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EFFECT OF SODIUM FLUORIDE ON BODY WEIGHT GAIN AND GONADOSOMATIC INDEX IN FRESHWATER CATFISHES

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ABSTRACT

Present investigation was undertaken to examine the toxic effects of different doses of sodium fluoride on body weight gain and gonadosomatic index (GSI) in freshwater catfishes *Heteropneustes fossilis* and *Clarias batrachus* during different phases of their annual reproductive cycle. Following acclimation 40 fishes of both species were divided into four groups i.e., Group I (control), Group II (1.5mg/L NaF), Group III (2.5mg/L NaF) and Group IV (3.5mg/L NaF). Experiment was continued for 30 days. After completion of experiment body weight gain and gonadosomatic index were computed. Results of ANOVA revealed a statistically significant effect of different doses of sodium fluoride on body weight gain and gonadosomatic index in both species, i.e., *Clarias batrachus* and *Heteropneustes fossilis*, irrespective of phase of annual reproductive cycle. It has also been noticed that as the concentration of sodium fluoride increases body weight gain was decreased. Further, in both *Clarias batrachus* and *Heteropneustes fossilis* male and female GSI were found to decline in most of the groups maintained in different concentrations of sodium fluoride as compared to control group.

INTRODUCTION

Fluorides are widely distributed in the rivers, lakes and seas of the world (Sigler and Neuhold, 1972). In general, fluoride has been suggested as an essential element for sustenance when it is used within optimum range, but its increased or decreased level cause adverse effect on the ecosystem (Semmalar and Nair, 2004).

Several reports documented the toxic effects of elevated fluoride on various aquatic species (Gikunju, 1992; Dwivedi *et al.*, 1997; Camargo, 2003) which may vary with the species. Aquatic life can take up fluoride from both food and water (Camargo, 2003). Fish can accumulate fluoride through the food chain, but few reports have determined the toxicity of dietary fluoride to fish (Yoshitomi *et al.*, 2007).

Aquatic and terrestrial animals take up and accumulate inorganic fluoride from food with the later being more important for fish, marine mammals and wild life than for invertebrates (Hemens and Warwick, 1972; Fleming *et al.*, 1987; Neuhold and Sigler, 1960; Wright, 1977). Fish populations vary widely with respect to their ability to live in specific concentra-

tions of fluorides (Sigler and Neuhold, 1972). The behaviour of aquatic animals, such as salmon migration is affected by high fluoride concentration (Damkaer and Dey, 1989).

The accumulation of fluoride disturbs the metabolic machinery that is interlinked with the structural integrity of cells and tissues and alters the biochemical profile of the exposed organisms (Bajpai and Tripathi, 2010). Deleterious effects of fluoride on biochemical contents in different tissues of fish has also been observed and reported earlier (Kumar *et al.*, 2007). Fluoride ions have been reported to act as enzymatic poisons, inhibiting enzyme activities and ultimately, interrupting metabolic process (FCDSW, 1984). High-fluoride exposure in fish, Acipenser baerii may cause growth retardation, increased activated glycolysis (Camargo, 2003; Kumar *et al*., 2007; Chlubek, 2003) respiratory alterations and violent and erratic movement (Tarazona *et al.*, 1987). Growth inhibition in Siberian sturgeon (Acipenser baerii) has been noticed by Shi *et al*. (2009) in waterborne fluoride.

Present investigation was undertaken to evaluate the toxic effects of different doses of sodium fluoride on body weight gain and gonadosomatic index in freshwater catfishes, *Heteropneustes fossilis* and *Clarias batrachus* during different phases of their annual reproductive cycle.

MATERIALS AND METHODS

Commercially important freshwater catfishes, Heteropneustes fossilis and Clarias batrachus were used as experimental models. The experiments were conducted during different phases of their annual reproductive cycle. Fishes were exposed to various concentrations of sodium fluoride in water (Figure 1).

Body weight gain and gonadosomatic index were estimated and compared with the respective control groups (Figure 1). Results were analyzed with the help of PC based statistical software.

RESULTS AND DISCUSSION

Results of ANOVA revealed a statistically significant effect of different dose of sodium fluoride on both studied variables in *Clarias batrachus* and *Heteropneustes fossilis*, irrespective of phase of annual reproductive cycle.

Body weight gain

Results of Duncan's multiple range test depicted a statistically significant decrease in body weight gain in both *Clarias batrachus* and *Heteropneustes fossilis* maintained in different concentrations (1.5 mg/L, 2.5mg/L and 3.5mg/L) of sodium fluoride in water as compared to control group (Figure 2). It has also been noticed that as the concentration of sodium fluoride increases body weight gain was decreased (Figure 2).

Few recent reports (Achyutha and Piska, 2006; Kumar *et al*., 2007) have documented reduction in tissue protein of fresh water cat fish, *Clarias batrachus*, as a function of time as well as increase in the concentration of fluoride. Further, maximum reduction was observed in muscle (Kumar *et al*., 2007). Camargo (2003), Kumar *et al.* (2007) and Chlubek (2003) worked on *Acipenser baerii* and *Clarius batrachus* and documented that increased fluoride concentration enhance glycolysis which support our findings of decreased body weight gain in fluoride water. Similarly in common carp (*Cyprinus carpio*) weight gain rate and specific growth rate in the fluoride exposed fish decreased as compared with those of the control fish (Chen *et al.*, 2001). Furthermore Fluoride has been suggested to cause adverse effect on the growth of Siberian sturgeon and Anabas testudineus, *Channa punctatus*, *Clarias batrachus*, *Heteropneustes fossilis*, and Chitala ornate (Shi *et al*., 2009). These results also corroborate with our findings.

Gonadosomatic index (GSI) in male

A statistically significant decrease in male GSI was observed in the groups of *Clarias batrachus* maintained in 2.5mg/L and 3.5mg/L sodium fluoride containing water as compared to control group (Figure 3). Further, in *Heteropneustes fossilis* male GSI was found to decline with statistical validation in all the groups maintained in different concentrations of sodium fluoride as compared to control group (Fig. 3).

Gonadosomatic index in female

In both *Clarias batrachus* and *Heteropneustes fossilis* female GSI was found to decline with statistical validation in all the groups maintained in different concentrations of sodium fluoride as compared to control group (Figure 4).

Depletion in total protein, lipid and glycogen content in Clarias batrachus has been reported by Kumar *et al*., 2007. Fluoride interferes with various metabolic activities and alters the levels of protein, lipids, glycogen and cholesterol of *Clarias batrachus* that are important in their physiological activities,

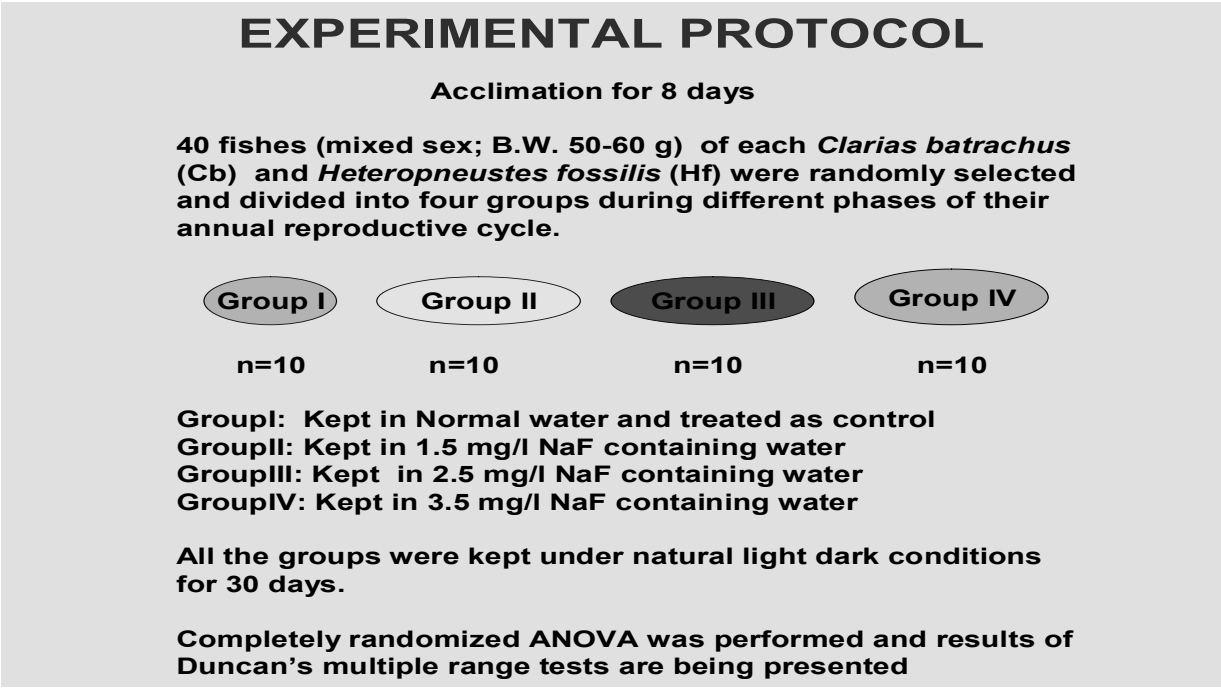

Fig. 1 Experimental protocol

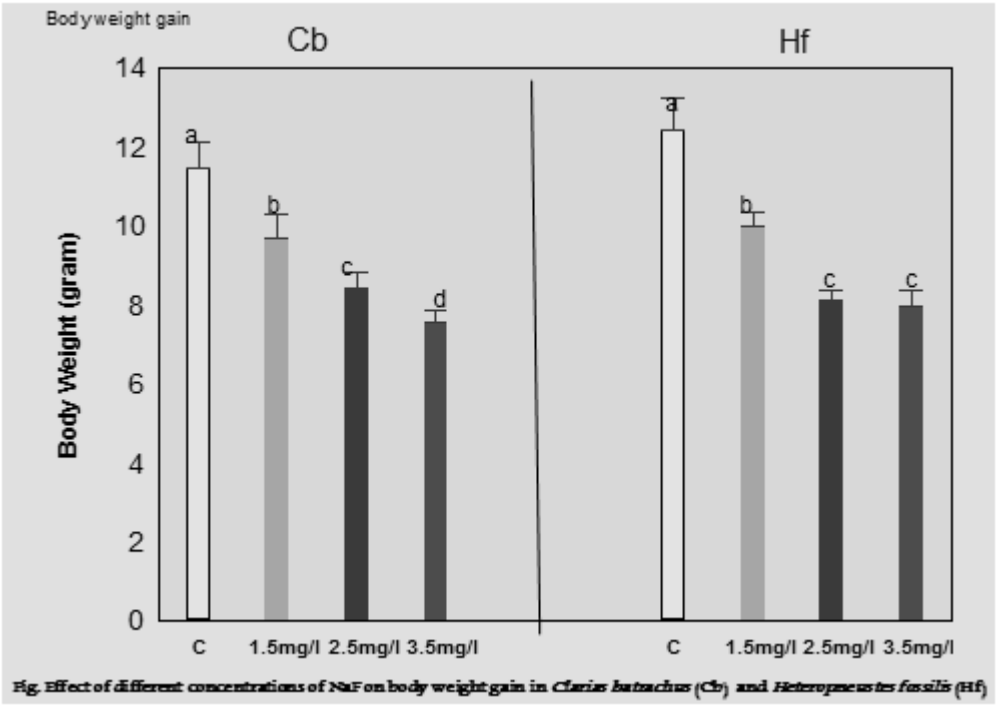

Fig. 2 Effect of different concentrations of sodium fluoride on body weight gain in *Clarias batrachus* (Cb) and *Heteropneustes fossilis* (Hf). Bars with similar alphabets do not have statistical validation (based on Duncan's Multiple Range Test).
C = Control group, 1.5 mg/L, 2.5 mg/L, 3.5 mg/L = Concentration of sodium fluoride in water.

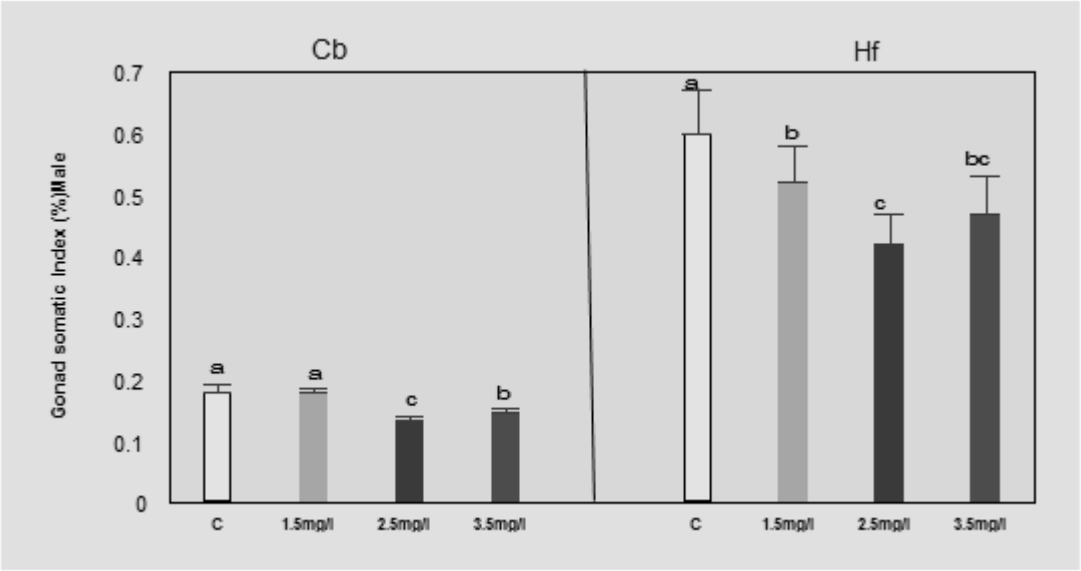

Fig. 3 Effect of different concentrations of sodium fluoride on male gonadosomatic index in *Clarias batrachus* (Cb) and *Heteropneustes fossilis* (Hf). Please see legend to Figure 2 also.

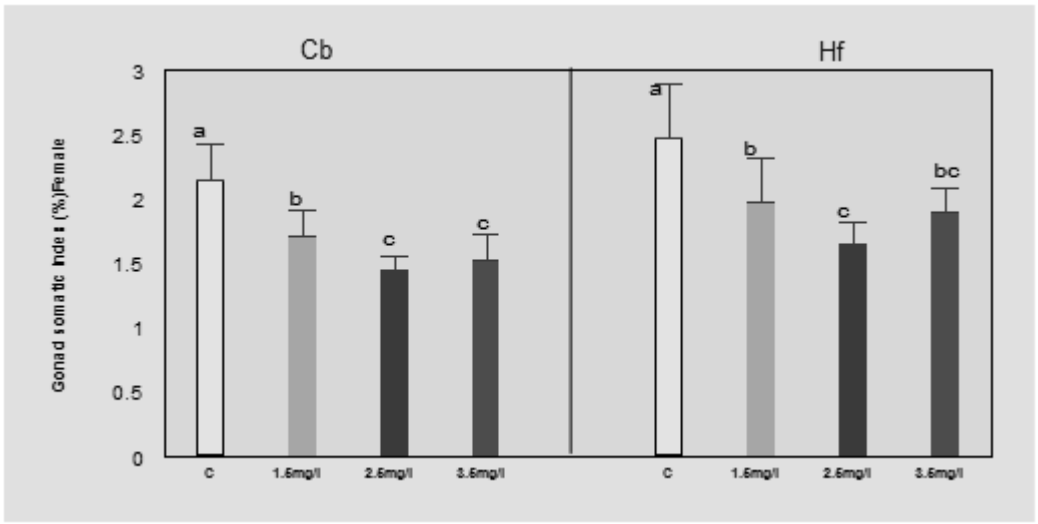

Fig. 4 Effect of different concentrations of sodium fluoride on female gonadosomatic index in *Clarias batrachus* (Cb) and *Heteropneustes fossilis* (Hf). Please see legend to Figure 2 also.

survival, growth and reproduction (Kumar *et al.*, 2007). In addition, high fluoride treatment in gerbil caused earlier puberty than the low fluoride ones (Luke, 1997). In additional, decreased ganosomatic indices noticed by Bharti and Banerjee (2013) on prolonged exposure of Heteropneustes fossilis in toxic water of coal mines. These findings also support our results suggesting fluoride toxicity in aquatic medium.

CONCLUSION

On the basis of present findings it could be concluded that increased fluoride content in water causes adverse effect on fish growth and gonad development.

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