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Effect of Salinity on Survival and Growth Parameters of Shyrbot (*Barbus grypus*) Fingerlings

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Abstract: Effects of different salinity (0, 3, 6, 9, 12 and 15 ppt) on growth and survival of Shyrbot (*Barbus grypus*) fingerlings were studied for 60 days. The results showed no significant effect ($p>0.01$) in weight gain (WG), percentage body weight gain (% BWG), specific growth rate (SGR), daily growth rate (DGR) and the condition factor (CF) for those fishes reared in 0 to 6 ppt salinity. But negative impacts were observed on the growth parameters of fish reared in 9, 12 and 15 ppt with the lowest growth rate and food intake observed in 15 and 12 ppt respectively. Also, there was significant difference ($P<0.01$) in FCR among the treatment. The best FCR result was obtained in freshwater (2.96) and the highest result (5.61) was for 12 ppt whereas negative FCR (-2.39) was obtained for 15 ppt treatment. Mortality was observed in 12 ppt, with no significant difference ($p>0.01$) and 15 ppt salinity, with significant difference ($p<0.01$) compared to other treatments.

Key words: Shyrbot · *Barbus grypus* · Salinity · Growth Rate · Survival

INTRODUCTION

If an optimum point for each water quality variable can be determined, production efficiency may be increased by managing culture systems for optimal growth. Since fish are poikilothermic and live permanently immersed in water, they are directly affected by changes in their ambient medium [1]. Many physical and chemical parameters affect fish, but fluctuating salinity is one of the most conspicuous physiological challenges faced during development. In fact, salinity may affect survival, growth and overall health of larvae and juveniles [2].

Salinity affects the growth rate and survival through osmotic pressure [3, 4]. As salinity increases changes occur in the physiology of fish and to provide the energy required for osmotic pressure, fish need more oxygen [5]. Since in low saline water the osmotic pressure of body fluids is almost equal to the environment, animal in these environments spend less energy on osmoregulation and as a result more energy is used for growth and survival [6]. Thus, larvae rearing of some freshwater fishes in lower salinities can result in higher growth rate and survival than in freshwater [7]. Data available on the effect of salinity on growth rate of young and adult stages of stenohaline species is scare [4, 8-12]. Most studies related to the effect of salinity on growth are mainly related to migratory species such as tilapia and Salmonidae [13] and some freshwater fishes such as catfish, *Clarias batracus* [14] and common carp, *Cyprinus carpio* [15].

Shyrbot (*Barbus grypus*) is one of the valuable fresh waters fishes of West and South West and specially Khuzestan province of Iran which due to its top quality meat and lower market price have a high marketable value among the indigenous inhabitants in those regions. Due to high demand it was introduced to aquaculture ponds in 2006. Therefore, due to aridity and availability of a wide range of brackish water sources in the country, the possibility of raising shyrbot fish in different salinities was investigated in this study.

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MATERIALS AND METHODS

A total of 1000 shyrbot (*Barbus grypus*) fingerlings with an average weight of 3.69 g were purchased from Indigenous fish development center of Susangerd and transferred to the Aquaculture Institute of South of Iran. They were acclimatized for one week in 1 m^3 fiberglass tanks containing freshwater with 29.2°C temperature and pH of 7.4. They were then divided into 6 different groups and were introduced to 0, 3, 6, 9, 12 and 15 ppt. salinity. Total of 45 fishes were randomly selected for each treatment and after biometry 15 fishes were introduced to one aquarium (3 repetitions) holding 30 liters of brackish water. Five percent of the biomass was fed to the fishes 5 times a day. A plastic filter was placed at the bottom of each aquarium to accumulate the remaining food. Water exchange was done every 4 days and water quality parameters were controlled during the experiment.

Fishes were reared under these conditions for 60 days and every two weeks biometric operation was performed for each tank. Growth parameters were calculated using the following formula:

Survival % = Number of fish/ Number of dead fish × 100 [16].

Weight Gain (WG) = Final weight - Initial weight [17].

Body weight % = (Final weight –Initial weight) / Initial weight × 100 [18].

Condition factor (CF) = Weight / $Length^3$ ×100 [17].

Specific growth rate (SGR) = $(LnW_2 – LnW_1) / T_2 – T_1$ [19].

Daily growth rate (DGR) = Final weight – Initial weight/Time [20].

Feed conversion ratio (FCR) = Feed given/weight acquired [17].

Physicochemical properties of water including temperature, salinity, pH and oxygen were measured on daily basis.

This study was conducted using a completely randomized design with 3 replications. Data were analyzed using ANOVA and Duncan test at a confidence level of 99% on SAS software. Graphs were plotted using Excel.

RESULTS

Water quality parameters (Table 1) including temperature, dissolve oxygen and pH were within the acceptable levels for warm water aquaculture defined by Boyd [21]. Effect of different salinity on survival of shyrbot is shown in Figure 1. Mortality was observed in 12 ppt treatment (77.76%), which showed no significant difference to other treatments and 15 ppt salinity (86.66%) with significant difference ($p<0.01$) compared to other treatments.

Growth factors (weight gain, condition factor, specific growth rate, percentage of body weight gain and feed conversion ratio) was compared among the treatments (Table 2) which shows a significant differences ($P<0.01$) among the treatments. The negative effects of increased salinity were found in fishes reared in 15, 12 and 9 ppt. respectively, where slow growth, lower food intake and high FCR were observed. Signs of stress, restlessness and also change in the appearance (smaller diameters and elongated body) were evident in fishes reared in 15 and 12 ppt salinity. The highest growth rates were observed in freshwater followed by 3 and 6 ppt salinity (Fig. 2).

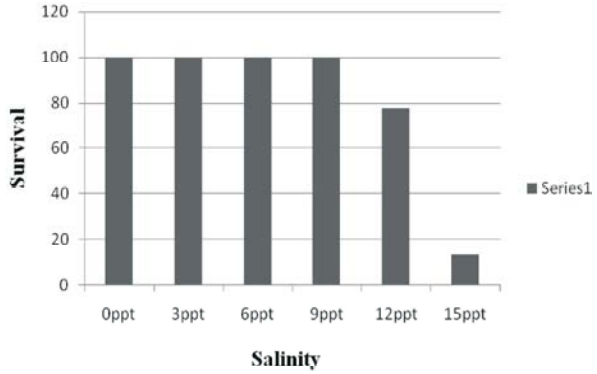

Fig. 1: Effect of salinity on survival rate of *Barbus grypus*

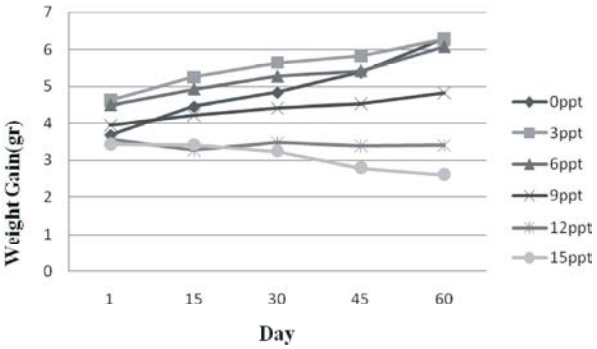

Fig. 2: Effect of salinity on growth rate of *Barbus grypus* during the experiment

Table 1: Average water quality parameters during the experiment

Salinity (ppt)	Oxygen (Milligrams per liter)	Temperature (° C)	pH
0	8.73	26.73	7.79
3	8.48	26.57	7.85
6	7.37	26.52	7.86
9	6.93	26.58	7.93
12	6.47	26.56	7.95
15	6.98	26.58	7.93

Table 2: Mean growth index of Shyrbot (*Barbus grypus*) fingerlings after 60 days of exposure to different salinities

Salinity (ppt)	Feed conversion ratio	Specific growth rate	Weight Gain (%)	Survival rates (%)	Daily growth rate	Condition Factor (%)
0	2.97^{b}	0.083^{a}	13.05^{a}	100.00^{a}	0.01^{a}	0.79^{a}
3	4.33^{ab}	0.06^{ab}	10.37^{ab}	100.00^{a}	0.01^{a}	0.78^{a}
6	4.21^{ab}	0.06^{ab}	10.07^{ab}	100.00^{a}	0.01^{a}	0.78^{a}
9	5.53^{a}	0.04^{b}	7.42^{b}	100.00^{a}	0.007^{b}	0.74^{a}
12	-5.61^{d}	-0.01^{c}	-2.81^{c}	77.76^{a}	-0.0026^{c}	0.65^{b}
15	-2.39^{c}	-0.002^{d}	-14.04^{d}	13.33^{b}	-0.004^{d}	0.041^{c}

Different letters represents a significant difference at the 99% confidential level.

DISCUSSION

It has been shown that at a low salinity of 3 ppt, oxygen consumption and metabolic rates of silver carp (*Hypophthalmichthys molitrix*) and common carp (*Cyprinus carpio*) are low because they spend less energy to maintain the proper balance of inside body [22]. During our experiments, fishes reared in 9 to 15 ppt salinity were gathered around the air stone and showed signs of stress, restlessness and mortality. This is maybe due to the founding that as salinity increases, fish need more oxygen and changes in fish physiology occur to provide energy required to regulate osmotic pressure [5]. As indicated in Fig. 1, mortality started in 12 ppt and increased in 15 ppt. This mean that an inversely proportional relationship exist between salinity level and survival of fingerlings because as the level of salinity in water increases the percent survival of fingerlings decreases. In previous studies, Luz *et al.* [23] showed that there were no casualties in transferring goldfish (*Carassius auratus*) to 0, 2, 4, 6, 8, 10 ppt for 21 days. Also Cecil *et al.* [24] in a study on fish survival and reproduction *Acipencer brevirostrum* showed that the salinity in the range of 14.8 to 20.9 ppt led to 50% mortality of fishes.

Table 2 shows the growth of shyrbot fish during this study. The growth rate is highest in freshwater closely followed by 3 and 6 ppt. salinity. The growth rate decreases as salinity increases and showed a significant difference at higher salinity ($p>0.01$). This result confirms Klaoudatos and Conides [25] work that increase in salinity causes an overall decrease in growth rate in freshwater fishes and hence higher salt concentration could be said to hamper growth in freshwater fish. Loss of energy due to osmoregulation and stress could be the most important factor. Salinities of 9, 12 and 15 ppt had a negative impact on fish growth and fish growth was significantly decreased in these salinities which can be due to the loss of energy on osmoregulation. In general, in an isosmotic environment, less amount of energy spends on osmoregulation and most of the energy is used for growth and development [6, 26]. Shyrbot fishes in control spent more energy on growth and since no significant difference was observed between growth parameters of control and the other 2 treatments (3 and 6 ppt), culture of shyrbot fishes in brackish water up to 6 ppt is recommended.

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