RESEARCH ARTICLE

EFFECT OF WATER TEMPERATURE ON THE GROWTH PERFORMANCE AND FEED CONVERSION RATIO OF SAHAR (TOR TOR)

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ARTICLE DETAILS

Article History:

Received 10 July 2021

Accepted 11 August 2021

Available online 13 August 2021

ABSTRACT

Water temperature is a major factor influencing growth performance and feed conversion ratio of fish. To optimize the growth and feed conversion ratio of *Tor tor* through maintenance of optimum water temperature, a 90 days experiment was conducted in complete randomized design from December 2018 to March 2019. *Tor tor* fingerlings (2.7 ± 0.1 g) were stocked in an aquarium maintained with desired temperature range of 19-21°C, 24-26°C and 29-31°C and was replicated five times such that 15 aquariums were kept for the intensive study. Ten such fingerlings were kept in each aquarium. The fingerlings were fed with a diet containing 30% crude protein and 4% of wet body weight twice a day, at 6:00 and 15:00 hours and a natural photoperiod was maintained during the experiment. There were few efforts to enhance growth of Mahaseer species through optimizing the water temperature. The aim of this research is to identify the optimal water temperature for growing *Tor tor*. Among different water, significantly higher body weight (3.892 ± 0.125 g) and total length (7.66 ± 0.059 cm) was observed under water temperature range of 29-31°C. This was followed by body weight of 3.512 ± 0.193 g and total length of 7.34 ± 0.031 cm under water temperature range of 24-26°C which was statistically at par with water temperature of 19-21°C. Best feed conversion ratio of 3.722 was obtained at 29-31°C. Temperature significantly affect different growth attribute of fingerlings. This experiment clearly demonstrated that 29-31°C is the most effective for rearing *Tor tor*.

KEYWORDS

Water temperature, body weight, total length, feed conversion ratio, *Tor tor*

1. INTRODUCTION

Enteric Sahar is well known game and food fish found in cold rivers and lake of hill and terai region of Nepal. Sahar is also a high value indigenous fish species as it fetches at a price almost double than that of commonly cultivated carps and tilapia in Nepalese fish market. Although Sahar is widely distributed in rivers, streams and lakes, its cultivation in pond has been increasing due to more economic return. Total ten species of tor have been recorded worldwide among them *Tor putitora* and *tor tor* are dominated in Nepal (FAO, 2017). Fishes can't control their body temperature as they are poikilothermic animals and they maintain equilibrium with the temperature of surrounding water.

Hence, water temperature is consider as a driving factor in fish production as it affects the body temperature, survival rate, growth rate, feeding rate, feed conversion and other vital biological functions (Turker, 2009). Each fish species has an optimum range of temperature within which they show maximum growth (Person-Le Ruyet et al., 2006). Low temperature causes languidness and lethargy by retarding the digestion ability whereas temperature above the optimum range will cause slow growth and even reduce the chance of survival at extreme temperature (Bailey and Alanärä, 2017). The optimum temperature for fish productivity ranges from 20-30°C (Njoku et al., 2015). Many tribe in hill and terai region consider it important fish species due to its large size, higher price and unique flavor. But, due to different anthropogenic factor like habitat destruction, overfishing, rapid urbanization and waste disposal in water resource its

population is in decreasing trend.

To increase its population and living standard of Sahar rearing farmer, optimum temperature for its growth should be known. The growth rate of *Tor tor* is very low as compared to other major carp (Chinese and Indian carp) and feed conversion ratio is also poor. As water temperature is considered as one of the prime factor responsible for growth, interventions can be done to improve growth of *Tor tor* by maintaining optimum water temperature. It has been found that increasing water temperature has resulted in better food conversion ratio and growth performance in some fishes. There is also limited information available concerning the optimum water temperature for growth of *Tor tor*. So, the study was carried out to find out the optimum water temperature for rearing *Tor tor*.

2. MATERIALS AND METHODS

A 90 days experiment was conducted in the laboratory of Begnas Fish Research Division, Pokhara, Nepal from December 2018 to March 2019. Complete Randomized Block Design was followed with three treatments (19-21°C, 24-26 °C and 29-31°C) and five replications with total of fifteen aquariums. 160 fingerlings of *Tor tor* obtained from the hatchery station of Begnas Fish Research Division were acclimated in glass aquaria for two weeks with experimental diet. Then, 150 fingerlings were randomly selected and stocked in fifteen glass aquariums at respective water temperatures at the rate of 10 fingerlings in each aquarium. The size of each aquarium was 62.5cm×20cm×40cm and a net was kept at the top of

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DOI:
10.26480/ppsc.01.2021.01.03

each aquarium to prevent the jumping action of the fingerlings. Water temperature was maintained by an auto adjustable quartz glass heater. 25 l of water was kept on each aquarium and the water of each aquarium was changed every 3-4 days leaving one-fourth quantity of previous water at the bottom of the aquarium. The average initial body weight of fingerlings was 2.7 ± 0.1 g. The fingerlings were fed 4% of wet body weight twice a day. The mean body weight of each treatment was calculated at fortnightly basis and was used to find out the feeding rate for the next 15 days. An experimental diet having 30% crude protein was given during the trial. Feeding was carried out daily at 6:00am and 3:00pm and siphoning was carried out at 9:00pm to remove the remaining feed and also to maintain the cleanliness of aquaria. Natural photoperiod was maintained throughout the experiment.

3. OBSERVATIONS RECORDED AND SAMPLING PROCEDURE

The body weight and total length were calculated every 15 days interval from 15 days of stocking to 90 days of stocking and feed conversion ratio was calculated at final harvest of the fingerlings. The observations recorded and sampling procedure are as follows:

- Body weight: Six fingerlings from each aquarium were randomly selected with the help of scoop net and were kept in a container with cloves oil at concentration of 0.1ml in 10 l of water which acted as an anesthetic agent to the fingerlings. Then, the individual was kept in a plastic bucket and finally weighed using electronic balance.

- Total length: The total length of the fingerlings was measured from the tip of mouth to the end of the caudal fin from the fingerlings selected to calculate body weight. The fingerlings which were removed from the aquarium were released back into their respective aquarium.
- Feed Conversion Ratio (FCR): After 4-5 hours of each feeding, the remaining feed was collected from each aquarium, dried and then weighed to calculate the net feed utilized by fish. Data on feed consumption and body weight gain were used to calculate FCR.

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed consumed (g, dry weight basis)}}{\text{Wet weight gain (g)}}$$

4. STATISTICAL PROCEDURE

Results were analyzed by one-way analysis of variance (ANOVA). When ANOVA identified differences among groups, their means were separated by Duncan's Multiple Range Test (DMRT) at 0.05 level of significance. Microsoft Word 2007 was used for word processing; MS excels for tables and R-Studio version 3.6.1 was used for running statistical analysis.

5. RESULTS AND DISCUSSION

Table 1: Body weight of Tor tor as influenced by water temperature

Time/Temp.	15days	30days	45days	60 days	75 days	90 days
19-21°C	2.765±0.075	2.777±0.046	2.826±0.058	2.914±0.036	3.134±0.093	3.349±0.058
24-26°C	2.802±0.059	2.898±0.040	3.002±0.112	3.093±0.133	3.320±0.161	3.512±0.193
29-31°C	2.820±0.054	2.960±0.121	3.095±0.107	3.202±0.147	3.453±0.113	3.892±0.125

Figure 1: Body weight of Tor tor as influenced by water temperature

Table 2: Total length of Tor tor as influenced by water temperature

Time/Temp.	15Days	30 days	45 days	60 days	75 days	90 days
19-21°C	6.70±0.170	6.73±0.200	6.83±0.126	6.87±0.111	7.01±0.206	7.32±0.024
24-26°C	6.73±0.154	6.88±0.154	6.96±0.162	7.08±0.206	7.12±0.156	7.34±0.031
29-31°C	6.76±0.171	6.88±0.170	7.08±0.187	7.22±0.189	7.50±0.132	7.66±0.059

Figure 2: Total length of Tor tor as influenced by water temperature

Table 3: Body weight, total length and FCR as influenced by different water temperatures at harvest (90 days of stocking)			
Treatments (Temperature)	Body weight (g)	Total Length (cm)	FCR
19-21°C	3.349b	7.316b	4.634b
24-26°C	3.512b	7.338b	4.263b
29-31°C	3.892a	7.664a	3.722a
LSD (0.05)	0.193	0.084	0.446
F-probability	<0.001	<0.001	<0.001
C.V%	4.0	7.2	12.841
Grand Mean	3.584	7.439	4.256

Means within a column with no letters in common are significantly different. Each treatment was differentiated with each other on the basis of Least Significant difference, C.V represents coefficient of variation and probability value (P-value) was designed on the basis of DMRT $P < 0.05$

5.1 Effect on body weight

The water temperatures had a significant effect on body weight at 90 days of stocking (table 3). Increasing water temperatures caused increased body weight. Highest body weight (3.892g) was observed under a water temperature range of 29-31°C which was statistically superior to both the temperature range. A group researcher also reported significantly higher body weight in artificial polyhouse where average minimum temperature in winter was 19°C compared to outdoor tanks with average minimum temperature of 14.8°C (Khan et al., 2004). Increase in growth rate due to increase in temperature (10,13,16 and 19°C) in juvenile turbot (*Scophthalmus maximus*) was also reported by (Imsland et al., 1996). Sahar can survive and thrive well at water temperature over 30°C in the summer season in the rearing pond and cages of Pokhara valley without any adverse effect on its growth (Bista et al., 2001). A group researchers reported merely 0.12 g per day growth rate of large size sahar at temperature ranging from 15-18°C (Bista et al., 2001). Increase in temperature causes better utilization of feed due to increased activity of digestive enzymes which accelerate the digestion of the nutrients and thereby resulting in better growth (Fatma and Ahmed, 2020).

5.2 Effect on total length

Highest total length (7.66cm) was observed in a water temperature range of 29-31°C which was significantly superior to 24-26°C. The total length (7.34cm) at 24-26°C was statistically similar with that of 19-21°C. The result clearly demonstrated that an increase in water temperature from 19-21°C to 29-31°C increases the total length of fingerlings. Kausar and Salim also attained a significantly higher total length under temperature range of 24-26°C compared to 22-24°C and 20-22°C in *Labeo rohita* (Kausar and Salim, 2006).

5.3 Effect on Feed Conversion Ratio (FCR)

Optimum FCR (3.872) was observed under water temperature of 29-31°C which was statistically superior to FCR under 24-26°C. Better FCR was also reported by in higher water temperature in polyhouse compared to outdoor tanks (Khan et al., 2004). Fatma and Ahmed suggested an increase in temperature can impute better utilization of feed due to increased activity of digestive enzymes (Fatma and Ahmed, 2020).

6. CONCLUSION

This experiment concluded that the growth and feed conversion ratio of Sahar is influenced by different water temperatures as assessed by weight, length and feed conversion ratio. Significantly higher body weight and body length was found in water temperature of 29-31°C. Similarly, the body weight and body length under the water temperatures of 19-21°C

was found statistically at par with water temperature of 24-26 °C. Similarly, better feed conversion ratio was also obtained at water temperature of 29-31°C which was superior to that of 19-21°C and 24-26°C. Hence, *Tor tor* fingerling can be effectively cultivating at tropical condition having average temperature of around 30°C. In context of Nepal, terai region is suitable for its rearing.

ACKNOWLEDGEMENTS

The authors would like to express their heartfelt gratitude to senior scientists of Begnas Fishery Research Division Mr. Agni Nepal and Dr. Md. Akbal Husen for their immense support and suggestion. We'd want to thank all of the employees of Begnas Fishery Research Division, Pokhara, Nepal who helped us out in various ways while we were conducting our investigation.

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