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# TOXICITY STUDY OF SELENIUM IN THE FRESH WATER CAT FISH *Heteropneustes fossilis* (BLOCH) AND THE ROLE OF *Eichhornia crassipes* IN ITS CONTROL

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## ABSTRACT

**Experiments were carried out to study the effect of water plant. *Eichhornia* to control the selenium residues in a fresh water cat fish. *Heteropneustes fossilis* (Bloch) Hundred percent mortality was observed at a concentration of 42 ppm selenium. The $LC_{50}$ value was found to be 26.4 ppm. At a concentration of 6 ppm and below, the fishes survived without any stress. So 6 ppm and below is considered to be the sub-lethal or around sub-lethal concentration. The rate of oxygen consumption decresed by 66.67% in control fishes, raised without plant, while experimental fishes, raised with aquatic plant, showed a drop of 58.99%. The protein content in the muscle tissue of experimental fishes was minimized by 18.29%. The heavy metal selenium accumulation in the muscle tissue of the control fishes was more significant (65.23%) than that of the experimental ones. The loss of energy was also found to be higher (1.35% higher) in the control fishes than that of the experimental fishes raised along with *Eichhornia*.**

**KEYWORDS :** Toxicity study, selenium, control

Among the various environmental pollutants heavy metal and their salts constitute the most widely distributed group of highly toxic and long retained substances, Metalev et al. (1983). Pesticides and metals head the list of environmental pollutants at the moment, which pose a greater potential risk than the entrophicating nutrients and organic wastes (Katz (1975). Environmental pollution by heavy metals is instantly recognised with the Minamata disaster in Japan, where several thousands of people suffered mercury poisoning by consuming the fish caught in Minamata bay, which was the recipient of mercury released from a vinyl chloride plant, between 1953 and 1960 (Smith and Smith 1975). Excess heavy metals are often introduced into aquatic ecosystems as by-products of industrial processes and acid-mine drainage residues.

A review of the environmental effects of selenium indicates that the environmentally importants forms are trivalent and hexavalent selenium Towil et al. (1978). Use of aquatic plants for industrial effluents is a safe treatments (Ekambaranath and Anantha krishnan, 1981). In the background of the above observations, the water plant *Eichhornia* was selected to study its efficiency in controlling common heavy metal selenium in the cat fish *H. fossilis*.

## MATERIALS AND METHODS

*Heteropneustes fossilis* used in the present experiments is a fresh water fish commonly seen in North India. They are found in ponds, pools, lakes and rivers (Ambasht, 1988). It is grant river cat fish. They have smooth, scale body. Fishes were acclimatized in lab conditions for 10 days. The water hyacinth, *E. crassipes* is a free floating hydrophyte. Roots are abundant and long with prominent roots pockets. For the present study, *Eichhornia* were used for reducing the toxicity of the heavy metal selenium in the aquatic environment. Aquatic plants were collected and cleaned with tap water and maintained for about three days in the tank.

At a concentration of 6 ppm, stock selenium solution and below no mortality was observed. Hence 6 ppm concentration was safely used for the experiments. Experiments and control were conducted in triplicate. For control ten uniform sized fishes were introduced into a plastic through containing 10 liters of selenium treated water, but without aquatic plant. In experimental set up. 100 gms of aquatic plant *E. crassipes* were added to the medium. Fresh goat liver pieces were given in excess to the fishes daily between 10 am to 11 am. The medium was changed every 48 hrs. The rate of oxygen consumed by the experimental fish exposed to 1, 2, 3 and 4 weeks was estimated by Winkler's (1948) fodometric method. This was

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compared with that of control. The rate of oxygen consumption is expressed in terms of cc/gm wet wt/hr.

After one week of the experiment, 2 fishes from the control as well as the experimental set up were dissected out in Fish Ringer (Lockwoad, 1977) solution to remove the muscle. The muscle tissue was dehydrated, powdered and stored in polythene bags. In the same way samples were prepared at the end of the second, third and fourth week of experiment. Plant materials (shoot and root) were also collected, dehydrated and powdered. The total protein was estimated using Lowry et al. method. Estimation of micro quantities of total selenium was carried out by colorimetric method developed by Trivedy and Goel (1984 a). The energy content of small quantities of dried samples were estimated by wet combustion method (Karzinkin and Tarkovskaya, 1964). Results obtained in the above experiments were subjected to statistical analysis.

## RESULTS AND DISCUSSION

In the present investigation 42 ppm selenium was found to be the lethal concentration at which 100% mortality occured within 96 hrs. At a concentration of 26.4 ppm of selenium 50% of the fishes died within 96 hrs. The fishes comfortably surrived at a concentration of 6 ppm and below for more then a weeks. Therefore 6 ppm was considered as a sublethal concentration. For experiments, a safe concentration of 6 ppm was to study the Oxygen consumption, total protein content, residual accumulation and caloric value.

At lethal concentration (26.4 ppm to 42 ppm), the fish *H.fossilis* exhibits symptoms of poisoning such as excitation secretion of mucous, loss of equilibrium followed by death (Fig.1). According to Ellis (1937) the industrial effluents, containing varying degree of suspended solids and toxic metals, affect the fish through respiratory and circulatory failures. Therefore, it is believed that in the present instance also, the selenium had affected the fish through the respiratory and circulatory system.

In the respiratory studies, it was observed that the rate of oxygen consumption decreased both in the control (fishes treated with selenium but raised without *Eichhornia*) as well as in the experimental fishes from the first week to the fourth week of the experimental (Fig.2). However, the drop in the rate of oxygen consumption was significantly less (7.68%) in experimental fishes than that of the control. In the present investigation, the experimental fishes showed 58.99% drop in the oxygen consumption from week to fourth week. But the drop was found to be 66.67% in the control fishes raised without the aquatic plant. Thus, it is obvious that the plant *Eichhornia*, introduced into the experimental through, had increased the oxygen consumption to some extent, by way of absorbing heavy metal residue. It is also believed that the aquatic plants may have also increased the oxygen content of the water through photosynthesis.

Another observation made in these experiments is the steady drop of total protein. The protein content of control fishes reduced from 11.48 to 8.52 mg/gm on a dry weight basis. In the experimental fishes it was found to be from 13.83 to 11.30 mg/gm dry weight (Fig.3). Thus the sliding down of protein content is minimized by 18.29% in experimental fishes. Srinivasa et al. (1984) are also of the same opinion that the depletion of protein may be due to it's utilization at the time of high energy demands warranted by altered metabolism because of the toxic stress, in fresh water mussel Pyrroysia rucosa, when exposed to effluents of textile mills. From the present study it is clear that the protein reduction in animal tissue may be due to the diversion of energy to meet the heavy metal accumulation stress. However, the water hyacinth *Eichhornia crassipes* lessened the toxic stress on the fish.

In the present study it was observed that total selenium accumulation in the muscle tissue increased from the first week to the fourth week of experiment, both in the control and the experimental fishes (Fig.4). Accumulation of heavy metal in different animals also supports this results. Mearn and Young (1977) reported the effects of trivalent chromium on marine organism. However, the biological magnification of the residue was more significant in the muscle tissue of the control, raised without aquatic plant. *Eichhornia* than the experimental fishes, raised with the aquaphytes. The waste water treated by simply growing water hyacinth in it for a specific period, was found to contain reduced levels of BOD, COD, solids, nutrients, phenols, pesticides, toxic elements, heavy metals and a number of other pollutants (Gudekar and Trivedy, 1984 b). The floating nature of water hyacinth, its easy availability or easy cultivation, its voracious apetite for nutrients and high growth rate, makes it an ideal candidate for waste water treatment. In the present work, the root tissue of *E. crassipes* was found to contain selenium residue than the shoot tissue.

In the present study the control fish lost 338.017 calories after four weeks of experimental durations whereas, the experimental ones lost 315.483 calories, showing 12.24% and 10.89 loss respectively (Fig. 5). The drop was more significant in the muscle tissue of control than the experimental fishes, treated with selenium but raised with aquatic plant.

Energy flow can be expressed in two ways, i.e. one is the energy incorporated in body tissues, used for maintenance and the other is to find the difference between the energy of food in take and the energy. Therefore it is concluded that 1.35% calories energy conserved in the experimental fish may likely to be due to the presence of fresh water plant, *Eichhornia*.

From the investigation, it is obvious that the toxic nature of total selenium produced lethal effects in fishes at higher doses. Even in sub-lethal concentration it results in degraded metabolic changes, affecting the nutritive value of an animal. Therefore, it may be suggested that the aquatic plant. *Eichhornia crassipes* can be used to control the residual accumulation of heavy metal toxicants in aquatic inhabitants.

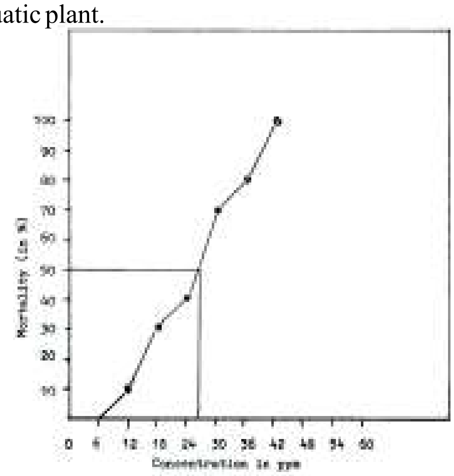


Fig. 1– $LC_{50}$ value of *Selenium* in *H. fossilis*

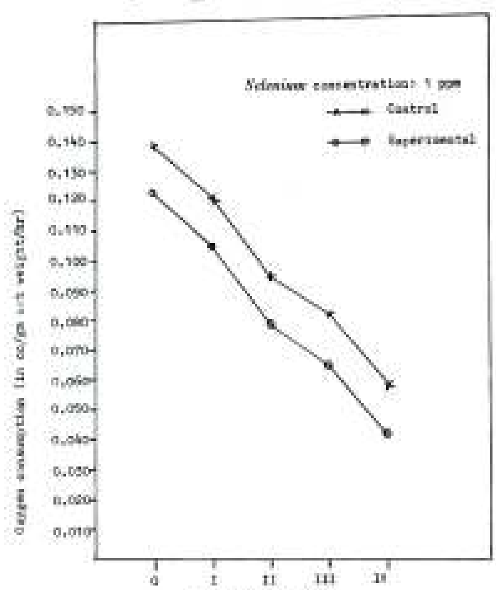


Fig. 2– Rate of respiration in *H. fossilis* treated with *Selenium* but raised with and without aquatic plant, *Eichhornia crassipes*

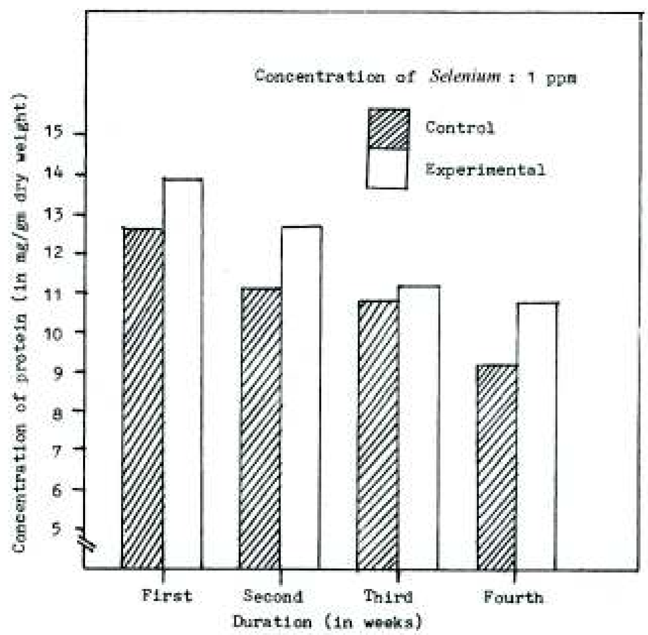


Fig. 3– Total protein content of muscle tissue of *H. fossilis* treated with *Selenium* but raised with and without aquatic plant

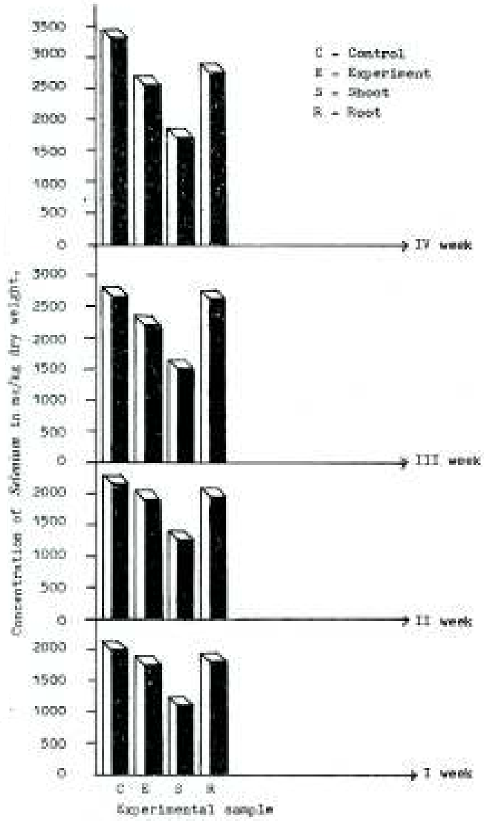


Fig. 4– Accumulation of *Selenium* in the muscle tissue of *H. fossilis* raised with and without *Eichhornia* plant.

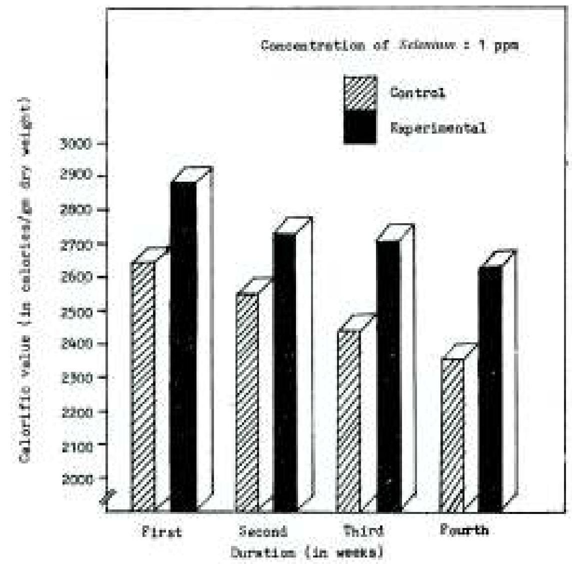


Fig. 5– Effect of *Selenium* residues on the calorific value of muscle tissue in *H. fossilis*.

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