THE EFFECTS OF SALINITY ON GROWTH OF SWORD TAIL, *XIPHOPHORUS HELLERI* (HECKEL, 1848)

Chinmaya Nanda[1], Mukesh Kumar Bairwa[2*], Sushree Subhasini Behera[3] and Saroj Kumar Swain[2]

[1]*ICAR-Central Institute of Fisheries Education, Mumbai, Maharashtra*

[2]*ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha-751002*

[3]*College of Fisheries, Junagadh, Veraval, Gujarat*

**Corresponding author: mukeshbairwa2@gmail.com*

This study was conducted to evaluate effect of different salinities (0, 2, 4, 6 ppt) on growth and survival of sword tail, *Xiphophorus helleri* for 45 days. The species were taken from the water sources, which has the salinity of zero ppt in the experimental unit and then transferred to control and respective treatments (T_1, 2 ppt, T_2 4 ppt and T_3, 6 ppt). Fifteen sword tail fish were placed in each aquarium (1.5x1.0x1.0 feet^3). They were fed with commercial feed along with plankton up to satiation once in a day and individually weighed at an interval of 15days. The highest final mean weight was recorded in T_1 (1.17 ± 0.09 mg) which was significantly (P<0.05) higher than control and other treatments. The final length of the sword tail reared in the control (4.45 ± 0.102 cm) and T_1 (4.45 ± 0.286 cm) was significantly different than other treatments T_2 (4.35 ± 0.076 cm) and T_3 (3.98 ± 0.119 cm). Survival was significantly different among the three salinity treatments (P<0.05). In conclusion, the species can grow well in water having the salinity of 2 ppt, but it can tolerate salinity of 6 ppt. These findings give us a lead to further upscale the study to understand the scope of culture of the ornamental species in saline affected areas.

INTRODUCTION

Growth is controlled in fish by environmental factors such as temperature, photoperiod and salinity. There are various studies on the effects of these factors on growth (Imsland *et al.*, 2001; Moustakas *et al.*, 2004; Engstrom-Ost *et al.*, 2005; Resley *et al.*, 2006; Kearney *et al.*, 2008; Luz *et al.*, 2008; Overton *et al.*, 2008; Arjona *et al.*, 2009). Nowadays, it is known that salinity affects fish growth rate but how it influences it is not totally understood. There is an accepted hypothesis of how salinity affects energy budget in fish. If salinity is too high or too low in the external environment than fish body fluid (depending on fresh water or marine fish), fish spends more energy to regulate osmotic balance. Therefore, less energy remains for growth in these environments because of the use of too much energy for active ion transport. It is recently cited that fish uses roughly 10% of total energy for osmoregulation (Boeuf and Payan, 2001). Salinity affects fish hormonal activity as well.

Swordtail (*Xiphophorus helleri*) is a freshwater fish in the family Poecilidae of the order Cyprinidontiformes. It is one of the earliest bred fish and the most commonly retained ornamental fish. Its original habitat is Mexico and Guatmala. The male grows up to 7.5 cm and female upto 11.5 cm in overall length. In domestic market swordtail male is sold in approximately Rs. 30-50. It is considered as a commercially important species in the market, though scarcity of published information about the salinity effect on growth of ornamental fishes. Therefore the aim of this study was to assess the influence of salinity on growth performance of sword tail as stenohaline fresh water fish. In this study, the fish is exposed to three salinity treatments (2 ppt, 4 ppt and 6 ppt) for 45 days to evaluate weight gain, specific growth rate, food intake and survival of sword tail in each treatment.

MATERIALS AND METHODS

This experiment was conducted in the ornamental fish hatchery of ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha. All the preparation needed for the experiment had been carried out in the unit. Three different salinity treatments (T_1 (2 ppt), T_2(4 ppt) and T_3 (6 ppt)) along with control were tested for sword tail. There were three replicate for each salinity treatment. Fishes were acclimatized for about 15 days before the experiment started. Sword tail (n = 15 i.e. stocking density@1 number/3 liter) 0.062 ± 0.03 g body weight, 3.10±0.11 cm length) were separately placed in each aquarium tank (27 litre each). Salinity was gradually raised by one ppt per day until desired salinity levels were reached in every treatment. The salinity was measured by Refractometer (Model 3250 Advanced Instruments, Inc.). Siphoning and water exchange (30%) was done weekly with water that had same salinity. Fishes were fed *ad libitum* twice a day for 45 days with commercially available feed (35% protein), Mixed zooplankton was given along with commercial feed once a day. All fish were weighed in each aquarium on days Initial, 15, 30 and45. Daily feed intake was determined for each replicate. Parameters of fish growth performance (weight gain, length gain and food intake) and survival were calculated (Hargreaves and Kucuk, 2001; Kangombe and Brown, 2008).

Formulae of growth parameters

$$\text{Percentage weight gain (WG \%)} = \frac{[(\text{Final Weight})-(\text{Initial Weight})]}{\text{Initial Weight}} X\,100$$

$$\text{Percentage length gain (LG \%)} = \frac{[(\text{Final Length})-(\text{Initial Weight})]}{\text{Initial Length}} X\,100$$

$$\text{Survival} = \frac{(\text{Number of fish at start of rearing})-(\text{Number of dead fish during rearing})}{\text{Number of fish at start of larval rearing}} X\,100$$

Statistical analysis

One way analysis of variance (ANOVA) was carried out using SPSS (Version 16.0, Chicago, IL, USA). Duncan's multiple range test was used for post – hoc analysis. All experimental data were expressed as mean ±SE.

RESULTS

Fishes were reared in the salinity range of control (0ppt), T_1 (2 ppt), T_2(4 ppt) and T_3 (6 ppt) for 45 day. Water quality parameters such as temperature, dissolved oxygen, alkalinity, hardness and pH were under the optimum range in all experiments (Table 1).

Table 1: Water quality parameters.

Parameters	Value (mean±SE)
Temperature (°C)	25.55 ± 0.43
DO (mg L^{-1})	6.15 ± 0.04
pH	7.37 ± 0.15
Free CO2 (mg L^{-1})	4.76 ± 1.19
Alkalinity (mg L^{-1})	86.59 ± 1.29
Hardness (mg L^{-1})	92.59 ± 1.35
NH4-N(mg L^{-1})	0.04 ± 0.01
NO3-N(mg L^{-1})	0.03 ± 0.01

Mean body weight

The mean body weight at the time of stocking was 0.62±0.03 mg. The mean body weight of fishes on 15day in different treatments was not significantly different (P<0.05). On 30daythe highest mean weight was recorded in T_1 treatment whereas lowest in control.The highest mean body weight on 45daywas also recorded in T_1 (1.17±0.09) group whereas lowest in T_3 (0.91±0.01) group and also had a stastical significant at 5% (Table 2).

Table 2: Mean body weight of Sword tail, *Xiphophorus helleri* larvae reared in different salinity at different time point.

Treatment	0 days	15 days	30 days	45 days
Control	$0.63±0.031^{a}$	$1.14±0.277^{a}$	$0.82±0.069^{a}$	$1.03±0.106^{b}$
T_1	$0.66±0.046^{a}$	$1.05±0.190^{a}$	$0.99±0.029^{b}$	$1.17±0.098^{b}$
T_2	$0.67±0.025^{a}$	$0.785±0.037^{a}$	$0.96±0.014^{b}$	$0.93±0.014^{ab}$
T_3	$0.63±0.005^{a}$	$0.68±0.008^{a}$	$0.89±0.005^{ab}$	$0.91±0.014^{a}$

Mean values (Mean ± SE) with different alphabets differ significantly among the treatments (P<0.05).

Mean body length

The mean body length of swordtail at the time of stoking was 3.10±0.10 cm. During the entire experimental period body length of fishes were not significantly different among the treatments. However, the highest mean body length was recorded in T_1 (4.45±0.28 cm) group whereas, lowest in T_3 (3.98±0.11 cm) group on 45 day of experiment (Table 3).

Table 3: Mean body length of Sword tail, *Xiphophoroushelleri* reared in different salinity density at different time point.

Treatment	0 days	15 days	30 days	45 days
Control	3.13±0.11 [a]	3.65±0.14 [a]	4.06±0.15 [a]	4.45±0.10 [a]
T_1	3.10±0.10 [a]	3.68±3.13 [a]	4.36±0.15 [a]	4.45±0.28 [a]
T_2	3.13±0.09 [a]	3.86±0.18 [a]	4.28±0.17 [a]	4.35±0.07 [a]
T_3	3.15±0.11 [a]	3.75±0.17 [a]	4.20±0.17 [a]	3.98±0.11 [a]

Mean values (Mean ± SE) with different alphabets differ significantly among the treatments (P<0.05).

Weight gain (%)

In present experiment after 45 day rearing of swordtail, the highest weight gain (%) was recorded in T_1 group, whereas lowest in T_3 group. Here weight gain (%) in T_1 was significantly different from other treatment group (Fig. 1).

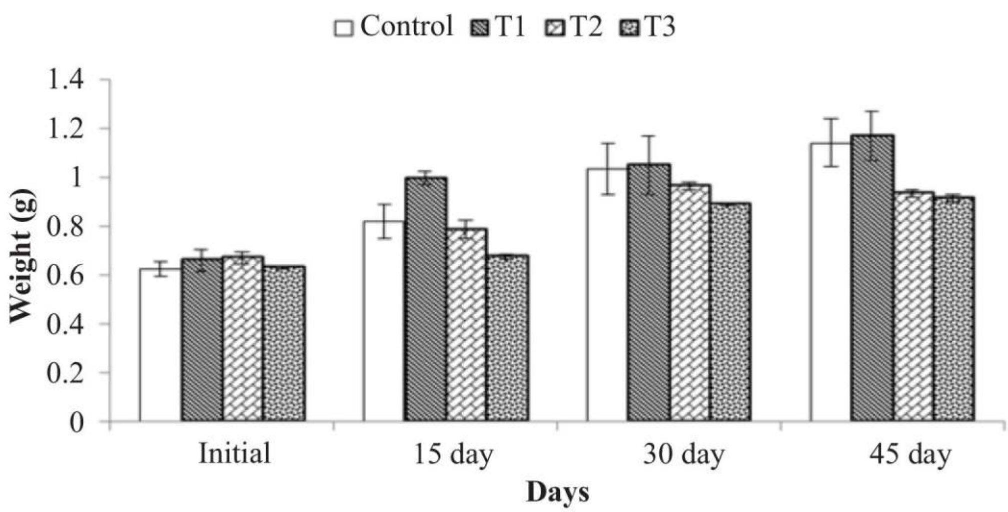

Fig. 1. Weight gain (%) of Sword tail, *Xiphophorous helleri* reared in different salinity at different time point.Mean values (Mean ± SE) with different alphabets differ significantly among the treatments (P<0.05).

Length gain (%)

Length gain (%) in T_1 larval group was significantly higher (P < 0.05) than other groups. In present study, the highest length gain (%) was recorded in T_1 larval group whereas lowest length gain (%) was in T_3 group (Fig. 1).

Survival (%)

The survival of different treatment was significantly different ($P < 0.05$) among the treatment than control. The highest survival was recorded in control (88.88 %) whereas lowest in T_3 treatment (73.33 %). During the experiment more mortality occurred during the initial days of rearing (mainly T_3) compare to later.

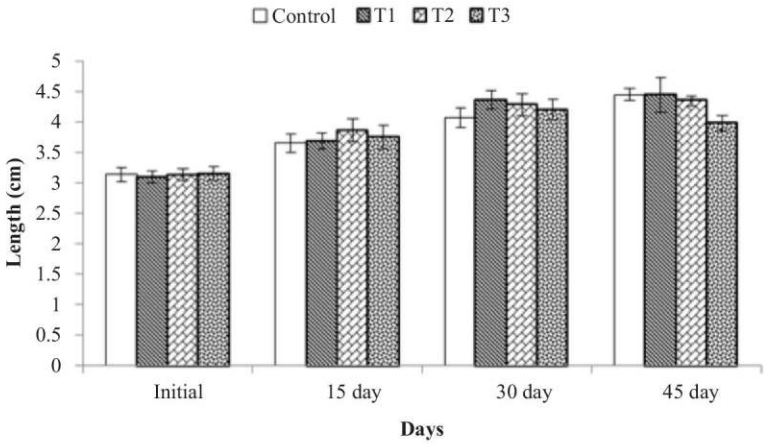

Fig. 2. Length gain (%) of Sword tail, *Xiphophorous helleri* reared in different salinity density at different time point.Mean values (Mean ± SE) with different alphabets differ significantly among the treatments (P<0.05).

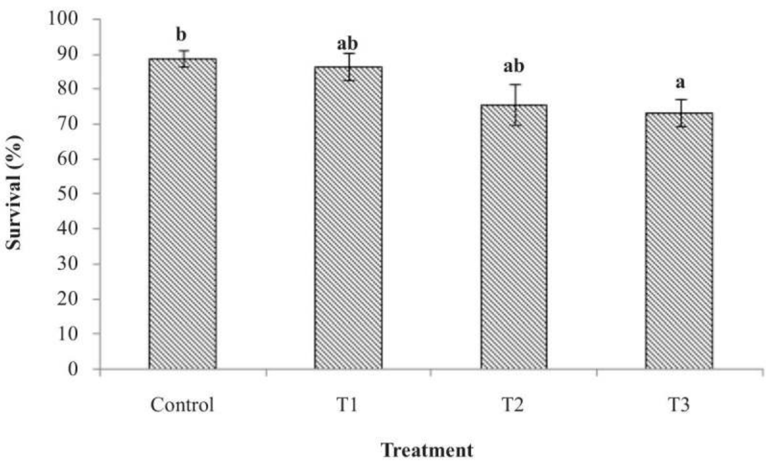

Fig. 3. Survival (%) of Sword tail, *Xiphophorous helleri* reared in different salinity density at different time point.Mean values (Mean ± SE) with different alphabets differ significantly among the treatments (P<0.05).

DISCUSSION

Aquaculturists are trying to find the optimum salinity conditions for each species so that fish production will increase and brackish water areas will be used more efficiently. In present study, sword tail, *Xiphophorus helleri* were reared in three different salinities with control as freshwater. The mean weight in T_1 group (2 ppt) was significantly higher than control however, mean length was not significantly different among the treatments. This result indicates that low saline water may be good for culture of swordtail.

The lower growth performance of swordtail at higher salinity may be due to that lower uptake of food by the fish. Wang *et al*. (1997) showed that food consumption rate decreased by increasing salinities in common carp. It began to reduce at salinity of 6.5 ppt. Even in marine fish, if salinity is too low (from 39 ppt to 15 ppt) in sole, it causes stress and fish decreases in feed intake and growth (Arjona *et al.,* 2008). In the present study, salinity increase resulted in reduction of food uptake. Wan *et al.*(2014) reported that culture of black molly (*P. sphenops*) in a slight saline condition from 3 to 6 PSU is better than freshwater. Luz *et al.* (2008) and Wang *et al.* (1997) found higher growth of gold fish and common carp respectively in low saline water compared to freshwater.

Freshwater fish generally grow well in both freshwater and low salinity environments. If salinity level increases more, growth rate starts declining. In the present study the survival showed significant difference among the treatments. The study indicates that salinity of6 ppt greatly affect the survival.

In conclusion present study recommends the culture of swordtail in low saline (2 ppt) water compared to freshwater however higher salinity (4 ppt and 6 ppt) does not suit for better growth.

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