganese, copper etc. produce toxic effects on living biota only at higher concentration (Cohen et al., 2001; Karadore & Unlu, 2007; Yilmaz et al., 2010). In the aquatic environment, fishes appears to be remarkable bioindicator of arsenic toxicity (Gerhofer et al., 2001; Ghosh et al., 2007). Allen and Rana (2004) reported that toxicity of arsenical compounds depends upon species, sex, age, dose, duration of exposure, organic or inorganic form, valancy state etc. Arsenic has been reported to be present in two different oxidation states (+3 and +5). Trivalent arsenic (As^{+3}) has been observed to be more deleterious than the pentavalent arsenic (Bears et al., 2006; Ghosh et al.,2006; Kovandon et al., 2013; Shukla and Shukla, 2016, & 2017). Even though, the toxicity of arsenic (+3) in aquatic biota, particularly fishes has been enormously documented (Storelli et al., 2006, Venkatrama reddy et al., 2009; Shukla and Shukla, 2016, 2017). However, deleterious effects of trivalent arsenic on the glycogen and lipid during different phases of testicular cycle is scarce and hence present study has been undertaken.

MATERIALS AND METHODS

Adult specimens of *Mystus (M.) vittatus* (Bl.) were collected from local lake having weight 92.38±4.48gm during preparatory phase (January to April); Spawning phase (April to August) and post-spawning phase (September to December). They were acclimatized in laboratory tap water having pH=7.2±0.02; temperature = 22.4±2.2°c; DO= 6.2±40.52 mg/l; hardness as $CaCo_3$ = 126.62±3.6 mg/l. Analysis of physico-chemical features of tap water was made by the methods outlined by APHA (2005). Sublethal concentration of analytic grade of trivalent arsenic (11.24 mg/l) as $AsCl_3$ was detected for long-term experimentation (15 and 30 days) as outlined by Shukla and Pandey (1988). The control and experimental media was aerated 3-5 hours daily using stone diffuser, though *Mystus (M.) vittatus* is hardy air breathing fish. 20 specimens were placed each in control and experimental media. The total glycogen and lipid in testis during preparatory, spawning and post-spawning phases were estimated by adapting the methods outlined by Kemp and Kits (1954) and Pandey et al.,(1963). The data obtained in our study was statistically analyzed for significance by Student's 't' test as proposed by Fischer (1983) and a p value of 0.05 of less was noticed as significant between control and experimental group.

RESULTS & DISCUSSION

Table 1. Total glycogen and lipid content in mg/gm dry weight of testis during its different phases under SLC of trivalent arsenic in *Mystus (M.) vittatus*. Each value represents mean ±SE of 5 observations.

Content	Parameters	Control	15 days exposure	% Change	30 days exposure	% Change
Preparatory	Glycogen	20.24±0.22	18.64±0.18**	7.90	16.42±0.20****	18.87
	Lipid	60.14±1.22	56.26±1.34*	6.45	52.34±1.64***	12.96
Spawning	Glycogen	26.28±0.26	24.12±0.16**	8.21	21.64±0.32***	17.65
	Lipid	68.36±1.66	62.38±1.42**	8.74	58.44±1.62***	14.51
Post-spawning	Glycogen	12.24±0.16	11.36±0.12**	7.18	10.44±0.20***	14.70
	Lipid	36.26±1.04	34.18±1.02*	5.73	32.66±1.54**	9.92

* = p>0.05 (insignificant)
** = p<0.05
*** = p<0.01
**** = p <0.001

Reproductive cycle includes gonadal cycle which is a dynamic process always in state of gametogenesis. SLC of trivalent arsenic produced less significant diminsion in the glycogen and lipid content during preparatory, spawning and post-spawning phases under 15 days exposure when compared to control. But clear significant decrease in glycogen and lipid content was noticed after 30 days of exposure during all the phases. From Table-1, it becomes clear that the level of glycogen and lipid in testis during its control spawning phase of testicular cycle was maximum in comparison to preparatory and post-spawning phase which clearly indicates towards the

possible supply of carbohydrate and lipid content in the form of glucose and lipid derivatives for active maturation of sperms. The increasing order of decrease in glycogen content during preparatory and spawning phases of testicular cycle of *Mystus (M.) vittatus* , a siluroid fish may be due to its enhance utilization as an immediate source to meet energy demands for maturation of testis under trivalent arsenic stress. It could also be an account of the prevalence of hypoxic or anoxic condition of the trivalent arsenic stress which generally enhances glycogen utilization in one way or other (Dezwaan and Zandee,1973; Geetha et al., 1991; Ozretic and Ozretic, 1993; Shukla et al., 2005,2012; Shukla and Shukla,2011).

The diminsion in the lipid content during different phases of testicular cycle of *Mystus (M.) vittatus* (Bl.), a freshwater siluroid might be partly due to its utilization in cell repair and tissue organization with the formation of lipoprotein which is salient constituent of cell membrane and cytoplasmic organelles (Harper, 1983).

Our findings may well be correlated with the observation made by Ambrose et el., (1994); Vutukuru (2003,2005); Shukla and Shukla (2012) and confirms that long term exposure under trivalent arsenic interferes in the testicular physiology of the fishes.

Acknowledgements

Author (JPS) thanks to CST (UP) for financial assistance vide letter no. CST/D-265 dt. 14.5.2015.

REFERENCES

1. APHA (2005) : Standard Methods for examinations of water and waste water, 21st Edition, Washington DC.
2. Allen, T., and S.V. Rana (2004) : Effect of arsenic on glutathione dependent enzymes in liver and kidney of fresh water fish Channa punctatus. Biol. Trace. El. Res. 100:39-48.
3. Bears H, R Chards, J.G. Chitti, PM (2006) :Arsenic exposure alters hepatic and stress mediated gene expression in the common killfish, Fundulus hetroclitius. Aquat Toxicol 77:257-266.
4. Cohen T; Hee, S and Ambrase R (2001) : Trace metals in fish and invertebrate of three California coastal wetlands. Mal. Pollu. Bull. 42: 224-232.
5. Dezwaan, A and Zondee, DI (1973): Body distribution and seasonal changes inglycogen content of the common sea mussel, Mytilus edulis, Comp. Biochem. Physiol. 43:53-55.
6. Geetha S, Suryanarayan H, and(BI). Nair NB (1991): On the nature of variations of biochemical constituents during the breeding cycle in Heteropneustes fossilisProc.Nat. Acad Sci. India. 61(B): 311-315
7. Fischer RA (1983) : Statistical methods for research workess. 13 Eds. Oliver and Boyd, London. P. 122-125.
8. Gertofer,M, Poert, M. Schramm, M., Muller, & Rriebskorn, R. (2001): Ultra-structureal bio-markers as tools to c :haracterize the health states of fish in contaminated streams. J.Aqua. Ecosyst. Stress Res. 8:241-260.
9. Ghosh D, Bhettacharya S, and Mazumdar S (2007): Long term exposure to arsenic effects to head kidney and impair humoral immune response of Clarias Satrachus. Aquat. Toxicol. 81: 79-89.
10. Harper AH (1983) : Review of biochemistry. 20th Eds. Large Medical Publication Co. California. Pp.1012.
11. Kemp AJM, and Kits VH (1994): A calorimetric micromethod for the determination of glycogen. J. Biochem. 56: 640-648.
12. Karadede AH and Unlu E (2007): Heavy metal concentration in water, sediment, fish and some benthic organism from Tigris river, Turkey Env. Monit. Assess. 131:323-327.
13. Kovandon K, S, Janansthan S, and Saranaman M (2013) : Expression of malathion in liver and Kidney of freshwater Vineerfish,cyprinus carpio var communis (Linn) exposed to arsenic. trioxide Ame J. Sci. Indus. Res. 4(1):1-10.
14. Ozretic,B. and Ozretic, KM (1993): Plasma sorbitol dehydrogenase, glutamate dehdrogenese, and alkaline phosphatase as potential indicators of liver intoxication in grey mullet (Mugil auratus). Bull. Environ. Contain. Toxicol. 50:586-592.
15. Pandey SV, Khan AP, and Subhranmanayam TAV (1963) : Micro-determination of lipids and serum fatty acids. Anal. Biochem. 6(5): 120-125.
16. Shukla, JP and Pandey K (1988): Toxicity and long-term effects of a sublethal concentration of cadmium on the growth of the fingerlings of ophiocephalus punctatus (Bl.). Acta Hydrogen. Hydrobiol. 16(5); 537-540.
17. Shukla Anuradha, and Shukla JP (2016): Toxic impact of arsenic on the blood pyruvate level in the fingerlings of a freshwater siluroid, Mystus (M.) vittatus (BI). The GI. J. Env. Sci. & Res. 3:59-62.
18. Shukla Anuradha, and Shukla JP (2017): Succinate dehydrogenase activity as an index of trivalent arsenic toxicity in fingerlings of tropical fresh water siluroid Mystus (M)vittatus (BI). Int.J.Curr. Trends in Sci & Tech. 8(1):20482-20486.
19. Shukla, A and Shukla, JP (2011) : Distillery effluent induced alterations in the nucleic acids and protein during testicular cycle of Colisa fasciatas (Bl. & Schn.) a tropical freshwater perch. Int.J.Pharma & Bio.Sci. 3(1):532-537.
20. Shukla, JP, Tripathi,S,Chandel,BS and Dwivedi, ND (2005): Deleterious effects of arsenic on blood pyruvate level in a tropical freshwater fish Colisa fasciatas. Nat.J.Life Sci.1:125-126.
21. Shukla JP, Shukla Anuradha, and Dubey RK (2012): Deleterious effects of hexavalent chromimum on the blood puruvate level in the fingerlings of Cchanna punctatus (BI) a Freshwater murrel. Int. J. Pharma & Bio Sci. 3(4) 789-794.
22. Storelli MM, Isabarove G, Storelli A, Macrotrigiano GO (2006): Trace metals in tissue of Mugilids (Mugil aratus, Mugil capito and Mugil labrus) from the Mediterranean sea. Bull Env. Conam. Toxicol. 77: 43-50.
23. Vutukur SS (2003): Chromium induced alterations in some biochemical profiles of the Indian major carp, Labao rohita (Ham). Bull. Environ. Contam Toxicol. 70(1): 118-123.
24. Vutukur SS (2005): Acute effects of hexavalent chromium on survival, oxygen corsumption, hematological parameters and some biochemical profiles of Indian major carp, Labeo rohita. Int. J. Environ. Res. Public Health. 2(3): 456-462.
25. Vankataramraddy V, Vutukutu SS, and Tchounnam PB (2009): Ecotoxicology of hexavalent chromium in freshwater fish.Rev. Environ. Health 24 (2): 129-145.
26. Yilmaz,AB, Cemal T,And Tashin, T (2010): Uptake and distribution of hexavalent chromium in tissue gill, skin and muscle of a freshwater fish, Tilapia, (Oreochromis aureus). Env. Chem & Ecotoxicol. 2(3): 28-33.