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BIOCHEMICAL EFFECT OF CADMIUM TOXICITY ON A HILL STREAM TELEOST *GARRA MULLYA* (SYKES) DURING EGG MATURATION. II. CHOLESTEROL AND GLYCOGEN

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ABSTRACT

The effect of sublethal concentration of cadmium on the cholesterol and glycogen content of liver and ovary of a hill stream teleost *Garra mullya* (Sykes) during gonad maturation has been discussed. Cadmium toxicity caused significant decrease in cholesterol level in both liver and ovary, while glycogen decreased in ovary but remained unaltered in liver of Cd-exposed specimens.

INTRODUCTION

Cadmium is now considered as a significant environmental pollutant with profound toxic effects on aquatic animals. The toxicity effects of cadmium on different species of fish has been studied (Banerjee *et al.*, 1978; Wani and Latey, 1982, 1983; Dutta and Sinha, 1987). Some reports are also available on the effects of sublethal dose of cadmium on the haematological parameters, growth and survival of the fish and deposition of cadmium in different tissues when exposed to Cd (Banerjee *et al.*, 1977). However, little attention has been paid to study the effect of cadmium on the biochemical parameters of hill-stream fishes in relation to reproduction and gonad maturation. In the present communication an attempt has been made to study the cholesterol and glycogen profile in the ovary and liver of a hill-stream fish teleost *Garra mullya*, exposed to Cd-toxicity in relation to egg maturation. This species is a common type available in the rivers and streams of Chhotanagpur plateau and is also relished as food in rural areas.

MATERIALS AND METHODS

The test fishes (female *Garra mullya*) were collected from Suvarnarekha river at Getalsud, 30 kms. west of Ranchi town with the help of local fishermen. Fishes were acclimatized for a week in the laboratory aquaria in normal tap water. Length of the test fishes varied between 14.00 cm to 15.00 cm with a mean weight of 33.2 gm. The physico-chemical characteristics of the water used to maintain fish were same as described earlier (Khan *et al.*, 1991).

Test fishes were kept in water containing 4 mg/lit $CdCl_2$ for 28 days each in April, May and June. One dozen individuals were kept each in Cd-containing and control waters. Methods for the determination of LC50 value of cadmium, maintenance of fish along with control in aquarium, statistical analysis and timing of experiment were same as described in previous communication by Khan *et al.* (1991).

Tissue Analysis

At the end of each treatment (28 days) the liver and ovary were dissected out and placed in fish saline until processed for desired estimation. Extraction of cholesterol and glycogen was carried out from weighed quantities of liver and ovary. Extraction of cholesterol was done by the method of Kabara (1962) using acetic acid-ferric chloride mixture (50 mg $FeCl_3$ in 100 ml acetic acid). Colour was developed in the supernatent by adding Conc. Sulphuric acid. The optical density was recorded on spectrophotometer at 515 nm.

Glycogen was extracted by the method of Kemp *et al.* (1954) as modified by Krishnaswami and Srinivasan (1961) using 10% trichloroacetic acid as extracting reagent and Conc. Sulphuric acid for colour development. Optical density was read at 520 nm on a spectrophotometer.

RESULTS

Results of the experiment has been represented graphically in Fig. 1. Cholesterol content in the ovary and liver of Cd-treated specimens exhibited a highly significant decrease ($p<0.001$) in comparison to control groups, during all the three months– April, May and June. However, the glycogen content of liver showed only slight decrease in April and May in Cd-treated groups but this decrease was statistically insignificant. It also exhibited narrow elevation in June but this change was also not significant. In ovary, the glycogen content recorded significant decrease ($p<0.001$) in Cd-treated group in comparison to control during all the three months under consideration.

DISCUSSION

In teleosts, the steroid hormones play a very important role in vitellogenesis and maturation of eggs (Goetz, 1983; Nayak and Singh, 1991). Cholesterol is regarded as the major source for steroidogenesis during maturation, prespawning and spawning periods (Armstrong, 1968; Sen and Bhattacharya, 1981). Accordingly, the mobilisation of cholesterol has been reported in the ovary under the influence of ganadotropin in fish (Armstrong, 1968; Sen and Bhattacharya, 1981) including some hill-stream teleosts (Singh and Nauriyal, 1990) during maturation and spawning periods. The process of steroidogenesis via cholesterol precursor involves complex enzyme systems (Upadhyaya and Hyder, 1985). Thus, the cholesterol profile in the ovaries of fish indicate a significant aspect of the physicological state of the ovary specially during maturing period. Serum cholesterol has been found to decrease in *Salmo trutta* whereas an increase in gonad and liver has been found during maximum sexual activity in case of *Onchorynchus nerka* (Idler and Bitner, 1960). During the present study, the cholesterol level in both ovary and liver

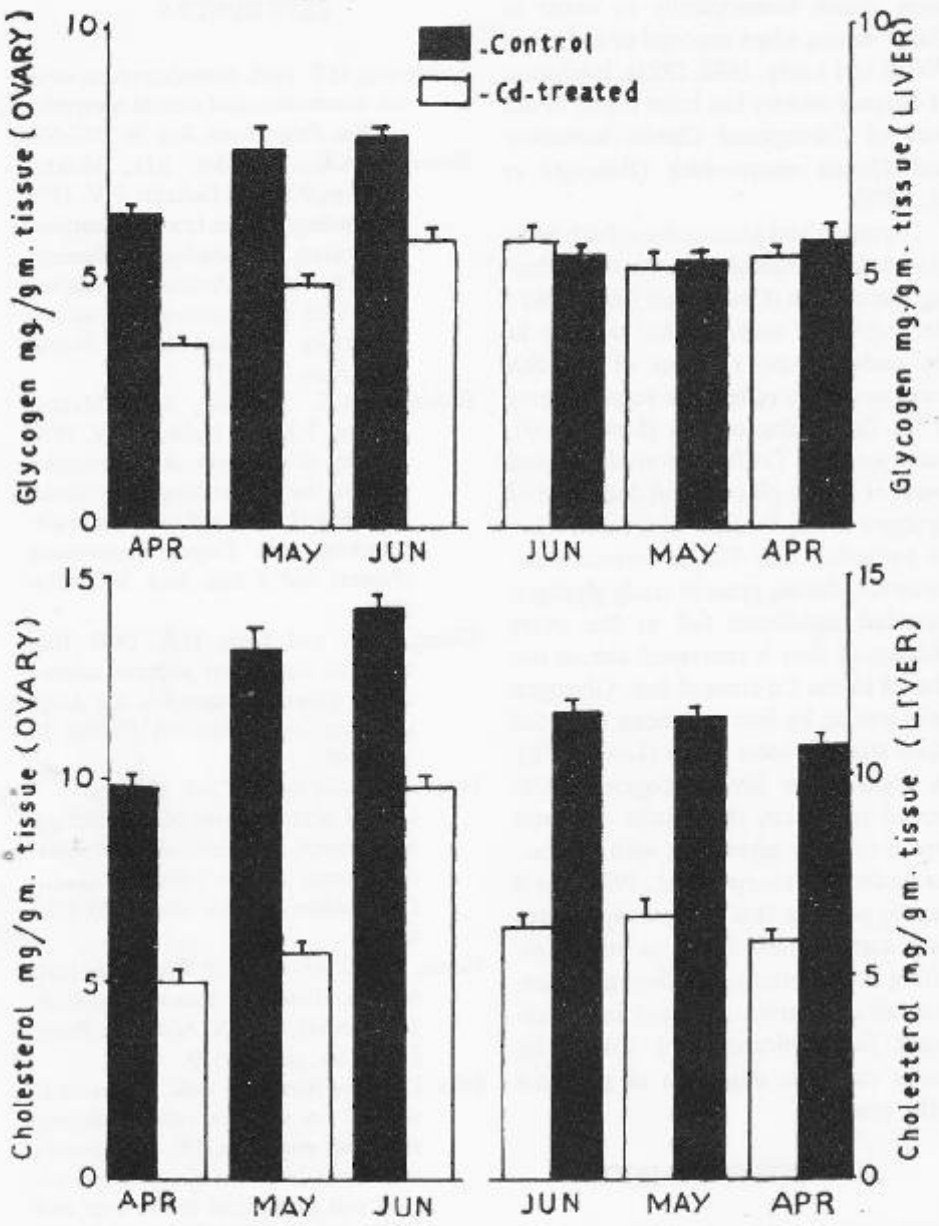

Fig. 1. Graphical representation of variation in cholesterol and glycogen content of liver and ovary due to Cd-toxicity in *Gara mullya*.

showed significant decrease in Cd-exposed specimens in comparison to control. Therefore, it might be possible that Cd-toxicity causes general damage, blockade of enzyme systems for steroidogenesis in ovary and capacity of liver to store cholesterol due to general damage. Damage of liver in ovary has

been shown histologically to occur in *Garra mullya* when exposed to cadmium (Wani and Latey, 1982, 1983). Inhibition of enzyme activity has been found in the liver of Cd-exposed *Clarias batrachus* and *Tilapia mossumbica* (Banerjee *et al.*, 1978).

Glycogen and glocose have both been reported to accumulate in the ovary during maturation (Chang and Idler, 1960 : *Onchorynchus nerka*). The changes in the carbohydrate reserves of the fish seem mostly to reflect the requirements of the developing ovaries (Love, 1970). Banerjee *et al.* (1978) reported elevated levels of serum glucose and depletion of glycogen in the liver of Cd-treated *Clarias batrachus* and *Tilapia mossumbica*. However, during present study glycogen recorded significant fall in the ovary whereas in liver it remained almost unaltered in the Cd-treated fish. Glycogen mobilisation by liver has been reported under stress in some fishes (Love, 1970). As regards the liver glycogen of Cd-treated specimen, the results does not appear to be in agreement with the earlier findings (Banerjee *et al.*, 1978) but it may be possible that Cd-toxicity creates some sort of stress in *Garra mullya* resulting in the retention of liver glycogen. The fall of ovarian glycogen in Cd-exposed fish indicates that Cd-toxicity causes extensive depletion of glycogen in the ovary.

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