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EFFECT OF WATER TEMPERATURE ON THE GROWTH PERFORMANCE AND FEED CONVERSION RATIO OF *LABEO ROHITA*

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ABSTRACT

This study was conducted to investigate the effect of different water temperature ranges on growth performance, total length and feed conversion ratio of *Labeo rohita*. The three temperature ranges were 20-22, 22-24 and 24-26°C. Two replicates were followed for each water temperature range. The feed was offered at the rate of 4% of wet body weight of the fish twice a day. *Labeo rohita* attained significantly higher body weight (11.650 ± 0.212g) and total length (10.485 ± 0.191 cm) under water temperature range of 24-26°C. This was followed by 10.803 ± 0.003g body weight and 9.720 ± 0.003 cm total length under water temperature range of 22-24°C and 10.356 ± 0.062g and 9.335 ± 0.078 cm for body weight and total length respectively for the water temperature range of 20-22°C. The fish reared in water having temperature between 24-26°C showed the best FCR value (2.270 ± 0.059), followed by those maintained in 22-24°C (2.680 ± 0.146) and 20-22°C (2.970 ± 0.073). It was concluded that water temperature ranging from 24-26°C seemed to be the most effective for rearing of *Labeo rohita*.

Key Words: Water temperature, growth, FCR, *Labeo rohita.*

INTRODUCTION

Being cold-blooded animal, fish is affected by the temperature of the surrounding water which influences the body temperature, growth rate, food consumption, feed conversion and other body functions (Houlihan *et al*., 1993; Britz *et al*., 1997; Azevedo *et al*., 1998). Therefore, water temperature is a driving force in the fish life because its effects are more than any other single factor. Growth and livability in fish are optimum within a defined temperature range (Gadowaski and Caddell, 1991). Although short-term changes, such as weather conditions, may influence a fish for a day or two, but temperature has more predictable and seasonal effect.

Each fish species has an ideal temperature range within which it grows quickly. However, fish move into more favorable areas of a stream to regulate their body temperatures. In warmer environments fish have a longer growing season and faster growth rate but tend to have a shorter life span than in cool water. High water temperatures increase the metabolic rates, resulting in increased food demand. Although, fish can generally function in a wide range of temperatures, but they do have an optimum range, as well as lower and upper lethal temperatures, for various activities (Beschta *et al*., 1987)

Freshwater fish have an optimum growing temperature in the range of 25-30°C (Anonymous, 1983) at which they grow quickly. During winter, temperature falls, thus influencing biological functions in fish. *Labeo rohita* is an important freshwater fish cultured in Asia, particularly in Pakistan and India, Therefore, growth rate of this fish and other cultured freshwater carps decreased during the low water temperature period.

Keeping in view the information given above, it can be envisaged that by understanding how temperature affects the performance of fish, particularly during winter season, a farmer can maximize his profit by exploiting maximum production potential of local fish species. However, information regarding the effect of water temperature on various species of fish in Pakistan is limited. Therefore, a project was designed to investigate the effect of different temperature ranges on the growth performance and feed conversion ratio of *Labeo rohita*.

MATERIALS AND METHODS

Six weeks experiment was conducted in six glass aquaria in Fish Nutrition Laboratory, Department of Zoology and Fisheries, University of Agriculture, Faisalabad, Pakistan. One hundred *Labeo rohita* finger-lings obtained from a local Fish Seed Hatchery were acclimatized on experimental diet for two weeks in the glass aquaria. After the acclimatization, 10 fingerlings were randomly stocked in each aquarium having water at three temperature ranges of 20-22, 22-24 and 24-26°C. Two replicates were followed for each water temperature range. The average initial body weight of the fingerlings was 8.65g.

An experimental diet having 30% crude protein and 4.6 Kcal/g gross energy was prepared by mixing

different feed ingredients (Table 1). The feed was offered at the rate of 4% of wet body weight of the fish twice a day in feeding aquaria. After two hours of each feeding, the remaining feed was collected from each aquarium, dried and weighed to calculate net feed utilized by the fish.

At the end of each experimental week, five fish from each treatment were taken out from each aquarium on replicate basis and weighed to record their weekly wet body weight. The total length was also measured. After weighing and body length measuring, these fish were released back into their respective aquarium. Mean wet body weight of the fingerlings in each aquarium was calculated to work out the feeding rate for the next week. The data on feed consumption and body weight gain were used to calculate feed conversion ratio according to Jhingran (1991).

The data on body weight, total length and feed conversion ratio were statistically analyzed using completely randomized design under analysis of variance technique. The differences in the means were compared by Duncan's Multiple Range test according to the procedure described by Steel *et al*. (1996).

Table 1: Ingredients and their inclusion rate in the experimental diet

Ingredients	Rate of inclusion (%)
Rice polishing	43.0
Soybean meal	12.5
Wheat bran	3.5
Blood meal	30.0
Fish oil	10.0
Vitamin/mineral premix	1.0
Total	100

RESULTS

Labeo rohita gained higher body weight 11.650 ± 0.212g under water temperature range of 24-26 °C. The next higher weight of fish was 10.803 ± 0.003g and 10.356 ± 0.062g in water temperature ranges of 22-24°C and 20-22 °C, respectively (Table 2). The comparison of means of body weight in different water temperatures (Table 3) indicated that three water temperature ranges significantly affected the average body weight gain of the fish.

Labeo rohita attained higher total length (10.485 ± 0.191 cm) under temperature range of 24-26°C, followed by 22-24°C (9.720 ± 0.003 cm) and 20-22°C (9.335 ± 0.078 cm, Table 2). The analysis of the data revealed that the temperature of water significantly influenced the total length of the fish. The interaction between weeks and water temperature in respect of total length gain was also significant. The comparison of means of total length on different water temperatures (Table 3) indicated that all three temperature ranges differed significantly from one another.

The fish kept in water having temperature between 24-26°C showed better FCR value (2.270 ± 0.059), followed by 22-24°C (2.680 ± 0.146) and 20-22°C (2.970 ± 0.073, Table 3). These results showed that temperature of the water significantly influenced the feed conversion values of the fish. However, the interaction between weeks and water temperature in respect of feed conversion ratio was non significant. Mean values of feed conversion ratio under three water temperature ranges (Table 3) were found to be significantly different from one another.

DISCUSSION

The results of the present study revealed that *Labeo rohita* fish maintained under low temperature (20-22°C) gained significantly less body weight as compared to the other treatment groups. The weight gain increased with increase in water temperature. These results support the earlier findings that growth and survival of fish are optimum within a defined temperature (Gadowaski and Caddell, 1991).

The highest weight gain was observed in the fish maintained on 24-26 °C. Houlihan *et al.* (1993), Britz *et al.* (1997) and Azevedo *et al.* (1998) observed that fish were markedly influenced by the temperature of water in which they lived. Increased growth has also been reported in *Labeo rohita* reared in polyhouse at average temperature of 19°C as compared with those in outdoor tanks at average temperature of 14.8°C (Khan *et al.*, 2004).

An increase in temperature increases the activity of digestive enzyme, which may accelerate the digestion of the nutrients, thus resulting in better growth (Shcherbina and Kazlauskene, 1971). Hilge (1985) found that the optimum temperature for best growth of European catfish *Silurus glanis* was within the range of 25 to 28°C with best results noted at 27°C. Brown *et al.* (1989) reported a 40% increase in growth rate of cod reared at 8.3°C compared with 4.5°C. This value was similar to that of Otterlei *et al.* (1994), who reported a growth rate increase of about 50% with each 4°C increase in temperature between 6 and 14°C. However, different fish require different temperature regimes; a range between 25-30°C being the optimum for *Labeo rohita*. The lower body weight gain of the *Labeo rohita* maintained in low water temperature (20-22°C) may be due to less feed intake than those kept under higher water temperature (24-26 °C) because Jauncey and Ross (1982) have reported that most species cease to feed at low temperatures (below 16°C). Therefore, better growth rate at 24-26°C in *Labeo rohita* may be attributed to the high water temperature, which increased the feed intake and metabolic rate of the fish.

Table 2: Weekly variations of mean body weight, total length and feed conversion ratio of *Labeo rohita* kept in different temperature ranges of water

Weeks	Temperature range-I 24-26°C			Temperature range-II 22-24°C			Temperature range-III 20-22°C		
	Body weight (g)	Total length (cm)	FCR	Body weight (g)	Total length (cm)	FCR	Body weight (g)	Total length (cm)	FCR
Initial	8.800 ± 0.052	7.970 ± 0.054	-----	8.600 ± 0.027	0.735 ± 0.035	-----	8.550 ± 0.063	7.700 ± 0.076	-----
1	9.240 ± 0.156	8.310 ± 0.141	2.200 ± 0.127	8.940 ± 0.113	8.040 ± 0.099	2.565 ± 0.205	8.813 ± 0.046	7.930 ± 0.042	2.855 ± 0.078
2	9.710 ± 0.170	8.735 ± 0.148	2.220 ± 0.042	9.296 ± 0.081	8.360 ± 0.071	2.610 ± 0.170	9.105 ± 0.021	8.190 ± 0.014	2.900 ± 0.071
3	10.189 ± 0.182	9.165 ± 0.163	2.250 ± 0.071	9.669 ± 0.062	8.700 ± 0.057	2.650 ± 0.184	9.404 ± 0.000	8.460 ± 0.002	2.975 ± 0.106
4	10.670 ± 0.197	9.595 ± 0.177	2.270 ± 0.057	10.043 ± 0.042	9.035 ± 0.036	2.705 ± 0.148	9.711 ± 0.027	8.735 ± 0.021	2.990 ± 0.014
5	11.157 ± 0.208	10.035 ± 0.191	2.330 ± 0.028	10.419 ± 0.022	9.375 ± 0.021	2.750 ± 0.099	10.022 ± 0.049	9.015 ± 0.050	3.060 ± 0.057
6	11.650 ± 0.212	10.485 ± 0.191	2.380 ± 0.028	10.803 ± 0.003	9.720 ± 0.003	2.800 ± 0.071	10.356 ± 0.062	9.335 ± 0.078	3.080 ± 0.113

Table 3: Comparison of means of body weight, total length and FCR of *Labeo rohita* in different temperature ranges of water

	Temperature range-I 24-26°C	Temperature range-II 22-24°C	Temperature range-III 20-22°C
Body weight (g)	11.65 ± 0.212A	10.803 ± 0.003B	10.356 ± 0.062C
Total length (cm)	10.485 ± 0.191A	9.720 ± 0.003B	9.335 ± 0.078C
FCR	2.270 ± 0.059A	2.680 ± 0.146B	2.970 ± 0.073C

The values followed by different letters are significantly different at 5% level of significance.

The best FCR was observed in the fish kept at 24-26°C temperature range, followed by those maintained at 22-24 and 20-22°C. These results are consistent with the findings of Andrews and Stickney (1972), who reported that channel catfish, *Ictalurus Punctatus*, fingerlings reared at a temperature range of 18-34°C registered improvement in FCR, with the best values obtained at 30°C. Osborne and Riddle (1999) observed better efficiency of feed in fish reared at high temperature than those kept at low temperature (17-27°C). However, the findings of Azevedo *et al.* (1998) revealed that water temperature had very little effect on feed efficiency of rainbow trout (*Oncorhynchus mykiss*).

Probable explanation of improved feed efficiency of fish maintained at higher temperature might be the increased feed intake of the fish with increase in water temperature, which resulted in better growth of the fish, leading to better feed conversion ratio. Another probable explanation may be the less energy required for the process of thermoregulation to the fish kept at this temperature. Goolish and Adelman (1984) observed that an increase in temperature resulted in better utilization of feed in fish than those kept under lower temperature (20.9-24.3°C). In contrast to the better efficiency of feed utilization at higher temperature range, Alanara (1994) did not observe any difference in the feed efficiency of rainbow trout reared at 5 or 15°C. This discrepancy may be due to difference in water temperature used in these studies. Better feed conversion ratio of the fish maintained at 24-26°C in this study may be attributed to the increased feed intake of the fish, which spared more nutrients for growth of the fish after meeting the maintenance requirements.

In conclusion, water temperature ranging from 24-26°C seemed to be the most effective for rearing of *Labeo rohita*. However, the effect of water temperature on nutrient digestibility of the diet fed to the *Labeo rohita* still remains an important factor, which might play an important role in understanding the growth performance of the fish.

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