



EFFECT OF SALINITY ON GROWTH AND SURVIVALITY OF LABEO ROHITA IN CAPTIVITY

Agricultural Science

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ABSTRACT

Present experiment was conducted to study comparative growth performances of rohu, *Labeo rohita* (Cypriniformes: Cyprinidae) juveniles in different salinity conditions including freshwater systems. Six uniform-sized (80 L capacity) rectangular glass aquaria (experimental tanks) were used for the purpose. Salinity in experimental units was maintained from 0 to 6.5 ppt by mixing desired saline water with freshwater from deep bore-well. In total, 300 rohu juveniles were purchased from a private hatchery, stocked in a cemented tank (CT) filled with freshwater after giving a dip bath in 0.5% KMNO₄ as a quarantine measure. After completion of 24 hours of stocking, saline water was added in the CT to raise the salinity up to 0.5 ppt and the juveniles were kept there for another 24 hours. Subsequently, juveniles were transferred to experimental tanks and each was stocked with 40 specimens. Every alternate day, salinity of the tanks was recorded and adjustment was made by adding fresh/ saline waters as per the requirement. After completion of 20 days and 40 days of rearing, body weights were recorded. All the results were compared. The finding of the study reveals that normal growth was observed in salinity level 0 to 3.8 ppt, and was significantly affected in higher salinity. Therefore, it is resulted from the study that rohu juveniles can adopt gradual increase in water salinity at < 4 ppt and also perform well in their growth.

KEYWORDS

Labeo rohita, juvenile rearing, low salinity, growth.

INTRODUCTION

Fish is a major source of animal protein, essential minerals, vitamins and un-saturated fats (Javed, 1988). In India, fish constitutes Carp culture is the mainstay in Indian freshwater aquaculture and its practices have been found to be compatible with other farming systems. Among carps, Indian major carps, Catla (*Catla catla*), Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus cirrhosus*) possess culture importance due to their larger size, faster growth, market demand and are being cultured extensively all over the country including low salinity affected areas. *Labeo rohita* (Cypriniformes: Cyprinidae) is commonly known as 'Rohu', is well distributed in rivers of India and also throughout freshwater bodies of South Asia. This is recognized as an important fish species that possesses the potential to contribute significantly to the total production when cultured along with other IMC species.

In India, semi-intensive or extensive carp polyculture is a traditional practice and more than one species of IMC are cultured in a single pond. Higher productions are generally achieved in all forms of polyculture rather than monoculture (Wahab *et al.*, 2001). This is because with different feeding habits, the reared fish species can minimize the inter-specific and intra-specific competitions for the food available at various levels or zones in the pond and utilize the available natural food at different niches in the system more effectively for optimum growth. According to Halver (1984), polyculture may produce expected results if fish with different feeding habits are stocked in proper ratio and combination.

Under both natural and aquaculture conditions, a number of biotic and abiotic factors influence the growth of IMCs, where salinity or saline environment can potentially act as a stressor (Islam *et al.*, 2014). Salinity is one of the most important environmental factor, that regulates not only growth and survival of fish (Garcia *et al.*, 1999; Mateen *et al.*, 2004; Islam *et al.*, 2014) but also plays vital role in variability of biochemical parameters of fish (Lisboa *et al.*, 2015).

Salinity is considered as a limiting factor for the survival and growth of freshwater fish species like Catla, Rohu and Mrigal. The fringe areas of western and north-western side of Chilika Lake (the largest brackish water lagoon on the east coast India), are being used for carp farming in dugout ponds wherein the annual salinity level fluctuates from a minimum of 0.05 ppt to as high as 5 ppt with no sustainability in carp production. Under such culture conditions, information on the impact of salinity levels on carp growth is very relevant to the farming

community for information on the growth potential of IMC, particularly for *Rohu*, in low saline waters. Therefore, an experiment was conducted using the carp species *Labeo rohita* to record its growth and survival under different low saline environments.

MATERIALS AND METHODS

The experiment was conducted in six rectangular glass aquarium sized 50 cm x 40 cm x 40 cm of 80 liters capacity. All the experimental units (glass-aquaria) were cleaned properly before stocking of seeds. To make the freshwater of experimental units to saline (as per requirement), brackish water was collected from the mouth area of Chilika Lake using in 20 l glass jars by boat three days prior to stocking. First glass-aquaria or experimental unit (Control or A0) was filled with freshwater (60 l) collected from a deep-bore-well. Other five glass-aquaria were filled with calculated quantity (60 l) of collected brackish water manually and the salinity was adjusted to 0.2 ppt (Treatment-1 or A1), 1.6 ppt (Treatment-2 or A2), 3.5 ppt (Treatment-3 or A3), 4.5 ppt (Treatment-4 or A4) and 6.5 ppt (Treatment-5 or A5) by addition of desired quantity of aged bore-well water under vigorous aeration. Another cemented tank (CT) was used to serve as acclimatization unit (capacity of 250 l). The tank was filled with freshwater of aged bore-well water three days before procurement test species.

Total of 300 rohu (*Labeo rohita*) juveniles were purchased from a private hatchery, brought to the experimental site in oxygen packed polythene bags and stocked in the CT after giving a dip bath in 0.5% KMNO₄ as a quarantine measure. After completion of 24 hours of stocking in freshwater, collected brackish water from Chilika was added in the CT to raise the salinity up to 0.5 ppt under strong aeration and the juveniles were kept for another 24 hours before they were transferred to experimental tanks (A1 to A5). Each experimental tank was stocked with 40 juveniles. The salinity of each tank was monitored daily with a DKK-TOA made water quality checker (Model-WQC-ZZA) and salinity was maintained with addition of fresh water. Ambient temperature too was recorded daily at 10-11 am. Water volume was maintained during the experimental period using premixed saline water of equal salinity in each experimental tank. Commercial feed (first 20 days: 0.5 mm meshed, protein- 41%, fat-6%; second 20 days: 0.6 mm meshed, protein- 36%, fat- 6%) available in the local market was used and provided to the test carp juveniles at 10% of average body weight twice daily during morning and evening hours. The experimental units were cleaned by siphoning out the unutilized feed and faecal matters daily on priority basis. Survival rate

of the juveniles was also checked every day. To register the gross weight gain under different salinity levels, body weight were recorded by an electronic balance (Precisa, XB 320 M) respectively at 20th day and 40th day of rearing. Data generated was processed to record the growth performance.

RESULTS

The detail results in terms of growth performance (weight gain) in 20th day and 40th days of rearing are summarized in Table 1. During the whole 40 days of experiment, the ambient temperature in the experimental tanks was ranged between 24.7°C to 27.2°C.

Table 1. Details of growth performance of rohu juveniles under different salinity conditions

Experiment al code	Salinity (ppt)	Mean weight±SD		
		Initial	At 20 th Day	At 40 th Day
A0	0	0.24±0.07 (0.12-0.34)	1.04±0.23 (0.34-1.54)	2.11±0.22 (1.29-3.87)
A1	0.2-0.3	0.23±0.07 (0.12-0.35)	0.94±0.26 (0.29-1.34)	1.96±0.19 (0.98-3.37)
A2	1.6-1.9	0.23±0.06 (0.12-0.36)	0.91±0.19 (0.51-1.24)	1.83±0.22 (0.91-3.51)
A3	3.5-3.8	0.23±0.06 (0.13-0.38)	0.88±0.16 (0.62-1.32)	1.66±0.19 (0.98-3.33)
A4	4.5-4.9	0.23±0.05 (0.12-0.35)	0.76±0.21 (0.51-1.21)	1.51±0.17 (0.84-3.26)
A5	6.5	0.24±0.07 (0.12-0.36)	0.77±0.28 (0.56-1.27)	No fish survived

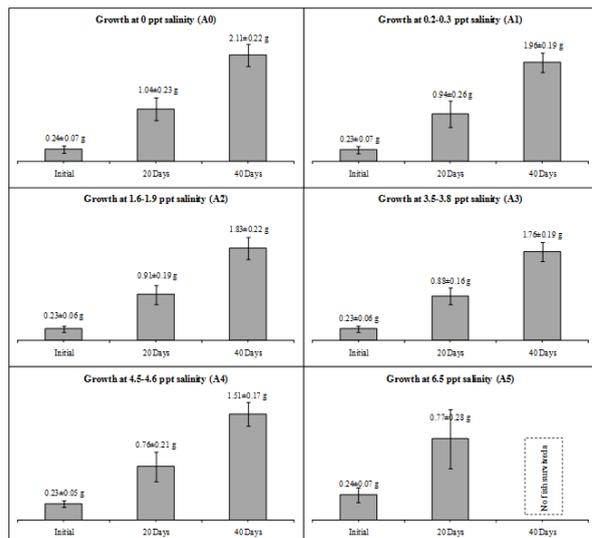
Body weight in gram and weight range in bracket

Values bearing same superscripts in the same row are not significantly different, p>0.05

In A0 (Tank as control), water salinity was ranged from 0.2 ppt to 0.3 ppt. Initial mean size of the juveniles at stocking was 0.24±0.07g while their size ranged from 0.12g to 0.34g. At 20th day of rearing, mean size of the juveniles was 1.04±0.23g. Similarly, the mean size of juveniles at 40th day of stocking was found to be 2.11±0.22g (Table 1).

In A1, initial mean size of the juveniles at stocking was 0.23±0.07g which was grown to 0.94±0.26g at 20th day and 1.96±0.19g at 40th day of rearing (Table 1). Similarly, in A2, initial mean weight of the juveniles was 0.23±0.06g. After 20 days of rearing, the juveniles had grown to the mean weight of 0.91±0.19g. The mean weight of juveniles after 40 days of rearing was found to be 1.83±0.22g (Table 1). In A3, mean body weight of juveniles at stocking was 0.23±0.06g which grown to 0.88±0.16g and 1.66±0.19g after 20 days and 40 days of rearing. Similarly, the juveniles of 0.23±0.05g in A4, grown up to 0.76±0.21g after 20th days of rearing and finally to 1.51±0.17g after 40 days of captive management (Table 1).

Fig. 1. Growth performance of rohu juveniles under different salinity conditions in 20 days and 40 days of rearing



At high salinity (6.5 ppt), the juveniles of 0.24±0.07g grown to 0.77±0.28g after 20 days of rearing but the juveniles found alive after 20 days was only 18. Mortality was continued in the tank and the last juvenile was survived till 33rd day. First mortality in the tank was noticed at 3rd day. Therefore, mean weight at 40 days was not included.

In comparison of all the unit treatments, the rohu juveniles shown remarkable growth in 0 ppt, whereas, the values gradually decreased with increase in salinity concentrations. In both cases (20 days and 40 days), growth performances was found decreasing as salinity increases (Fig. 2). The rate of growth in first 20 days was slower than the next 20 days of rearing.

Fig. 2. Comparative growth performance of rohu juveniles at different salinity concentrations

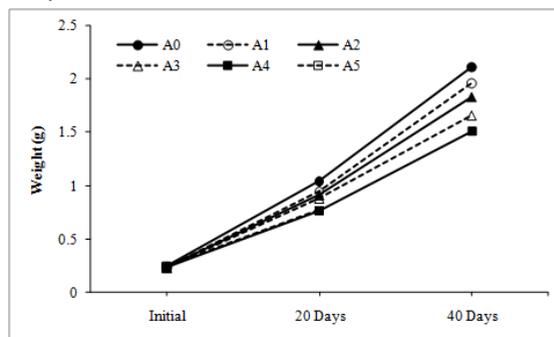


Table 2. Status of weight gain in rohu juveniles under different salinity concentrations

Experiments	Initial weight (g)	Weight at 20th Day		Weight at 40th Day	
		Weight gain (g)	Weight gain (%)	Weight gain (g)	Weight gain (%)
A0	0.24	0.80	333.3	1.87	779.2
A1	0.23	0.71	308.7	1.73	752.2
A2	0.23	0.68	295.7	1.60	695.7
A3	0.23	0.65	282.6	1.43	621.7
A4	0.23	0.53	230.4	1.28	556.5
A5	0.24	0.53	220.8	Juveniles did not survive	

Weight gain after 20 days and 40 days of rearing in different salinity concentration is presented in Table 2. In all treatments (A0 to A5), initial mean body weight was ranged from 0.23 to 0.24 g. After completion of 40 days of rearing, highest weight gain was recorded in A0 (779.2%) followed by A1 (752.2%), A2 (695.7%), A3 (621.7%), A4 (556.5%). Almost similar trend of weight gain after 20 days was also recorded in of rearing. In control, weight gain (%) was recorded highest (333.3%), followed by A1 (308.7%), A2 (295.7 %), A3 (282.6%), A4 (230.4%) and A5 (220.8%).

DISCUSSION

Salinity concentration in aquaculture influenced its growth and survival, although role of water temperature and nutrition is also has similar role on it. Water temperature greatly affects the feeding pattern in fish which ultimately reflects in their growth (Woyanovich *et al.*, 2011). Furthermore, as an important and basic parameter for any aquatic animal, water temperature was regularly monitored. In the current study, the range of water temperature was in ideal conditions for carps in aquaculture system.

In general, fish in hyper-osmotic environments would show more energy requirements than the normal for their osmoregulation (Tsuzuki *et al.*, 2007; Herraera *et al.*, 2009). Response to salinity has shown to be highly variable among fish species (Lisboa *et al.*, 2015).

In present experiment, growth performances in terms of weight gain were significantly shown affected in all tests. Canagaratnam (1966) opined that the efficiency of feed conversion depends on many factors, but the best response is probably strongly related to optimize the environment so as to approximate that to which the fish is accustomed. Therefore, current study, suggests the feed conversion in the juveniles reared at lower salinity (< 4 ppt) was good as compared to the high salinity level. Generally, in fish, growth was comparatively slower in initial and later stage of life whereas it rapid in middle age. Similar kind of result also we recorded. The rate of growth in first 20 days was

slower than the next 20 days of rearing. In higher salinity (> 6 ppt), survival rate of juveniles also found critical. Since 3rd day, mortality was found started. The sluggish movement of juveniles with very low intake of feed after stocking as observed suggest prolonged stress on the species resulting in total kill by 33rd day of stocking. So, it may be concluded that at high salinity (> 4 ppt), growth of juveniles of *rohu* slows down and puts a question mark on its survival on prolonged exposure. According to Islam *et al* (2014), at high salinity, metabolism of fish increases and fish becomes restless and this hyper-activeness if intolerant to them, the fish might die.

As a freshwater inhabit species, *rohu* may be difficult to survive in higher salinity above 4 ppt. But it has been reported that *Labeo rohita*, have shown better growth performance (in terms of condition factor) at 6 % and 8 % salinity level and further described that the food conversion ratio (FCR) were observed better in these salinity levels (Islam *et al.*, 2014). Moreover, at lower salinity level (< 6 ‰), growth performance was comparatively low (Islam *et al.*, 2014). A similar finding was also reported by Tsuzuki *et al* (2000) as FCR value of common carp, *Cyprinus carpio* was better in between 1.8 and 3.0% of medium salinity. But, in the current study, we found comparatively lesser growth as salinity increases.

Therefore, current study reveals that at least normal growth occurs in juveniles of *rohu* up to 3.8 ppt and its growth can be affected at higher salinity level. Hence, the *rohu* can adopt gradual increase in water salinity up to level less than 3.8 ppt. This study could be helpful in preparation of management plan for carp culture purpose in coastal waters where water salinity remains within the study level.

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