*J. Adv. Zool. 2021: 42(2) : 194-198* **ISSN-0253-7214**

# ALTERATIONS IN THE CENTRAL DOGMA UNITS UNDER TRIVALENT ARSENIC STRESS DURING PREPARATORY PHASE OF OVARIAN CYCLE OF MYSTUS (M.) VITTATUS (BL.)

**Anuradha Shukla, Yogendra Kumar Payasi* & J.P. Shukla***
P.G. Department of Zoology
SH. Kisan P.G. College, BASTI (U.P.)
*IGNTU (A Central University) Amarkantak, 484 887 (M.P.), India.

**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. 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; Ovarian 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[26,27]. Their high toxicity even at low concentration may exert cumulative toxic effects in a wide variety of fish fanna and other aquatic biota[23]. 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[4,14,28]. In the aquatic environment, fishes appears to be remarkable bioindicator of arsenic toxicity[10,12]. Allen and Rana[2], 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[3,12,15,21,22]. Even though, the toxicity of arsenic (+3) in aquatic biota, particularly fishes has been enormously documented[21,22,23,25], however, impact of trivalent arsenic on the units of central

dogma in ovarian cycle phases 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[1]. 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[20]. 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 estima-tion 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[24].

The protein concentration in the testis during preparatory phase was measured using the method proposed by Lowery *et al.*[17]. The data obtained in our study was statistically analyzed for significant by Student's 't' test as proposed by Fischer[7], and a p value of 0.05 or less was noticed as significant between control and experimental.

## RESULTS AND DISCUSSION

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 oogenesis which occurs in ovary is a dynamic event and starts during preparatory phase of ovarian cycle. Available literatures reveal that arsenical compounds inhibit the DNA synthesis by producing a number of chromosomal abnormalities[5,9,19]. Further, Peters *et al.*[18] and Fowler[8], 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[16], Farag *et al.*,[6], 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

**Table-1.** Nucleic acids (DNA and RNA) and protein in the ovary of *Mystus (M.) vittatus* during preparatory phase 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 | 56.26±0.48 | 54.44±0.62$^{00}$ | -3.23 | 49.36±0.36$^{**}$ | 12.31 |
| RNA(µg/100mg) of wet testis | 98.46±0.44 | 94.52±0.52$^{00}$ | 4.00 | 88.22±0.66$^{**}$ | 10.40 |
| Protein(mg/gm) of wet testis | 106.28±0.88 | 98.36±0.92$^{*}$ | 9.90 | 92.20±0.82$^{***}$ | 13.24 |

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

transcription may be damaged, hence quantitative decline in the RNA content during preparatory phase of ovarian 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 ovarian cycle becomes obvious.

## ACKNOWLEDGEMENT

Authors (A. Shukla & J.P. Shukla) thank to CST (UP) for financial assistance vide letter no. CST/D-265 dt. 14.5.2015.

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