

Salinity Tolerance of Rohu (*Labeo rohita*) and its Hybrid Under Different Temperature Regimes

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ABSTRACT

An experiment was carried out at Fisheries Research Farms, University of Agriculture, Faisalabad, in order to find out the tolerance of Rohu (*Labeo rohita*) and its Hybrid (*Labeo rohita* ♂ x *Catla catla* ♀) for different levels of salinity under three temperature gradients. The salinity levels were prepared on the basis of electrical conductivity (E.C.), by adding commercial grade NaCl in the water. The five experimented EC levels were 1.2 mS/cm for control, 5, 10, 15 and 20 mS/cm for treatment T1-T4, respectively. The selected temperature gradients were 14, 21 and 28°C. The 7-days LC-50 values for rohu were remained as 17.383, 19.649 and 10.158 mS/cm at temperature 14, 21 and 28°C, respectively, while the 7-days LC-50 values for its hybrid remained as 20.465, 11.640 and 8.352 mS/cm at temperature 14, 21 and 28°C, respectively. Hybrid showed more susceptibility towards salinity as the temperature rises. Rohu proved to be more resistant against salinity at high temperature than low temperatures. The important physico-chemical parameters varied significantly but remained favorable during the whole period of study.

Key Words: Salinity; LC 50; Temperature gradients; *Labeo rohita*; Hybrid

INTRODUCTION

Fish meat is a major source of protein, essential minerals, vitamin A&D, and unsaturated fats (Javed, 1988). By adopting and improving the fish culture practices, a plentiful amount of quality protein could be produced. Fish culture system requires a relatively less amount of energy for protein production than that of any other system (Werner, 1991).

In Pakistan fish culture attitude is developing widely to produce the protein of animal origin. Traditionally composite culture of 'Indian Major Carps' viz; *Labeo rohita*, *Catla catla* and *Cirrhinus mirigala*, and 'Chinese Carps' viz; *Ctenopharyngodon idella* and *Hypopthalmichthys molitrix*, has been done in the country.

Pakistan, being located on the tropic, falls under arid and semi-arid climatic region with scarce and irregular rainfall, so, much of the land and groundwater of the country is affected with high levels of salinity. Such areas can be used for pond fish culture. The establishment of fish pond not only provides fish meat but also act as a tool for rehabilitation and desalinization of soil of the area through flushing (Payne *et al.*, 1988).

The water salinity affects the fish directly or indirectly through generating changes in the ecological factors and production of food organisms. A change in salinity effects the survival and growth of fish (Muir & Roberts, 1995).

Due to these high levels of salinity, the traditionally cultured fish species fall under stress and could not performed well. So, they have shown stunted growth and low production. For salt-water aqua culturists, it is important to determine the threshold levels and to establish the optimal

requirements for salt contents of the cultured fishes. In the present study the threshold levels of rohu (*Labeo rohita*) and its Hybrid for salinity, with the rise in temperature were investigated.

MATERIALS AND METHODS

The experiment was carried out in the wet laboratory of Fisheries Research Farms, Department of Zoology & Fisheries, University of Agriculture, Faisalabad. The fish seed of Rohu (*Labeo rohita*) and its hybrid (*Labeo rohita* ♂ x *Catla catla* ♀) was collected from the government hatchery and transported to the laboratory. The fingerlings were acclimatized for a period of one week prior to the start of experiment.

The experiment was carried out in glass aquariums having the capacity of 80 L of water. The selected levels of salinity having electrical conductivity i.e. 5, 10, 15 and 20 mS/cm were prepared by adding the stock solution of commercial grade NaCl in to the aquarium water slowly. The control received no NaCl.

There were 3 sets of 5 aquariums (1 control+ 4 treatments) with two replicates of each. The temperature of each set was controlled by using aquarium water thermoregulator model; vigor-RT 50/250. The temperature at 14, 21 and 28°C was maintained in 1st, 2nd, and 3rd set respectively. The aquariums were supplied with pumped air in order to keep the dissolved oxygen level near to saturation.

Ten fishes of each species were stocked in each aquarium. The fishes were fed commercially available 30% crude protein feed @ 10% of body weight daily. The

mortality data were recorded daily at dawn and dusk for a period of seven days. The dead fish, if any, was removed from the aquarium daily. The observation on the important physico-chemical parameters such as dissolved oxygen (D.O) and pH was also made by using digital meters and recorded for the analysis of variance. For both the species median lethal concentration (LC: 50) for seven days was calculated with help of multiple linear regression analysis following Steel and Torrie (1986).

RESULTS AND DISCUSSION

The results of mortality, recorded after every 12 h are presented in Table I, for the temperature gradients 14, 21 and 28°C.

At 14°C, the mortality of rohu started after 108 h in T3, while in T4 (the highest selected salinity) at the same time both fish species showed a heavy mortality of 80% each (Table I). All (100%) of fishes were found to be expired in T4, rohu after 132 h and hybrid after 144 h (Table I). The 7 days LC: 50 value recorded for rohu was 17.383 mS/cm and for hybrid was 20.465 mS/cm (Table I). The average dissolved oxygen values for all the treatments

ranged between 5.6-6.2 mg/L, while pH remained between 8.6-8.8 (Table III).

At 21°C, the mortality of both fish varieties was started after 24 h in T4 (Table I). All (100%) hybrid was expired after 60 h in T4 and after 156 h in T3. Rohu showed highest mortality (80%) after 132 h in T4 (Table I). The 7 days LC:50 value recorded for rohu was 19.649 mS/cm and for hybrid was 11.640 mS/cm (Table I). The average dissolved oxygen values for all the treatments at this temperature ranged between 4.1-4.7 mg/L, while pH remained between 9.3-9.5 (Table III).

At the highest selected temperature gradient i.e. 28°C, the mortality of both fish species was started after 24 h (Table I). All (100%) of rohu was expired just after 24 h both in T3 and T4, while 100% of hybrid died after 24 h in T4 and after 48 h in T3 (Table I). Hybrid showed a mortality of 60% in T2 after 120 h and in T1 at the end of experiment. Rohu showed a mortality of 20% after 144 h in T2 and in T1 at the end of experiment. The 7 days LC:50 value recorded for rohu was 10.158 mS/cm and for hybrid was 8.352 mS/cm (Table I). The average dissolved oxygen values for all the treatments at this temperature ranged between 4.1-4.5 mg/L, while pH remained between 7.9-8.5

Table I. Response (% age mortality) of Rohu (R) and its Hybrid (H), against different levels of salinity at different temperatures

Time (Hours) ↓	Temperature 14 °C								Temperature 21 °C								Temperature 28 °C													
	Control		T1		T2		T3		T4		Control		T1		T2		T3		T4		Control		T1		T2		T3		T4	
	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H	R	H
00	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
36	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
48	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
60	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
72	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
84	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
96	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
108	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
120	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
132	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
156	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
168	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
	Calculated 7 Days LC:50								Calculated 7 Days LC:50								Calculated 7 Days LC:50													

Rohu:17.383 mS/cm, Hybrid: 20.465 mS/cm. Rohu:19.649 mS/cm, Hybrid: 11.640 mS/cm. Rohu:10.158 mS/cm, Hybrid: 8.352 mS/cm
Control = 1.2; T1 = 5; T2 = 10; T3 = 15; T4 = 20 (mS/cm)

Table II. Multiple linear regression equations regarding Rohu and its Hybrid mortality and lethal concentration for salinity under different temperatures

			Intercept	+C ₁ x time	+ C ₂ x Conc.	+ C ₃ x time x conc.
Temperature	Rohu	Mortality	7.70848	+4.02049 x time	+ 1.5373 x conc.	+ 0.79846 x time x conc.
14 °C	Hybrid	Mortality	6.74926	-3.6451 x time	-1.2084 x conc.	+0.6526 x time x conc.
Temperature	Rohu	Mortality	-1.8897	-2.3767 x time	+2.0738 x conc.	+0.8297 x time x conc.
21 °C	Hybrid	Mortality	1.84527	-4.7410 x time	-1.0641 x conc.	+1.1502 x time x conc.
Temperature	Rohu	Mortality	-30.4076	+3.1420 x time	+6.7273 x conc.	-0.1395 x time x conc.
28 °C	Hybrid	Mortality	-24.0426	+3.2814 x time	+6.1911 x conc.	-0.0109 x time x conc.

Table III. Mean values of important physico-chemical parameters of the experiment

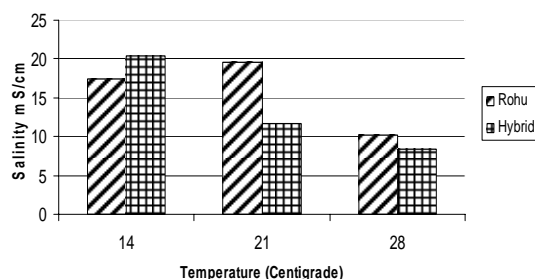
		Control (1.2 mS/cm)	T1 (5 mS/cm)	T2 (10 mS/cm)	T3 (15 mS/cm)	T4 (20 mS/cm)
Temperature 14 °C	Dissolved Oxygen (DO) mg/L	6.2 (5.3-6.8)a	5.9 (5.2-7.0)a	5.8 (5.2-6.8)a	5.7 (5.1-6.8)a	5.6 (5.0-6.7)a
	pH	8.8 (8.6-8.9)A	8.7 (8.6-8.8)AB	8.6 (8.4-8.8)B	8.6 (8.5-8.8)B	8.6 (8.5-8.7)B
Temperature 21 °C	Dissolved Oxygen (DO) mg/L	4.3 (3.7-4.7)ab	4.5 (3.7-5.2)ab	4.7 (4.0-5.2)a	4.1 (3.0-5.5)b	4.4 (3.9-4.9)ab
	pH	9.5 (8.8-9.7)a	9.3 (8.8-9.5)b	9.3 (8.7-9.5)b	9.3 (8.7-9.5)b	9.3 (8.8-9.8)b
Temperature 28 °C	Dissolved Oxygen (DO) mg/L	4.5 (4.0-5.0)ab	4.2 (3.4-5.0)b	4.2 (3.6-5.0)b	4.7 (4.6-4.8)a	4.1 (3.5-4.7)b
	pH	8.5 (8.1-8.6)a	8.3 (8.0-8.5)ab	8.3 (7.9-8.5)ab	7.9 (7.9-7.9)b	7.9 (7.8-8.0)b

(Values given in parenthesis are the lowest and highest limits of parameters recorded during the study)

(Table III).

The results of experiment showed that both fish species tolerate different levels of salinity in a significantly different manner, Rohu proved a bit more resistant towards salinity (Fig. 1). The 7 days LC: 50 values calculated with the help of multiple linear regression equations (Table II), were remained as 17.383, 19.649 and 10.158 mS/cm for rohu and 20.465, 11.640 and 8.352 mS/cm for its hybrid at different temperatures. Tarer (2000), also recorded significant species difference in *Labeo rohita* and *Cirrhinus mrigala* in tolerance of salinity and found *Labeo rohita*, (Rohu) more tolerant towards salinity with LC:50 values of 5.658, 7.482 and 9.174 g/L (8.44, 11.68 and 13.69 mS/cm). Nelson (1987), also found similar results while working on

Fig. 1. Comparison of LC:50 values of Rohu and its Hybrid against salinity



salinity tolerance of different freshwater fish species. Kasim (1983), during his work on salinity tolerance of different carps stated that they behaved in different ways for tolerating salinity. He recorded that common carp was highly tolerant, followed by rohu and mirigal. Kliambi and Zdinak (1980), while working with grass carp fingerlings recorded between 71-90% mortality in 24 h under 1.5‰ (22.3875 mS/cm) salinity. The statistical analysis of different physico-chemical parameters reveals that a significant difference among them was present (Table III) and this might be influence the result of experiment (Kinne, 1965).

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