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EFFECT OF STARVATION ON THE CORTISOL LEVEL OF FISH *GARRA GOTYLA GOTYLA*

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ABSTRACT
To evaluate the effect of starvation on serum cortisol level of fish *Garra gotyla gotyla,* fishes were starved for a period of 9 weeks. An increment in the levels of cortisol of starved fishes was recorded for initial 5 weeks and thereafter a decline was observed in their values. Even though cortisol witnessed a decline in its titre after 5th week of experiment yet it never got restored to its basal level till the end of experimental period (9th week) and always remained higher than control values.

Key Words: *Garra gotyla gotyla*, Cortisol, Starvation

INTRODUCTION

Hormones play a central role in the regulation of growth and nutrient utilization in fish and it is also known that endocrine system of fish is sensitive to alteration in nutrient uptake. Cortisol being one of the major catabolic stress hormones is postulated to increase the levels of glucose as well as activates several glycogenolytic enzymes in hepatocytes to compensate the increased demand of the energy under the stressful condition (Mommsen *et al*., 1999). Additionally, cortisol may increase the gluconeogenic activity in the liver and promote the release of gluconeogenic precursors from protein and lipid stores within body (Fujiwara *et al*., 1996 and Vijayan *et al*., 1997). The release of cortisol hormone is dependent on such factors like starvation, stocking density, reproduction, physical and chemical properties of water as well as the pollutants present in it (Pickering *et al*., 1982; Sumpter *et al*., 1986; Mommsen *et al*., 1999; Pottinger *et al*., 2000; Chen *et al*., 2003). Both in nature and in aquaculture, fishes could experience periods of food deprivation or starvation. Data about the effects of fasting on cortisol level in different groups of fishes *Onchorhynchus mykiss* (Sumpter *et al*., 1991) and Rhamdia quelen (Barcellos *et al*., 2010) are inconsistent, from no effect of starvation to a decrease or increase in cortisol level in response to starvation. Since the effects are species specific and moreover also bears a relation with age/ stage/ sex etc. therefore the present work is aimed to evaluate the effect of starvation on serum cortisol level of fish *Garra gotyla gotyla* in response to starvation.

MATERIALS & METHODS

Adult specimens of *Garra gotyla gotyla* were collected with the help of cast net from Jhajjar stream a tributary of Chenab (J&K), India and were brought live to the laboratory. Fishes were acclimatized in laboratory conditions for a fortnight and during this period they were fed with natural diet. Experimental fishes were then divided into two groups control and starved ones. Control fishes were fed regularly with natural diet, no food was given to starved fishes and sampling was done at weekly intervals. Blood was taken from the heart of the fish with non heparinized syringe, collected in plastic Eppendrof tubes. After centrifugation, blood plasma was removed and the samples were then analyzed for measuring the levels of cortisol by Radioimmunoassay following the methodology adopted by Tort *et al*. (1998). The data was statistically analyzed by using SPSS 17 version.

RESULTS

Changes in cortisol levels of fish *Garra gotyla gotyla* exposed to starvation is depicted in Table 1. Data obtained clearly reveals that compared to controls, starved fishes exhibit a significant increase ($P<0.01$) in cortisol levels upto 5th week only and hereafter a significant decline in its values was observed till the end of experimental duration of nine weeks. It is also clear from the data that cortisol hormone though witnessed a decline in its titre after 5th week of experiment yet it never reached to its basal level and always remained higher than control values.

TABLE 1: The level of cortisol (ng/ml) in blood serum of *Garra gotyla gotyla* exposed to starvation for an experimental period of nine weeks.

Time Interval	Cortisol
Control	115.0±0.84
1st week	125.5±0.25
2nd week	138.0±1.20
3rd week	146.5±0.38
4th week	175.2±1.54
5th week	210.5±0.86
6th week	172.0±0.46
7th week	158.3±1.24
8th week	140.0±0.78
9th week	124.5±0.69

DISCUSSION

Review of literature reveals that there are three different schools of thought regarding the hormonal response (cortisol) of fishes to starvation. According to workers like Kelly *et al*. (2001) (representing first school of thought)

there is an increase in the titre of cortisol in fishes following an exposure to starvation whereas Farbridge and Leatherland (1992) and Holloway *et al*. (1994), who supported second school of thought reported a decline in the values of cortisol during the entire period of starvation. Still others like Sumpter *et al*. (1991), Bloom *et al*. (2000), Peterson and Small (2004) and Barcellos *et al*. (2010) advocate a third school of thought reporting a mixed response to starvation and held that initial increase in titre of cortisol in starved fishes is followed by decline during the later period of their experiments. The possible reason for difference in cortisol response by starved fishes, they attributed, is the feeding status of fish in unstarved conditions. Present results on effect of starvation on cortisol hormone when seen in light of above discussion where an initial increase in level of cortisol upto 5th week has been followed by a decline till end of 9 week of experimental duration appears to conform to and support the third school of thought. Present author therefore, upholds that fish *Garra gotyla gotyla* seemingly depict a mixed response to cortisol under stress of starvation. Fishes have been reported by Johnstone *et al*. (2004) to respond to prolonged period of starvation by producing cortisol hormone which they held is probably a primary response to cater stressful condition of starvation. Cortisol hormone so produced stimulates the secretion of glucose by various processes *viz.* 1) glycogenolysis and 2) gluconeogenesis, to meet the increased energy demand created by stress of starvation. Primary function of cortisol as stated by Barton (1997) is the production of glucose which they held is recognized as secondary response in starved fishes. Presently also fish *Garra gotyla gotyla* has been observed to respond to starvation by producing cortisol hormone that may possibly results in the secretion of glucose as secondary response. Increment in level of cortisol, present author proposes seems to be a strategy on the part of fish to create hyperglycemic conditions by liberation of more and more glucose to cope with periods of food deprivation. Present view point gets corroborated by the findings of Sheridan and Mommsen (1991) and Gamperal *et al*. (1994) who also reported hyperglycemic response by starved fishes by producing cortisol hormone and proposed it to be an effort on the part of fish to meet energy demand created due to starvation like conditions.

Data further reveals that cortisol exhibit a decline in its titre from 5th week onwards to the end of experimental period. Present author proposes that starvation like condition in *Garra gotyla gotyla* for considerably longer period of time lead to exhaustion of endocrine system as was also witnessed under stress of metal manganese (Gupta *et al*., 2012). Therefore a suppressed cortisol response by fish *Garra gotyla gotyla* after 5th week is considered to be result of a down regulation of the hypothalamus pituitary interrenal axis (HPI), a system responsible for secretion of cortisol by continual feed back by present author. To strengthen above view point a direct support can be taken from the findings of Hontela *et al*. (1992) who also advocated exhaustion of endocrine system in fishes following an exposure to metal. Similar to present view point they also held down regulation of HPI axis through negative feedback that finally results in lower secretion of cortisol by HPI system. Hence decrease in titre of cortisol is justified.

CONCLUSION

Thus it can be inferred from above results and discussion that alterations in ration level (including food deprivation) influence the metabolic hormone in general and cortisol in particular.

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