# WATER SCARCITY EFFECTS UPON AMMONIA AND UREA IN BLOOD AND HEPATIC GLUTAMATE DEHYDROGENASE ACTIVITY IN *CHANNA GACHUA* (HAM.)

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**ABSTRACT**

Ammonia is the chief excretory product in fishes. However, non-availability of enough of water in the habitat, may lead to the formation of urea, in fishes. In the present study, the possible role of urea formation to avoid the toxicity of ammonia under water-restricted condition was tested in *Channa gachua*. Circulatory urea and ammonia were estimated in the blood of the fishes and glutamate dehydrogenase activity was measured in the hepatic tissue. From the present study, it is found that blood ammonia in *Channa gachua* showed a decreasing trend from 1st to 10th day and blood urea showed a steady increase during the experimental period. The correlation study between the blood ammonia and blood urea concentrations in *C. gachua* establishes the presence of definite relationship between these two parameters. However, hepatic glutamate dehydrogenase activity showed a fluctuating trend. Presence of high circulatory urea in the experimental fish indicates that ureogenesis may get activated, if the fishes face water-limitation.

**Key words:** *Ammonia, Blood, Ureogenesis, Glutamate dehydrogenase.*

## INTRODUCTION

In fish the general mode of nitrogen excretion is in the form of ammonia diffusing directly to the environmental aquatic media. Ammonia is the end product of protein catabolism and is stored in the body of fish in high concentrations relative to basal excretion rates. It takes a lot of water to dissolve and flush ammonia. Each ammonia molecule carries only one nitrogen (Choudhury and Mahanta, 2013). Ammonia is eliminated from the blood upon passage through the gills (Randall and Wright, 2005). However, under some circumstances as stress or enhanced ammonia level in the surrounding, fishes are reported to change their nitrogen excretion mechanism by forming urea as the end product for nitrogen excretion (Saha *et al.*, 2003). The presence of a functional urea cycle has recently been reported in some Indian air-breathing teleosts (Saha and Ratha, 1987, 1989). Tay *et al.* (2006) reported the transportation of active ammonia and metabolism of excretory nitrogen in the climbing perch, *Anabas testudineus*, during four days of emersion or ten minutes of forced exercise on land. Choudhury and Mahanta, 2013 reported the presence of urea in the blood of *Heteropneustes fossilis*. Anderson *et al.* (2005) reported an increased concentration of plasma and hepatic urea with salinity and suggested a direct correlation between hepatic productions of urea with osmoregulatory strategy of *Carcharhinus leucas*, a euryhaline elasmobranch. Chew *et al.* (2001) reported decrease in ammonia and urea excretion, with aerial exposure, in *Misgurnus anguillicaudatus*, and suggested very high levels of accumulated ammonia in the muscle and liver.Glutamate dehydrogenase (GLDH) is an important enzyme, linking nitrogen elimination with utilization of amino acid carbons for energy metabolism. NAD-linked glutamate dehydrogenase catalyzes the major, but not sole, pathway for generation of ammonia from glutamate. In liver, excessive glutamate dehydrogenase activity results in increased ammonia production. Cammaerts and Jacobs (1984) suggested that NADH-glutamate dehydrogenase was involved in the detoxification of high nitrogen levels. The endogenous ammonia production in different fishes has a significant role in glutamate catabolism (Lim *et al.*, 2001; Hirata *et al.*, 2003). The activity of NADP-GLDH increases 2-4 times in the mitochondria and practically ten times in the cell cytoplasm of the fish muscle and liver. The established regularity is considered as the adaptation of hydrobionts to the changes of ecological conditions of dwelling (Hrubinko and Iavonenko, 1993). Hence the present study is aimed at finding the

importance of ureogenesis in tackling the water shortage in the habitat of *Channa gachua*. The findings of the present study suggested the possible involvement of urea cycle in *Channa gachua* to tide over water-shortage.

## MATERIALS AND METHODS

The experimental and control fishes were maintained in separate aquarium of 15 litre capacity to 15 days for acclimatization. The water level were maintained in control fishes with daily 1litre reduction in aquarium contain experimental fishes. Every day, one fish from one aquarium was sacrificed for the experiment. The experiment was continued till tenth day with one fish withdrawal for estimation of Blood urea, blood ammonia and hepatic glutamate dehydrogenase activity. The collected blood was centrifuged and the serum was collected for ammonia and urea analysis. The liver tissue from the normal and experimental fishes was weighed and homogenized using distilled water. The homogenized tissue was centrifuged and the supernatant was used for enzyme assay.

Ammonia was estimated by following the method of Anken and Schiphorst (1974). Urea was estimated by following Crest Biosystems Modified Berthelot method by Fawcett and Scott (1960).

Glutamate dehydrogenase activity was determined by following the method of Dohertry (1970).

## RESULTS AND DISCUSSIONS

There mean value of metabolites and enzyme showed alteration, when water level simultaneously reduced during study period. The fish density maintained 10/litre through use of container which resulted in given table.

**Table 1: Mean value of Blood ammonia and Blood urea (mg/dl) and GLDH activity (U/ mg) in control and experimental fishes**

| | Days | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Values | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Blood ammonia | 13.70 | 13.20 | 12.10 | 11.24 | 10.70 | 10.02 | 9.10 | 8.04 | 7.20 | 6.15 |
| Blood Urea | 20.52 | 21.18 | 22.06 | 22.62 | 23.30 | 24.42 | 25.10 | 26.30 | 28.10 | 30.11 |
| Hepatic GLDH | 11.10 | 8.50 | 4.84 | 6.10 | 8.12 | 8.68 | 10.36 | 10.12 | 6.18 | 8.15 |

Fishes, though ammonotelic, are reported to change their nitrogen excretion mechanism by forming urea as the end product for nitrogen excretion, during water-restricted conditions (Saha *et al.*, 2003). Activity of glutamate dehydrogenase is influenced by the factors producing the transition from one type of excretion to the other (Choudhury and Mahanta, 2013). In the present study, changes in the activity of hepatic glutamate dehydrogenase in *Channa gachua* is tried to probe with monitoring the circulatory urea and ammonia. The blood ammonia in *Channa gachua* showed a steady decrease with duration of experimental period (Fig.1) suggesting significant decrease in ammonia concentration in blood which is dependent on duration of exposure to experimental condition. The blood urea level however showed a steady increase (Fig. 2).

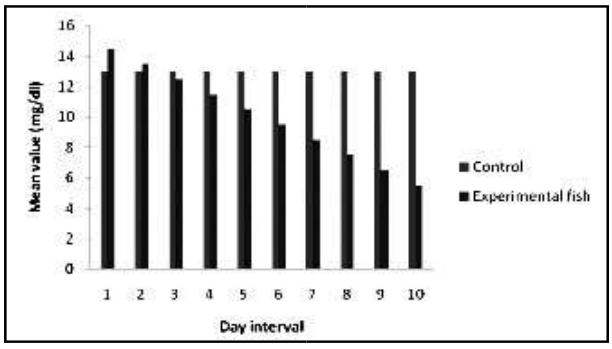


**Fig.1: Mean ammonia (mg/dl) in Channa gachua blood during experimental period**

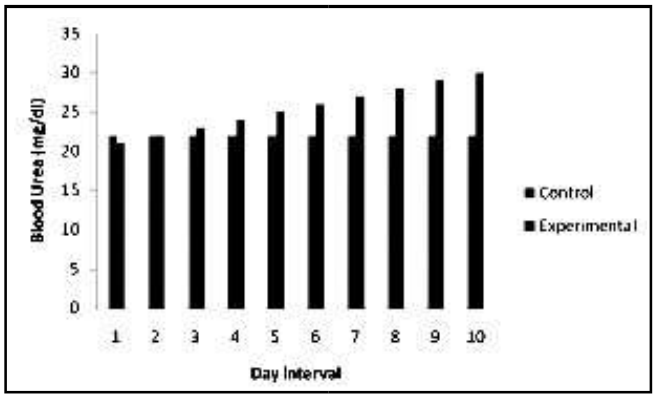


**Fig. 2: Mean Blood Urea (mg/dl) in Channa gachua blood during experimental period**

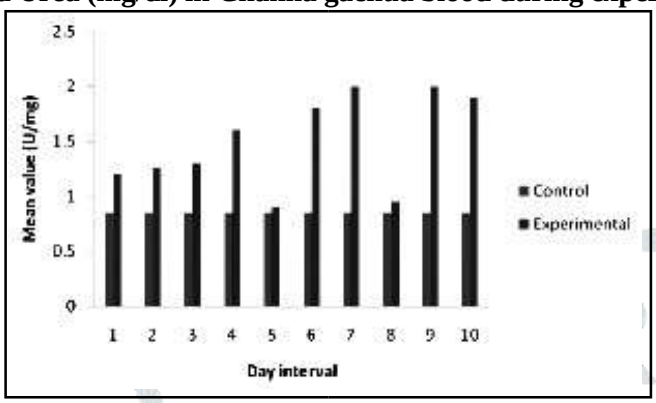


**Fig. 3: Mean GLDH (U/mg) in Channa gachua blood during experimental period**

However, in the present study, daily fluctuation in the glutamate dehydrogenase activity was reported in the experimental fishes. In *Channa gachua* the fluctuating glutamate dehydrogenase activity results in a gradual increase in activity with increase in number of days of experiment. (Fig.3).

## CONCLUSION

From the present study, the determination of circulating nitrogen status in the form of blood ammonia and urea and their relationship with hepatic glutamate dehydrogenase (GLDH), it has been observed that blood ammonia and urea are interrelated with each other with certain degree of variation and the relationship is not so prominent in the experimental *C. gachua*. However, it

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