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Original Research Paper

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ALTERATIONS IN UNITS OF CENTRAL DOGMA UNDER ARSENIC EXPOSURE DURING PREPARATORY PHASE OF TESTICULAR CYCLE OF *Mystus (M.) vittatus* (Bl.)

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ABSTRACT Central dogma units comprise of DNA, RNA and synthesis of protein. Reproductive cycle in fishes is always dynamic and the units of central dogma are always changing in different phases of testicular and ovarian cycle which constitute reproductive cycle in fishes. The adult specimens of Mystus (M.) vittatus, a tropical siluroid, when exposed for 30 days to sublethal concentration of trivalent arsenic (11.24 mg/l) revealed significant decline in DNA, RNA and consequently protein in the ovary of Mystus (M.) vittatus during its preparatory phase of Testicular cycle. However, 15 days exposure revealed less significant alterations. Causes for declining in various units of central dogma and consequently protein synthesis is discussed in this paper.

KEYWORDS : DNA; RNA; Protein; Mystus (M.) vittatus ; Preparatory phase; 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 leow 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, impact of trivalent arsenic on the units of central dogma 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. 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). Fish were acclimatized for 10 days in tap water during preparatory phase (January to April). Sublethal concentration (11.24 mg/l) of trivalent arsenic (one tenth of LC_{50} 96 hours) was selected for long term experimentation (30 days) during preparatory phase of ovarian cycle of Mystus (M.) vittatus as outlined by Shukla and Pandey (1988). The control and experimental media was aerated 3-5 hours daily using stone diffuses, though Mystus (M.) vittatus is hardy air breathing fish.

The biochemical estimation of the key units of central dogma (DNA and RNA) in the testis during its preparatory phase was made using the methods adopted by Schneider (1945).

The protein concentration in the testis during preparatory phase was measured using the method proposed by Lowery et al., 1951. The data obtained in our study was statistically analyzed for significant by Student's 't' test as proposed by Fischer (1983) and a p value of 0.05 or less was noticed as significant between control and experimental.

RESULTS & DISCUSSION

Table 1. Nucleic acids (DNA and RNA and protein in the testis during preparatory phase of Mystus (M.) vittatus exposed for 15 and 30 days under SLC of trivalent arsenic compared with control. Each value represents mean ±SE of 5 observations.

Content	Control	15 days exposure	% alterations	30 days exposure	% alterations
DNA (µg/100mg) of wet testis	48.46+0.14	44.22+0.16*	8.74	42.62+0.22***	12.05
RNA (µg/100mg) of wet testis	84.48+0.32	82.22+0.5200	2.67	78.36+0.52**	7.24
Protein (mg/gm) of wet testis	94.22+0.66	90.62+0.7200	3.82	80.68+0.84***	14.37

* = p<0.05; ** = p<0.01; *** = p <0.001 ; 00 = > 0.05

The DNA and RNA content in the control group during preparatory phase of testicular cycle was 48.46±0.14 and 84.48±0.32 µg/100mg wet weight of testis where as protein content was 94.22±0.66 mg/gm wet weight of testis. Poorly significant decrease was noticed in these units after 15 days of exposure to SLC of trivalent arsenic. However, significant decrease was noticed after 30 days of exposure in experimental media showing exposure duration dependent alterations.

It is a well known fact that spermatogenesis which occurs in testis is a dynamic event and starts during preparatory phase of testicular cycle. Available literatures reveal that arsenical compounds inhibit the DNA synthesis by producing a number of chromosomal abnormalities (Freed ad Schatzis, 1969; Palmer et al., 1972; Dikhshith, 1973). Further, Peters et al., 1970 and Fowler, 1977 reported that arsenical compounds cause chromosomal abnormalities by simply substituting for phosphate which form phospho-diaster bonding in the DNA chain and prove teratogenic. Reports of Lolyd et al., (1997), Farag et al., (2006) reveal that metallic toxicants bring intra-strand cross links and strand breaking in fishes and hence decrease in the DNA content takes place. Significant decline in RNA content after 30 days of exposure under trivalent arsenic stress during preparatory phase may be attributed to the fact that the enzymes responsible for transcription may be damaged, hence quantitative decline in the RNA content during preparatory phase of testicular cycle of Mystus (M.) vittatus becomes obvious. Also it is possible that arsenical components may interfere in the transcription process causing quantitative decline in RNA.

The decline in the protein content under SLC of trivalent arsenic after long-term exposure (30 days) may be because of its interference in nucleic acids metabolism as shown in Table 1, hence quantitative decrease in protein content becomes obvious. Also, trivalent arsenic may inactivate the intracellular protein and may also block the metabolism of proteogenic amino acids whose number is 20. As a result, decrease in protein content during preparatory phase of testicular cycle becomes obvious.

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