**Growth and survival performance of freshwater fish *Labeo rohita* fingerlings under various conditions**

**Abstract:**

Implementing various goals for sustainability in aquaculture and fisheries depends on the environmentally friendly handling of *L. rohita*. The effects of raising the water temperature to 28°C, 30°C, and 32°C on the growth and development of *L. rohita* fingerlings housed in aquariums for 31 days were examined. The fish were given pelletized food on a continuous basis. Fish kept in water at 32°C grew significantly (P<0.05) more rapidly (SGR and FCR) than fish kept at other temperatures.This simple growth model produced a consistent growth (SGR 2.27%) between 28 and 32°C. At 30 to 32°C, the highest body weight increase and lowest feed conversion ratio (FCR) were observed 30 to 32°C was shown to have the highest specific growth rate. A temperature rise of around 28 °C is optimum, with 30 °C and 32 °C being the ideal range for manufacturing. Survival at acclimation temperatures was between 100.00±0.00, 100.0±0.00 and 100.0±0.00. This further implies that suitable measures must be implemented to maintain the optimal temperature in aquaculture farms in order to avert the adverse consequences of climate change. These steps might involve creating fish strains that can withstand moderate climate change or physically altering the production system to regulate temperature. In order to help fish culturists create adaptation plans, the fish species and culture methods will be suitable for the climate change scenarios.

**Key words:**

 **Aquaculture, Environmental temperature, *Labeo rohita*, survival, Growth,**

**I. Introduction:**

Temperature has a significant impact on the biological systems of all aquatic species and influences the growth and survival of organisms. When fish are exposed to less-than-ideal temperature fluctuations, their unique biological characteristics are altered, which negatively impacts their life cycles and aquaculture productivity. An important aquaculture species in the Indian Subcontinent is the freshwater Indian giant carp (*Labeo rohita*), which can achieve temperatures of 28°C to 32°C. Climate change has been a worldwide issue since the mid-1800s. Extreme weather events and sudden changes in the environment are the result of climate change and are becoming more frequent in the future (Islam et al. 2020). Anthropogenic activities have accelerated major changes in climatic indices, such as temperature and precipitation rates, causing abrupt changes in the temperature and salinity of water bodies (Shahjahan et al., 2021; Yilmaz et al., 2021). The freshwater aquaculture industry will be particularly affected since the majority of freshwater species need consistent environmental conditions and high-quality water (Phuc et al., 2017; Ninawe et al., 2018; Rahman et al., 2022). Temperatures between 25 and 30 °C are ideal for the development of most freshwater fish. Hossain et al. (2015) claim that higher temperatures raise metabolic activity and rate, which in turn raises food intake. The reverse is true in the winter, though, when it's colder. Wintertime low temperatures affect fish behavior, resulting in stressful conditions and decreased production (Alfonso et al., 2021). When the temperature of the open ocean rises, wild fishes can migrate to higher latitudes in a way that is unique to their species, according to several studies (Fogarty et al., 2017; Kleisner et al., 2017; Alabia et al., 2018). Knowing *L. rohita* different temperature tolerance and growth performance in connection to different acclimation temperatures would be essential to determining the extent of stress reaction in a developing aquaculture environment.

**II. Materials and Method**

**2.1 Experimental of fish collection:**

 Fresh water fish *Labeo rohita* weighing (4.10-4.20) g were collected from the suriya fish farm, Kallidaikuruchi, Tirunelveli. The fishes were then transported to the laboratory in polythene bags containing oxygenated water with least disturbance at low temperature. Then they were acclimatized to the ambient laboratory room temperature (27°C) in FRD tank. During the period of acclimatization, which was for one weeks.

**2.2 Experimental setup:**

 Five thermostatic aquariums were used for the experiment, and the temperatures that were tested were 28◦C,30◦C and 32◦C. The chosen temperature was attained via the thermostat (REI-SEA, 300 watts, Japan). The aquarium has a filtration/aeration system (Sebo-aquarium internal filter WP-850F) for aeration and self-cleaning during the research period. The pH, dissolved oxygen, ammonia, and total alkalinity of each tank were tracked and recorded. In order to maintain clean water, the fish were housed in carefully monitored laboratory tanks equipped with filtration and aeration systems. Fish farms in the vicinity provided us with *L. rohita* fingerlings

**2.3 Experimental diet:**

 In the present study, the experimental fishes were fed with lab prepared pellet diets. The diet was prepared by using the conventional feed ingredients such as fish meal, groundnut oil cake, soya meal, rice bran, wheat bran, fish oil, vitamin and mineral mix. The proximate composition of the experimental feed was recorded as protein (37.85%), carbohydrate (17.84%), fat (10.62%) and moisture content (8.45%). The experimental feed was offer to the fishes twice daily to satiation (Morning 7.00 am and Evening 5.00 pm). The unfed remains were collected daily and measured.

**(Table:1) Effect of different temperature levels on growth parameters (mean± SD) of Rohu (*labeo rohita*)**

|  |  |  |  |
| --- | --- | --- | --- |
| Growth parameter | 28 ◦C | 30 ◦C | 32 ◦C |
| Initial Weight(g) | 4.14±0.02 | 4.23±0.01 | 4.27±0.01 |
| Final weight(g) | 6.51±0.03 | 7.12±0.04 | 7.34±0.01 |
| Weight gain (g) | 2.37±0.04 | 2.89±0.04 | 3.07±0.02 |
| % weight gain | 57.32±1.14 | 68.28±0.93 | 71.82±0.85 |
| (SGR) (% /) | 2.09±0.008 | 2.21±0.009 | 2.25±0.005 |
|  (FCR) | 1.46±0.01 | 1.43±0.06 | 1.41±0.01 |
| Survival (%) |  100.0±0.00 | 100.0±0.0 | 100.0±0.0 |

Effect of temperature fluctuations on *Labeo rohita*, or Rohu, growth metrics (mean ± SD); subscripts that differ from each other indicate significant differences (P < 0.05).

**III. Result and Discussion:**

 While growth rates differed little among the grouped fish at 28°C, 30°Cand 32°C, the current study indicated that they considerably increased. However, the optimal temperature range for *Labeo rohita* growth is reported to be between 31°C and 33 °C by (Das et al.,2005). Fish grow in response to temperature; they usually rise until they achieve a perfect temperature, at which point they fall once more. The temperature has a major effect on the specific growth rates of *L. rohita* fingerlings. During each temperature, the growth rates of the fish in our study varied, ranging from 2.09 to 2.25% body weight daily shown that the range of temperatures between 30 and 32 °C is optimal for the growth of *L. rohita,* nonetheless. Fish growth is sensitive to temperature and usually rises to an ideal level before falling once more, according to (Myrick and Cech ,2000). The optimal temperature for development varies throughout species. The study's conclusions suggested that *Labeo rohita* development growth performance was negatively impacted by high water temperatures. The percentage of weight gain, SGR, and feed intake of L. rohita grown at 30–32 °C were significantly reduced in the water (Table 1). In a similar vein, slower growth and reduced feed intake were associated with water temperatures above or below the thermal limits (25–32 °C) (Stickney, 1994). In contrast, the more the metabolic rate rises over the optimal range, the less space there is for development. Fish eat feed at a rate that is only required for their physical maintenance (Stickney, 1994). Therefore, as compared to fish grown in water that was 34°C, fish raised at ambient temperatures of 29°C and 31°C showed better growth performance. Additionally, (Phuc, 2017) 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). This resulted in increases in growth and FCR. However, this study found that temperatures as high as 28 to 30 °C increased FCR; these may not yet be indicative of stress conditions in butter rohu cultivation, except than a slower rate of development. In culture systems, however, warmer water is advantageous for temperature fish species in their early life stages. Desired outcomes were obtained within the ideal temperature range of 28–37 °C.

**IV. Conclusion:**

 Overall, the study concluded that temperatures are stressful to Indian major carb *Labeo rohita.* The results of the study demonstrated that the growth performance and survival were significantly impacted by the water temperature. We looked at how *L. rohita* was affected by temperature, growth, and feed conversion efficiency. The findings indicated that 30°C was the ideal water temperature for *L. rohita* development, whereas fish at 32°C performed well in terms of growth.

**5.Reference**

Alabia, I.D., Molinos, J.G., Saitoh, S.I., Hirawake, T., Hirata, T., Mueter, F.J., 2018. Distribution shifts of marine taxa in the Pacific Arctic under contemporary climate changes. Divers. Distrib. 24, 1583–1597.

Alfonso, S., Gesto, M., Sadoul, B., 2021. Temperature increases and its effects on fish stress physiology in the context of global warming. J. Fish Biol. 98 (6), 1496–1508. <https://doi.org/10.1111/jfb.14599>.

Das T, Pal AK, Chakraborty SK, Manush SM, Ahu NP, Mukherje SC, 2005. Thermal Tolerance, Growth and Oxygen Consumption of Labeo rohita Fry (Hamilton, 1822) Acclimated to Four Temperatures. Journal of Thermal Biology, 30: 378-383.

Fogarty, H.E., Burrows, M.T., Pecl, G.T., Robinson, L.M., Poloczanska, E.S., 2017. Are fish outside their usual ranges, early indicators of climate-driven range shifts? Global Change Biol. 23, 2047–2057.

Hossain, Md.I., Khatun, M., Kamal, B.M.M., Habib, K.A., Tumpa, A.S., Subba, B.R., Hossain, Md.Y., 2015. Effects of seasonal variation on growth performance of mirror carp (*Cyprinus carpio Ver. Specularis*) in earthen nursery ponds. Our Nature 12, 8–18. <https://doi.org/10.3126/on.v12i1.12252>.

Islam, M.J., Slater, M.J., Bogner, M., Zeytin, S., Kunzmann, A., 2020. Extreme ambient temperature effects in European seabass, *Dicentrarchus labrax*: Growth performance and hemato-biochemical parameters. Aquaculture 522, 735093.

Kleisner, K.M., Fogarty, M.J., McGee, S., Hare, J.A., Moret, S., Perretti, C.T., Saba, V.S., 2017. Marine species distribution shifts on the U.S. northeast continental shelf under continued ocean warming. Prog. Oceanogr. 153, 24–36.

Myrick CA, Cech JJ., 2000. Temperature influences on California rainbow trout physiological performance. Fish Physiol Biochem 22: 245-254.

Ninawe, A.S., Indulkar, S.T., Amin, A., 2018. Impact of climate change on fisheries. In Biotechnology for Sustainable Agriculture. Woodhead Publishing, pp. 257–280.

Phuc, N.T.H., Mather, P.B., Hurwood, D.A., 2017. Effects of sublethal salinity and temperature levels and their interaction on growth performance and hematological and hormonal levels in tra catfish (Pangasianodon hypophthalmus). Aqua. Int. 25, 1057–1071.

Rahman, M.M., Salin, K.R., Tsusaka, T.W., Anal, A.K., Rahi, M.L., Yakupitiyage, A., 2022. Effect of stocking density on growth performance and gonadal maturity of all-female giant freshwater prawn, *Macrobrachium rosenbergii*. J. World Aqua. Soc. doi: org/ 10.1111/jwas.12888.

Shahjahan, M., Zahangir, M.M., Islam, S.M.M., Ashaf-Ud-Doula, M., Ando, H., 2021. Higher acclimation temperature affects growth of rohu (*Labeo rohita*) through suppression of GH and IGFs genes expression actuating stress response. J. Ther. Biol. 100, 103032.

Shcherbina MA, Kazlauskene OP, 1971. Water Temperature and Digestibility of Nutrient Substances by Carp. Hydrobiologia, 9: 40-44

Stickney, R. R. 1994. Principles of aquaculture. New York, NY: John Wiley and Sons

Yilmaz, S., Ergun, S., Celik, E.S., Banni, M., Ahmadifar, E., Dawood, M.A.O., 2021. The impact of acute cold-water stress on blood parameters, mortality rate and stress-related genes in *Oreochromis niloticus*, *Oreochromis mossambicus* and their hybrids. J. Ther. Biol. 100, 103049.