ORIGINAL RESEARCH PAPER

Biological Science

EFFECT OF THYROXINE ON EGG HATCHABILITY AND DEVELOPMENT IN BETTA SPLENDENS

KEY WORDS: Thyroxine, Egg hatchability, B. splendens

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ABSTRACT

Thyroxine concentrations increased the egg hatchability upto 0.005 ppm T4 and thereafter it significantly ($P < 0.05$) declined. High concentration of T4 (0.02 ppm) interfered the per cent hatchability of eggs. Development of gut, free rotation of eye, mouth opening, melanophores and emergence of anal and pectoral fins were earlier in B. splendens hatchlings treated in 0.005 ppm T4 as compared to other treatments. It suggests that, exogenous supply of thyroxine hormone at a required concentration is essential for the fast embryonic development and to fulfil the imbalance of maternal hormones in the eggs.

INTRODUCTION

The hormone thyroxine is primarily responsible for regulation of metabolism. It acts on every cell in the body and is essential for proper development and differentiation of all cells. According to Lam (1984), thyroxine has enhanced the larval survival, growth and development in *Sarotheroden mossambicus.* The change in their body shapes leads to the allometric growth patterns. But under unfavourable developmental conditions, the changes also lead to structural defects affecting the growth and survival of larvae and young fishes. These defects may be due to low levels of thyroxine which involved in the regulation of fish larval development, promotion of growth, survival and control of metamorphic process at early stages of development (Lam, 1994). Previous studies elicited the anabolic effects of thyroxine on many fish species (Brown *et al.,* 1988; Brown and Millward, 1983; Reddy and Lam,1991) and there is paucity of information on the effect of thyroxine on the fry and larva of *Betta splendens.* Hence, the present investigation has been undertaken to study the effect of thyroxine on embryonic development andmorphometric aspects in *B. splendens* fry.

MATERIALS AND METHODS

In order to study the egg development and yolk resorption, healthy and matured 15 pairs of males and females were selected from the stock and reared the male and female in the ratio of 1:1 in a plastic container containing in 5 *l* water (capacity of 10 *l*). After spawning, the brooders were emoved and subsequently the chosen concentrations of T4 (0, 0.001, 0.005, 0.010, 0.020 ppm) were added and provided the mild aeration on the opposite corner of eggs deposited for uniform mixing of thyroxine. Triplicates were maintained for each concentration. Samples of eggs before fertilization and subsequently at 30 minutes intervals were also taken for further studies. Descriptions of the developing stages were recorded on the basis of the examination of live specimens under a compound microscope and photomicrographs were taken using cyber-shot camera.

RESULTS

Egg hatchability and development

The number of egg hatched and per cent egg hatchability were high in eggs subjected to 0.001 and 0.005 ppm T4 followed by 0.01 ppm T4 and control treatments (Table 1). The egg hatchability did not show significant ($t = 0.89$; $P > 0.05$) difference between 0.001 and 0.005 ppm T4; but they were statistically significant in eggs treated with 0.01 ppm T4($t = 12.20$; $P < 0.01$) and control ($t = 24.94$; $P < 0.01$). However, the egg developments were totally ceased in 0.02 ppm T4 (Table 1). The various developmental (yolk resorption, eye rotation, formation of mouth, pectoral fin, anal opening and mealnophores) and morphometric (diameter of mouth, yolk length and diameter and length of hatchlings) characters of hatchlings were quickly formed in hatchlings subjected to 0.001 and 0.005 ppm T4 followed by 0.01 ppm and control (Table 2; Plates 1 – 2). For instance, yolk resorption was very quick and within 33 - 35 hrs in hatchlings treated with 0.005 and 0.001 ppm T4 and it significantly extended to 59 and 66 hrs in hatchlings treated with 0.01 ppm T4 and control respectively. The complete yolk resorption was 2 times faster in hatchlings treated with 0.001 and 0.005 ppm than those treated with control (Table 2). Further, significant decrease in yolk length ($t = 8.70$; $P < 0.01$) as well as yolk diameter ($t = 3.33$; $P < 0.05$) in eggs treated with 0.005 ppm as compared to control. Similar trend was obtained in other developmental and morphometric characters also. A significant increase in total length ($t = 2.33$; $P < 0.05$) and caudal fin length ($t = 3.33$; $P < 0.05$) of were observed in hatchlings treated with 0.005 ppm T4 as compared to control. However, all the developmental parameters were stopped in hatchlings treated with 0.02 ppm T4 (Table 2 and Plate 1 and 2).

DISCUSSION

The present study revealed that, thyroxine concentrations increased the egg hatchability upto 0.005 ppm T4 and thereafter it significantly ($P < 0.05$) declined. High concentration of T4 (0.02 ppm) interfered the percent hatchability of eggs. The appropriate levels of thyroxine promoted egg viability and hatchability whereas, higher levels of thyroxine (0.1 ppm) is detrimental in *Cyprinus carpio* (Lam and Sharma, 1985). Similar observations are also shown by Tay *et al.* (1997) in greasy grouper and Nayak *et al.* (2000a, b) in *Catla catla* and *H. fossilis* respectively. Thyroxine accelerated hatching in *Coho salmon* (Dales and Hoar, 1954) suggesting that thyroxine may stimulate embryonic development and / or the hatching mechanism in some fish. Yolk length and yolk diameter of *B. splendens* hatchlings were less in T4 treatments compared to control suggesting that the thyroid hormone stimulated the early embryonic larval development in *B. splendens* by accelerating the metabolism which speeded up yolk utilization. Short term thyroxine exposure of *O. massambicus* (Nugegoda and Lam, 1994) and *A. testudineus* eggs (Nayak and Thomas, 2000) resulted the fast yolk absorption. Development of gut, free rotation of eye, mouth opening, melanophores and emergence of anal and pectoral fins were earlier in *B. splendens* hatchlings treated in 0.005 ppm T4 as compared to other treatments. It suggests that, exogenous supply of thyroxine hormone at a required concentration is essential for the fast embryonic development and tofulfil the imbalance of maternal hormones in the eggs. The exogenous hormone supply is necessary for the improvement of metamorphic events such as formation of nervous system, gastrointestinal tract differentiation, swim bladder formation etc. (Nayak *et al.,* 2003a) supports the present investigation.

CONCLUSION

The present study concludes that , 0.005ppm T_4 was most suitable for enhancing the egg hatchability and early development in *B. splendens*

Table 1.Effect of thyroxine on hatching rate of eggs in *Betta splendens*. Each value is the mean (X ± SD) performance of three observations.

Thyroxine concentrations (ppm)	Total no. of eggs laid	No. of eggs hatched	No. of unhatched eggs	Per-cent hatching
0	361.67 ± 12.58	325.00 ± 10.00	36.67 ± 2.89	89.87 ± 0.49
0.001	351.67 ± 12.58	350.33 ± 12.06	1.33 ± 0.58	99.62 ± 0.15
0.005	356.67 ± 4.02	355.67 ± 3.51	0.67 ± 0.58	99.82 ± 0.28
0.010	351.67 ± 7.64	333.67 ± 5.13	18.0 ± 2.0	94.88 ± 0.50
0.020	352.33 ± 7.02	Nil	352.33 ± 7.02	Nil

Student's t test: Per-cent hatching

0.005 ppm Vs 0.001 ppm : t = 0.89; P > 0.05
0.005 ppm Vs 0.010 ppm : t = 12.20; P < 0.01
0.005 ppm Vs 0 ppm : t = 24.94; P < 0.01

Table 2. Effect of thyroxine concentrations on development and morphometry of hatchlings in *Betta splendens*. Each value is the mean X ± SD) performance of three observations.

Time of development and morphometry	Thyroxine concentrations (ppm)				
	0	0.001	0.005	0.010	0.020
Development of hatchlings (h)					
Yolk resorption	66.00 ± 6.00	35.0 ± 1.73	32.33 ± 0.58	59.00 ± 2.61	Development stopped
Mouth	50.33 ± 4.04	17.33 ± 1.15	16.00 ± 1.00	52.00 ± 4.00	- Do -
Emergence of pectoral fin	47.33 ± 0.58	18.01 ± 1.65	15.33 ± 0.58	33.33 ± 1.15	- Do -
Anal opening	50.33 ± 12.15	15.00 ± 2.00	15.67 ± 1.15	60.0 ± 2.00	- Do -
Gut	54.67 ± 3.06	40.67 ± 1.15	36.67 ± 1.15	52.67 ± 2.31	- Do -
Melanophores	70.02 ± 2.08	18.33 ± 0.58	6.67 ± 1.15	20.33 ± 1.05	- Do -
Morphometry of hatchlings (mm)					
Diameter of mouth	0.025 ± 0.00	0.035 ± 0.00	0.035 ± 0.00	0.025 ± 0.00	- Do -
Yolk length	0.10 ± 0.013	0.08 ± 0.003	0.08 ± 0.003	0.10 ± 0.006	- Do -
Yolk diameter	0.07 ± 0.003	0.06 ± 0.003	0.06 ± 0.003	0.07 ± 0.003	- Do -
Total length of hatchling	0.35 ± 0.043	0.42 ± 0.016	0.42 ± 0.005	0.40 ± 0.006	- Do -
Caudal fin length of hatchling	0.01 ± 0.003	0.02 ± 0.000	0.02 ± 0.003	0.02 ± 0.000	- Do -

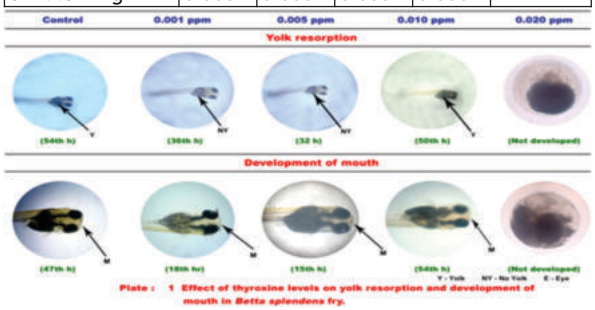

Plate : 1 Effect of thyroxine levels on yolk resorption and development of mouth in *Betta splendens* fry.

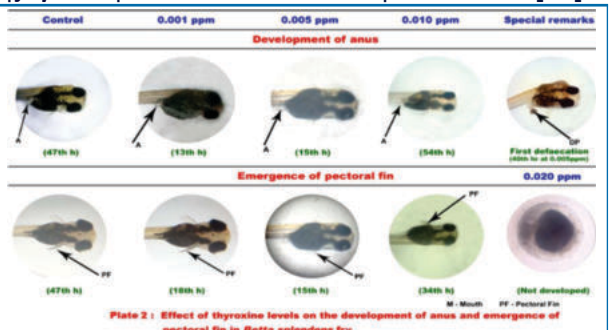

Plate 2 : Effect of thyroxine levels on the development of anus and emergence of pectoral fin in *Betta splendens* fry.

Students 't' test : 0Vs 0.005 ppm at hatching

Yolk length : t = 8.70; P < 0.01
Yolk diameter : t = 3.33 ; P > 0.05
Total length : t = 2.33; P < 0.05
Caudal fin length : t = 3.33; P < 0.0

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