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Effects of Salinity Changes on Growth Performance and Survival of Rohu Fingerlings, *Labeo rohita* (Hamilton, 1822)

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Abstract

Labeo rohita was reared in laboratory condition at different salinities to observe the growth and survival. Three hundred and fifty rohu fingerlings were subjected to salinity regimes of 0, 2, 4, 6, 8, 10 and 12% for 90 days. Hundred percent survival was detected at 0 to 6% salinity while 100% mortality was recorded at 10 and 12‰ salinity. Fish showed high appetitive behavior to food between 0 to 4% salinities. Lowest feed conversion ratio was found in control group while the highest was detected at 6% salinity. On the other hand, decreasing trend of specific growth rate was observed in rohu fingerlings from 0 to 8% salinity. Similar average daily gain was found at 0 to 4% salinity. Significantly higher condition factor was found in rohu fingerlings reared at all duration at 8% salinity than those of other salinities ($p<0.05$). Thus the present study suggests that rohu fingerlings can be reared in coastal water with salinity of up to 6% with 100% survival rate and up to 4% salinity with similar growth rate as freshwater.

Keywords: Rohu fingerlings; Appetitive behavior; Salinity; Survival; Feed conversion ratio; Specific growth rate

Introduction

Fish is the major protein source in the diet of the Bengali people. Fish contributes about 63% of the available protein in the diet and the rest 37% protein comes from livestock and poultry. In spite of having large inland water bodies, Bangladesh is facing malnutrition problem due to the shortage of fish protein in diet as supply of fish from open water bodies is declining significantly. To full-fill this gap, aquaculture has been becoming much popular in Bangladesh in last two decades.

Labeo rohita, commonly known as rohu in Indian sub-continent is highly delicious and valuable fish species among other Indian major carps. Therefore, it is considered to be the most of important fish of Bangladesh not only for its high market value but also the fingerlings are easily available from hatcheries. Fish culture attitude is developing widely in Bangladesh and composite culture of 'Indian Major Carps' viz; *Labeo rohita*, *Catla catla* and *Cirrhinus mirigala*, and 'Chinese Carps' viz; *Ctenopharyngodon idella* and *Hypopathalmichthys molitrix*, has been continued. Several factors influence on the growth and survival of carps where salinity can potentially act as a stressor under both natural and aquaculture conditions. Growth and survival to changes in salinity may provide a bio-energetic basis to evaluate performance of rohu under culture conditions. This is also relevant for the culture of salinity-tolerant aquaculture candidates which could be reared at different salinities. Salinity is considered as limiting factor for the survival and growth of fresh water fish species like rohu. Effects of salinity was widely reported on oxygen, pH, temperature and specific gravity [1], on gametes and fertilization period of the fish [2,3], on metamorphosis, early development and hatching of teleosts [4-6], on behavioral response [7,8].

Bangladesh experiences more floods, more droughts, drainage congestion, salinity intrusion and cyclones with higher intensities due to climate change [9]. Increase in ocean surface temperature and rising sea levels are likely to intensify cyclonic storm surges and further increase the depth and extent of storm surge induced coastal inundation. Water salinity and its distribution in the coastal area (including ponds in coastal zone) are increasing with the increase of sea level rise [10]. In fact thousands of ponds in coastal region of Bangladesh are facing salinity intrusion due to sea level rise and coastal storm surges. Thus freshwater aquaculture in coastal area of Bangladesh is in great threat due to sea level rise and global climate change. In Bangladesh, though rohu comprises a major portion of cultured fish, no research was conducted to investigate the effects of salinity on survival and growth of rohu fish. Therefore the objective of this study was to investigate the effects of different salinity regimes on survival and growth of rohu fingerlings in laboratory condition.

Materials and Methods

The experiment was carried out at the aquatic laboratory of Department of Fisheries, University of Dhaka, Dhaka, Bangladesh. The fingerlings were acclimatized for a period of 72 hours prior to start of the experiment at the acclimatization tank. The brine solution was prepared in the circular tank by adding the commercial grade of NaCl until the selected level of salinity achieved. The salinity level was measured by salinity meter. Two factorial design with two replicates was applied to determine different growth parameters. Two factors were: duration (0, 15, 30, 45, 60, 75 and 90 days) and salinity (0, 2, 4, 6, 8, 10 and 12%). Seven sets of aquariums having 60 L of water capacity were stocked with 20 fish in each. The replacement of water from each aquarium was done for every 7 days by siphoning the bottom of the aquariums for 90 days rearing period. To determine the effects of salinity, fingerlings were exposed into 0, 2, 4, 6, 8, 10 and 12% salinity for 90 days rearing period in the Laboratory. For the purpose of conditioning 300 L static rectangular plastic tank was used. At first the fish fingerlings were released into the plastic tank at 0% salinity. After 48 hours of acclimatization 20 fish fingerling were released at the 0% salinity water while the rest of the fingerlings were kept inside the

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plastic tank at 2% salinity for the next 48 hours. After another 48 hours of acclimatization 20 fish fingerlings were released at the 2% the rest of the fingerlings were again kept inside the plastic tank at 4% saline water for the next 48 hours. Following this procedure the salinity was raised up to 12%. Finally the mortality, growth and other responses of the fish were observed at different salinities. Sampling was accomplished at the 15th, 30th, 45th, 60th, 75th and 90th day of the experimental period which included recording of length and weight of individual fish.

Water quality parameters such as pH, dissolved oxygen (DO) and temperature were recorded in each alternative day. The fish were fed with fish feed meal of 50% Crude protein (CP) at 10% of total body weight. Weight gain was calculated by subtracting initial mean weight from the final mean weight. Specific growth rate (SGR), Feed conversion ratio (FCR), Average daily gain (ADG) and Condition factor (K) were calculated at the end of the each experiment for each salinity level using the formulae reported by Hopkins [11].

SGR (%)=(In W_2–lnW_1) / (T_2-T_1) ×100, Where, W_1=Initial weight (g), W_2=Final weight (g), T_1=Initial time (day) and T_2=Final time (day); FCR=Feed (g) consumed by the fish / (W_2-W_1), Where, W_1=Initial weight (g)and W_2=Final weight (g); ADG=(W_2-W_1) / (T_2-T_1), Where, W_1=Initial weight (g), W_2=Final weight (g), T1=Initial time (day) and T_2=Final time (day); K=(W/ L^3)×100, Where, W=Weight (g)and L=Length (cm)

Data were expressed as mean ± standard error of the means. General Linear Model (GLM) of two way ANOVA was used to analyze the data. Statistical software SPSS version 11.5 was used to analyze data with the levels of significance at p<0.05.

Results

Effects of salinity on the survival of *L. rohita*

100% survival rate was recorded in 0 to 6% salinities, 40% survival rate in 8% salinity and all death (100% mortality) in 10 and 12% salinities (Figure 1). All fingerlings survived in 0 to 6% salinities at 90 day rearing period. In 8% salinity survival rate was 85% at 30 days rearing period and then decreased up to 40% at 90 days rearing period. At 10% salinity survival rate was 100% up to 2 days and then dropped into 20% at 3rd day and 0% (100% mortality) at 4th day. In 12% salinity 100% survival was recorded at 1st day but it dropped to 0% at next day (Table 1).

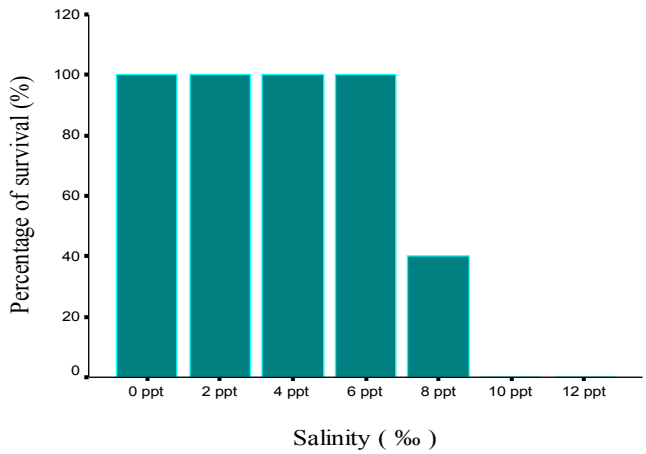

Figure 1: Percentage survival of *L. rohita* in different salinities.

Effects of salinity on specific growth rate and average daily gain

Specific growth rate (SGR) decreased as the salinity increased. The highest SGR was recorded at 0% salinity and lowest SGR was recorded at 8% salinity (Figure 2). The average daily gain (ADG) of *Labeo rohita* was similarly decreased like SGR as the salinity increased. Maximum ADG was found at 2% salinity and then it was decreased (Figure 3).

Similar SGR was found in rohu fingerlings reared at all salinities and rearing period (F=3.351, p>0.05; Table 2). However, the highest SGR (0.80 ± 0.37) was detected at 15 day duration while the lowest SGR (0.25 ± 0.50) at 90 day rearing period at 0‰ and 8‰ salinity respectively (Table 2).

Two way ANOVA results revealed that the effects of salinity on average daily gain (ADG) was found to be significant (F=33.557, p<0.05). FCR was found to be different at least one of possible pairs of salinity and duration. Post-hoc pair-wise comparison (LSD) was applied to determine the significant pair. Significantly higher ADG was found in rohu fingerlings reared at 0% salinity at 45 day (F=33.557, p<0.05; Table 3).

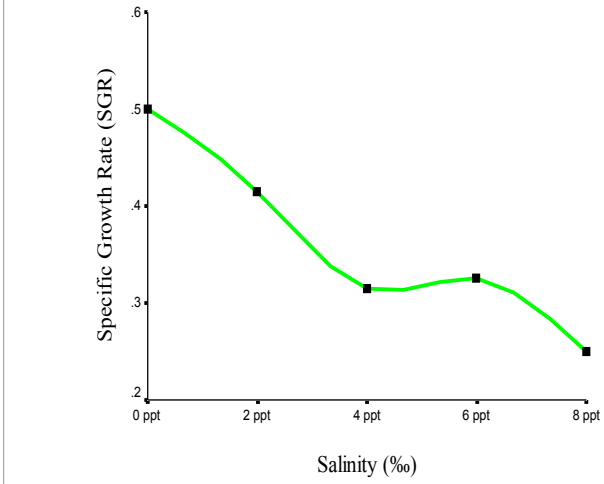

Figure 2: Specific growth rate (SGR) of *Labeo rohita* in different salinities.

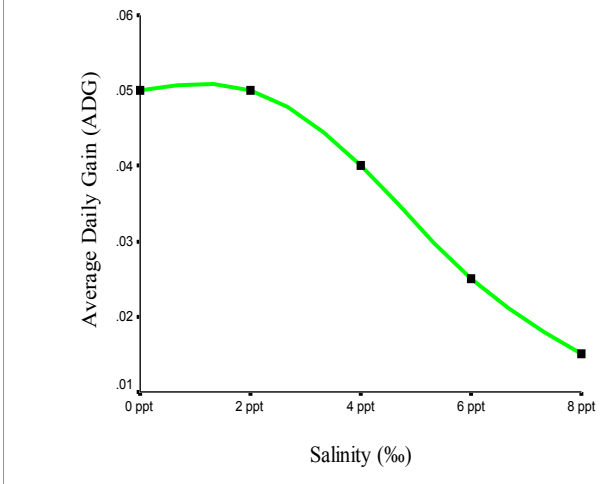

Figure 3: Average daily gain (ADG) of *Labeo rohita* in different salinities.

Salinity (%)	Survival rate (%) in different duration (Mean ± SEM)						
	0 day	15 day	30 day	45 day	60 day	75day	90 day
0	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}
2	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}
4	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}
6	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}	100 ± 0.0^{a}
8	100 ± 0.0^{aA}	100 ± 0.0^{aA}	85 ± 5.0^{bB}	65 ± 5.0^{bC}	55 ± 5.0^{bD}	50 ±10.0^{bD}	40 ± 10.0^{bE}
10	00 ± 0.0^{b}	00 ± 0.0^{b}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}
12	00 ± 0.0^{b}	00 ± 0.0^{b}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}	00 ± 0.0^{c}

Table 1: Survival rate (%) of rohu fingerlings in different salinity (%) of 90 day rearing.

Salinity (%)	SGR (%; (Mean ± SEM)					
	15 day	30 day	45 day	60 day	75 day	90 day
0	0.80 ± 0.37	0.80 ± 0.20	0.74 ± 0.19	0.61 ± 0.14	0.49 ± 0.19	0.50 ± 0.05
2	0.65 ± 0.05	0.59 ± 0.02	0.55 ± 0.03	0.46 ± 0.02	0.45 ± 0.01	0.42 ± 0.02
4	0.43 ± 0.03	0.38 ± 0.02	0.41 ± 0.02	0.36 ± 0.02	0.33 ± 0.01	0.32 ± 0.03
6	0.45 ± 0.02	0.45 ± 0.05	0.40 ± 0.03	0.40 ± 0.04	0.39 ± 0.03	0.33 ± 0.03
8	0.33 ± 0.03	0.50 ± 0.12	0.38 ± 0.07	0.38 ± 0.17	0.52 ± 0.31	0.25 ± 0.50

Table 2: Specific growth rate at 90 day rearing period of rohu fingerlings at different salinity with level of significance at p<0.05.

Salinity (%)	ADG(Mean ± SEM)					
	15 day	30 day	45 day	60 day	75 day	90 day
0	0.05 ± 0.01abc	0.06 ± 0.02ab	0.06 ± 0.01a	0.06 ± 0.02ab	0.05 ± 0.02abcd	0.05 ± 0.00abc
2	0.05 ± 0.00abc	0.05 ± 0.00abc	0.05 ± 0.00abc	0.05 ± 0.01abcd	0.05 ± 0.00abc	0.05 ± 0.00abc
4	0.04 ± 0.00abcd	0.04 ± 0.00abcd	0.04 ± 0.00abcd	0.04 ± 0.00abcd	0.04 ± 0.00abcd	0.04 ± 0.00abcd
6	0.03 ± 0.01abcd	0.03 ± 0.01abcd	0.03 ± 0.01abcd	0.03 ± 0.01abcd	0.03 ± 0.01abcd	0.03 ± 0.01abcd
8	0.02 ± 0.01cd	0.02 ± 0.01bcd	0.02 ± 0.02cd	0.02 ± 0.01bcd	0.01 ± 0.00d	0.02 ± 0.02cd

Table 3: Average daily gain at 90 day rearing period of rohu fingerlings at different salinity. Different letters denote significant difference within treatment and duration (p<0.05).

Effects of salinity on condition factor and feed conversion ratio

Condition factor (K) of rohu fish was similar up to 4% salinity and then it drastically increased at 6% and 8% salinity. However, lowest K was recorded at 0% salinity (Figure 4). Increasing trends of feed conversion ratio (FCR) was found with increasing salinity up to 6‰ and then decreased at 8‰ salinity. However, highest FCR was recorded at 6‰ salinity (Figure 5).

Two way ANOVA results revealed that the effects of salinity on condition factor was found to be significant (F=22.591, p<0.05). FCR was found to be different at least one of possible pairs of salinity and duration. Post-hoc pair-wise comparison (LSD) was applied to determine the significant pair. Significantly higher Condition factor, K was found in rohu fingerlings reared at 8% and both 4% and 6% salinity at 90 and 15 day respectively than that of others (F=22.591, p<0.05) while similar K was observed in respective salinity. Moreover higher K was found in rohu fingerlings reared at all duration of 6% and 8% salinity than that of other salinity while similar K was observed at the same duration at 0%, 2% and 4% salinity level (Table 4).

Two way ANOVA results revealed that effects of salinity on FCR was found to be significant (F=31.237, p<0.05). FCR was found to be different at least one of possible pairs of salinity and duration. Post-hoc pair-wise comparison (LSD) was applied for analyzing which pair was significant. Significantly higher FCR was found in rohu fingerlings reared at 0% and 2% at 60 day, 4% and both 6% and 8% salinity at 30 and 90 day respectively and than that of others (F=31.237, p<0.05) while similar FCR was observed at the same salinity respectively (Table 5). Moreover, significantly higher FCR was detected in rohu fingerlings reared at 6% and 8% salinity for all duration than that of others while similar FCR was observed at the same duration at 0%, 2% and 4% salinity level (F=31.237, p<0.05).

Effect of salinity on threat response of *L. rohita*

The fish exhibited a normal response to treat between 0 to 6% salinity levels (Table 6). At 8% salinity first 15 days showed moderate response and next 15 days showed hyper activeness and death was recorded at 30 day of rearing period. In 10% salinity hyper activeness showed at first two days and all death was recorded within 4 days. At 12% salinity death was recorded from very first day and all death within 2 days.

Effect of salinity on feeding response of *L. rohita*

Fish showed very high appetitive behavior to food between 0 to 4% salinities (Table 7). Different level of response to feeding, very high appetite, moderate appetite, low appetite and death were displayed between 6 to 12% salinity levels.

Discussion

The findings of the study showed that rohu, could tolerate salinity regime between 0 to 6%. In this regime no mortality were recorded. High growth performances in terms of total length (TL), body weight (BW), specific growth rate (SGR), feed conversion ratio (FCR), average daily gain (ADG) and condition factor (K) were recorded between 0 to 4% salinity level. This is an indication that the fish were perfectly able to regulate their body physiology within this regime. 100% mortality was recorded in 10 and 12% salinity which indicates the developed osmo-regulatory failure in fish. Salinity stress in freshwater fish affects primarily gills, as the major organ involved both in osmoregulation and waste nitrogen excretion [1]. High salinity displayed a highly

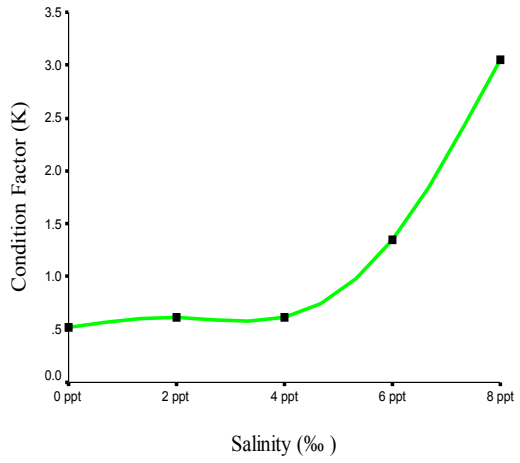

Figure 4: Condition factor (K) of *Labeo rohita* in different salinities.

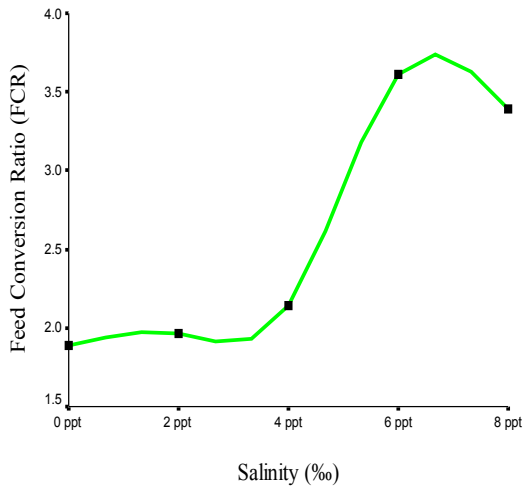

Figure 5: Feed conversion ratio (FCR) of *Labeo rohita* in different salinities.

Salinity (‰)	K					
	15 day	30 day	45 day	60 day	75 day	90 day
0	0.87±0.05^{ab}	0.78± 0.06^{ab}	0.71 ± 0.07^{b}	0.65 ± 0.07^{b}	0.59 ± 0.08^{b}	0.53 ± 0.07^{b}
2	1.01± 0.01+	0.91± 0.01^{ab}	0.82± 0.00^{ab}	0.74 ±0.00^{b}	0.68 ± 0.01^{b}	0.62 ± 0.01^{b}
4	0.88± 0.02^{ab}	0.80± 0.04^{ab}	0.74 ± 0.03^{b}	0.70 ± 0.03^{b}	0.65 ± 0.02^{b}	0.61 ±0.02^{b}
6	2.03± 0.51^{ab}	1.88± 0.46^{ab}	1.72± 0.40^{ab}	1.58± 0.36^{ab}	1.46± 0.30^{ab}	1.35± 0.26^{ab}
8	2.10± 0.28^{ab}	2.19± 0.78^{ab}	2.32± 0.28^{ab}	2.35± 0.49^{ab}	2.56± 0.82^{ab}	3.06± 1.45^{a}

Table 4: Condition factor at 90 day rearing period of rohu fingerlings at different salinity. Different letters denote significant difference within treatment and duration.

Salinity (‰)	FCR					
	15 day	30 day	45 day	60 day	75 day	90 day
0	1.98 ± 0.02^{e}	1.85± 0.12^{e}	1.79 ± 0.05^{e}	2.42± 0.65^{abcde}	2.14± 0.46^{bcde}	1.89 ± 0.01^{e}
2	2.12 ± 0.06^{bcde}	1.97± 0.02^{e}	1.89 ± 0.01^{e}	1.98 ± 0.03^{e}	1.99± 0.21^{e}	1.97 ± 0.01^{e}
4	2.07 ± 0.02+	2.38± 0.23^{abcd}	2.14± 0.06^{bcde}	2.27± 0.17^{bcde}	2.09± 0.01^{cde}	2.15± 0.14^{bcde}
6	2.60± 0.10^{abcde}	2.73± 0.07^{abcde}	2.62± 0.10^{abcde}	2.79± 0.16^{abcde}	3.28± 0.23^{abcd}	3.62± 0.34^{a}
8	2.74± 0.05^{abcde}	2.84 ± 0.06^{abcde}	2.62± 0.25^{abcde}	3.35± 0.34^{abcde}	3.01± 0.47^{abcde}	3.39± 0.19^{ab}

Table 5: Feed conversion ratio at 90 day rearing period of rohu fingerlings at different salinity. Different letters denote significant difference within treatment and duration ($p<0.05$).

disrupted epithelium with a diffuse oedema of both the primary and the secondary lamellae [6] and this could be the reason why 100% Rohu fish were died in salinity 10% and above. Significant difference in *Labeo rohita* and *Cirrhinus mrigala* in tolerance of salinity was recorded and tolerance of salinity upto 6% by *Labeo rohita* was found which supports the present findings [12]. A erotic behavioral patterns in different carps at different salinity was observed, where common carp showed higher tolerant to salinity than that of rohu and mirigal [13]. On the other hand research with grass carp fingerlings, 71-90% mortality in 24 h under 15% salinity was reported [14].

The study also indicated that the feed conversion ratio values in fish reared at 0, 2 and 4% indicates good growth rate. At 6% salinity good FCR values were observed for up to 60 days then increasing value was found. Better FCR (1.79 ± 0.05) showed 0% salinity at 45 day. The efficiency of feed conversion depends on many factors but the best response is probably strongly related to optimize the environment to approximate that to which the fish is accustomed [15]. Growth rate, feed intake and feed conversion efficiency of *Oncorhynchus kisutch* had the highest values at salinities 5 to 10% [16]. FCR value of Cyprinus carpio was reported between1.8 and 3.0 elsewhere [17].

In terms of specific growth rate (SGR) the highest SGR (0.80 ± 0.37) was detected at 0% at 15 day duration, but SGR decreased with increasing salinity. Pike silverside, *Chrostoma estor* can tolerate salinity up to 5% but SGR and survival reduced at salinities of 10% and above [18,19]. It has been reported that some freshwater euryhaline species had better SGR and FCR at 1 to 4% salinity compared to 7 to 9% salinity level [20].

During the experiment, *L. rohita* showed nearly similar average daily gain (ADG) between 0 to 4% salinities at 90 days rearing period. The maximum ADG was recorded at 0% salinity at 30, 45 and 60 days and lower ADG was found in 8% salinity at 75 day. Increased ADG of the fish suggested that the fish were able to regulate osmotic pressure of the body fluids, the more the osmo-regulatory adaptation, lesser the difference between the compositions and pressures of the internal fluid of the organism and its external environment [1]. Some authors suggested that at 10% salinity *Oreochromis mossambicus* was able to osmoregulate more efficiently with a consequent daily gain [21,22].

Condition factor (K) of this research work showed the less variation and good performance between 0 to 4% salinity. Here K increased according to salinity increased but at 8% salinity the increment was

Day	Salinity concentration (‰)						
	0	2	4	6	8	10	12
01	N	N	N	N	M	H	D
03	N	N	N	N	M	H	D
06	N	N	N	N	M	D	D
09	N	N	N	N	M	D	D
12	N	N	N	N	M	D	D
15	N	N	N	N	M	D	D
18	N	N	N	N	H	D	D
21	N	N	N	N	H	D	D
24	N	N	N	N	H	D	D
27	N	N	N	N	H	D	D
30	N	N	N	N	D	D	D
33	N	N	N	N	D	D	D
36	N	N	N	N	D	D	D
39	N	N	N	N	D	D	D
42	N	N	N	N	D	D	D
45	N	N	N	N	D	D	D
48	N	N	N	N	D	D	D
51	N	N	N	N	D	D	D
54	N	N	N	N	D	D	D
57	N	N	N	N	D	D	D
60	N	N	N	N	D	D	D
63	N	N	N	N	D	D	D
66	N	N	N	N	D	D	D
69	N	N	N	N	D	D	D
72	N	N	N	N	D	D	D
75	N	N	N	N	D	D	D
78	N	N	N	N	D	D	D
81	N	N	N	N	D	D	D
84	N	N	N	N	D	D	D
87	N	N	N	N	D	D	D
90	N	N	N	N	D	D	D

N= Normal Response, M= Moderate Response, H= Hyperactive, D= Death

Table 6: Threat response of *L. rohita* in different salinity regimes at different duration.

Day	Salinity concentration in (‰)						
	0	2	4	6	8	10	12
01	VHA	VHA	VHA	VHA	HA	LA	LA
03	VHA	VHA	VHA	VHA	HA	LA	D
06	VHA	VHA	VHA	VHA	HA	D	D
09	VHA	VHA	VHA	VHA	HA	D	D
12	VHA	VHA	VHA	VHA	HA	D	D
15	VHA	VHA	VHA	VHA	MA	D	D
18	VHA	VHA	VHA	VHA	MA	D	D
21	VHA	VHA	VHA	VHA	MA	D	D
24	VHA	VHA	VHA	VHA	MA	D	D
27	VHA	VHA	VHA	VHA	MA	D	D
30	VHA	VHA	VHA	VHA	MA	D	D
33	VHA	VHA	VHA	VHA	MA	D	D
36	VHA	VHA	VHA	VHA	MA	D	D
39	VHA	VHA	VHA	VHA	MA	D	D
42	VHA	VHA	VHA	HA	MA	D	D
45	VHA	VHA	VHA	HA	MA	D	D
48	VHA	VHA	VHA	HA	MA	D	D
51	VHA	VHA	VHA	HA	LA	D	D
54	VHA	VHA	VHA	HA	LA	D	D
57	VHA	VHA	VHA	HA	LA	D	D
60	VHA	VHA	VHA	HA	LA	D	D
63	VHA	VHA	VHA	HA	LA	D	D
66	VHA	VHA	VHA	LA	LA	D	D
69	VHA	VHA	VHA	LA	LA	D	D
72	VHA	VHA	VHA	LA	LA	D	D
75	VHA	VHA	VHA	LA	LA	D	D
78	VHA	VHA	VHA	LA	LA	D	D
81	VHA	VHA	VHA	LA	LA	D	D
84	VHA	VHA	VHA	LA	LA	D	D
87	VHA	VHA	VHA	LA	LA	D	D
90	VHA	VHA	VHA	LA	LA	D	D

VHA= Very High Appetite, HA= High Appetite, MA= Moderate Appetite, LA= Low Appetite, D= Death

Table 7: Summary of daily feeding response of *L. rohita* in different salinity regimes.

greater than other treatments. The better K value (0.53 ± 0.07) was found in 0% salinity at 90 day. The maximum K value was found in 8% salinity level at 90 day. This finding is in agreement with the result of similar investigations with *Clarias batrachus* [23].

Fish behavioral characteristics are highly influenced by the metabolism rate and fish become restless due to high salinity as this increases fish metabolism rate. The restlessness or hyper-activeness or erratic behavior in high salinities indicates fast rate at which the fish were approaching their tolerance limits and loss of water to external medium from the body. In case of *L. rohita* from this research normal response was found up to 6% salinity and then hyper-activeness or erratic behavior or death shown at 8 to 12%.Some authors reported external lesions and severe hemorrhages in internal organs in *O. aureusin* 10 to 12% salinities [24,25].

High appetitive behavior of *L. rohita* was recorded between 0 to 4% salinity level in this study and sequentially lowered and death occurred at 6 to 12%.The high appetitive behavior displayed by the fish towards food is an indication that fish body metabolism can still be maintained or regulated in these salinities, while low appetite is an indication of near or total body metabolic break down. High appetitive behavior between 0 to 6% salinities was observed by *Oreochromis niloticus* which has been reported by some authors [26-28].

Conclusion

This research reveals that rohu fingerlings can adapt to gradual increase of salinity. Normal growth was observed at salinity regimes of 0-4%. However, the most preferred salinity was 2%. In Bangladesh about 60 million people live in coastal zone (the coast line is about 710 km long).It is almost impossible to relocate the vast number of inhabitants from the coastal zone as the country is heavily overpopulated and tiny. Therefore, adaptation with the changed climatic condition is the best policy to combat the global climate change. In that aspect the finding of this study could be applicable in carp polyculture in saline water contaminated coastal ponds as rohu fish can be easily grown up to 4% salinity.

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