

Assessment of the Effects of Feeding Frequency on Growth Performance and Survival Rate of Texas Cichlid Larvae (*Herichthys cyanoguttatus*)

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Abstract: This study (at 90 days) was carried out to evaluate the effect of feeding frequency on growth performance and survival rate Texas cichlid larvae (*Herichthys cyanoguttatus*). Four groups of texas cichlid larvae (average weight 0.5 ± 0.11 g) designed with 4 feeding frequencies every other day (S1), 1 meal a day (S2), 2 meals a day (S3) and 4 meals a day (S4) with 3 replicates of each treatment combination were applied in this study. The Texas cichlid larvae in experimental treatments were fed by commercial food (Biomar) with 5% of body weight. Feeding frequencies had positive effect on growth performance ($p < 0.05$). Final live weight and Specific Growth Rate (SGR) values of group S4 were significantly higher than those of the other groups ($p < 0.05$). Similar responses were observed for Body Weight Increased (BWI) and Daily Growth Rate (DGR) and the best BWI and DGR were obtained in the S4 that showed significantly different to other groups ($p < 0.05$). The best Feed Conversion Ratio (FCR) was obtained from four daily feeding (S4), however there were not significantly different between S4 and S3 ($p > 0.05$). Also feeding frequencies had positive affect fish survival rate but it had not showed any significantly different between treatments. The best results in growth performance and survival rate were obtained by feeding 4 meals a day (S4) and some what in S3.

Key words: Texas cichlid, *Herichthys cyanoguttatus*, feeding frequency, growth performance, survival rate, growth

INTRODUCTION

Ornamental fish farming is an important primary industry (Fishman, 2001). Ornamental fishes are often referred as living jewels due to their color, shape and behavior. They are peaceful, generally tiny, attractively colored and could be accommodated in confined spaces. Modern ornamental fish culture and breeding operations have become vertically and horizontally intensified, necessitating a continuous supply of nutritionally balanced, cost effective feed (Mandal *et al.*, 2010). Among one the most popular freshwater fish species in the aquarium trade industry is the Texas cichlid (*Herichthys cyanoguttatus*).

The Texas cichlid also known as the rio grande perch and the rio grande cichlid is an iridescent golden color with pearl highlights and white dots on its body and fins. There are several black spots at the base of the caudal fin and along the middle, rear half of the body. The juveniles have an iridescent pearl-gray body with white dots on the

body and fins. There is a black dot at the base of the caudal fin and one in the center of the body. It is also leaner in size. Since, diet cost represents 30-70% of the total operating cost of an aquaculture enterprise (Webster *et al.*, 2001) determination of the appropriate daily feeding rate and frequency required to give optimal growth and feed efficiency could reduce the amount of diet fed, decrease the amount of time involved in feeding and may increase profits. Results of feeding studies with fish suggest feeding rate or frequency may significant influence growth rate and body composition. Therefore, in different fish species cultured under various environmental and husbandry conditions, more effort is needed to calculate the optimum feeding rates and frequencies (Andrews and Pages, 1975; De Silva and Anderson, 1995). Many researchers studied the effect of feeding frequency on food intake and growth on edible fishes (Jobling, 1983; Bascinar *et al.*, 2007) but little attention has been paid to the impact of feeding frequency on growth and reproductive performance in

ornamental fishes (James and Sampath, 2003). The present study was aimed at determining optimum daily feeding frequencies of Texas cichlid.

MATERIALS AND METHODS

Fish: Larvae of Texas cichlid with initial weight, 0.5 ± 0.11 g were obtained from an Institute of commercial supplier the Ornamental Fish Hatchery in Gorgan, Iran. They were kept in glass aquariums (each with a dimension of $30 \times 40 \times 60$ cm). This study was conducted in a completely randomized design with 4 treatments and 3 replicates per treatment for a total of 30 larvae of Texas cichlid. The density of fish larvae per aquarium were 10 fish. The fish were weighed individually at the beginning during and at the end of the study. Water quality parameters of input water to rearing system were monitored each week throughout the experimental. The water temperature was $19.46 \pm 1.23^\circ\text{C}$, pH was 7.85 ± 0.26 and water oxygen level was maintained above 7.65 ± 0.55 mg L^{-1} during the experiment an electrical air pump (by a single filtration unit).

Feed analysis: Nutrient compositions of experimental diets (Biomar) are shown in Table 1. Proximate composition of diets was carried out using the Association of Analytical Chemists (AOAC, 2000) methods. Protein was determined by measuring nitrogen ($\text{N} \times 6.25$) using the Kjeldahl method crude fat was determined using petroleum ether (40-60 bp) extraction method with soxhlet apparatus and ash by combustion at 550°C .

Feeding frequency: In experiments, fishes were fed by commercial extruder diet (Biomar) to satiation. Triplicates of 5 feeding schedules were tested and every other day (S1) (6 a.m.), 1 meal day^{-1} (S2) (6 a.m.), 2 meal day^{-1} (S3) (6 a.m. and 12 p.m.) and 4 meals day^{-1} (S4) (6 a.m., 12 p.m., 18 p.m. and 12 a.m.), for 60 days.

Determination of growth parameters: Growth parameters were calculated as (Tacon, 1990; Hevroy *et al.*, 2005; Shalaby *et al.*, 2006; De Silva and Anderson, 1995; Ai *et al.*, 2006):

$$\text{BodyWeight Gain (BWG)} = \frac{\text{Final fish weight (G)} - \text{Initial fish weight (G)}}{\text{Initial fish weight (G)}} \quad (1)$$

Table 1: Nutrient composition of experimental diets (%)

Ingredients	Percentage
Protein	54.0
Lipid	18.0
Fiber	1.5
Ash	10.0
Vitamin	2.0

$$\text{Specific Growth Rate (SGR)} = (\text{Ln } W_t - \text{Ln } W_0) \times 100 \text{ ton}^{-1} \quad (2)$$

$$\text{Feed Conversion Ratio (FCR)} = P / (W_t - W_0) \quad (3)$$

$$\text{Daily Growth Rate (DGR)} = \left\{ \frac{100 \times (\text{Final weight (g)} - \text{Initial weight (g)})}{(\text{Days} \times \text{Initial weight (g)})} \right\} \quad (4)$$

$$\text{Survival rate} = (N_t \times 100 N_0^{-1}) \quad (5)$$

Statistical analysis: In order to determine significant differences, results were analyzed by One-way Analysis of Variance (ANOVA) and Duncan's Multiple Range Tests were used to analyze the significance of the difference among the means of treatments by using the SPSS program.

RESULTS AND DISCUSSION

Table 2 shows the growth performance in all different groups at the end of feeding trial. The mean body length and weight generally were improved by increasing the feeding frequency during the time (Fig. 1 and 2).

The maximum of Body Weight Gain (BWG) was observed in S4 (2.53 ± 0.8), followed by S3 (2.06 ± 0.32) and the lowest of BWG was observed in S1 (0.79 ± 0.06). Also Specific Growth Rate (SGR) values of treatments S4 (1.39 ± 0.19) was significantly higher than other groups ($p < 0.05$), followed by S3 (1.18 ± 0.5) and S2 (0.88 ± 0.02) that had significantly different to each other and other groups ($p < 0.05$). The lowest SGR was observed in S1 (0.63 ± 0.03) ($p < 0.05$).

The growth parameters were significantly affected by addition of frequency during the time to the rearing aquarium ($p < 0.05$). Also the Food Conversion Ratio (FCR) by increase feeding frequency was significantly decreased in comparison to those of other groups ($p < 0.05$) and the lowest FCR was observed in S4 (1.3 ± 0.12) and S3 (1.36 ± 0.05) and had not significantly different ($p > 0.05$) to each other but they had significantly different to S1 (1.83 ± 0.05) and S2 (1.66 ± 0.11). Daily Growth Rate (DGR) was also improved with the feeding frequency and the difference was significant among treatments ($p < 0.05$) and the maximum of DGR was observed in S4 (1.3 ± 0.06) followed by S3 (0.9 ± 0.11) that had significantly different to each other and other groups ($p < 0.05$). Followed by S2 (0.5 ± 0.17) and S1 (0.4 ± 0.01) however DGR in S2 was higher than S1 but had not significantly different to each other ($p > 0.05$).

Table 2: Growth parameters and survival rate of Texas cichlid larvae (*Herichthys cyanoguttatus*) in experimental treatments (trial 1-4)

Parameters	S1	S2	S3	S4
Initial weight (g)	0.50±0.11	0.50±0.11	0.50±0.11	0.50±0.11
Final body weight (g)	0.87±0.01 ^d	1.10±0.10 ^c	1.30±0.06 ^b	1.70±0.06 ^a
Body weight increased (g)	0.37±0.01 ^d	0.60±0.17 ^c	0.86±0.01 ^b	1.20±0.06 ^a
Body weight gain (g)	0.79±0.06 ^d	1.23±0.60 ^c	2.06±0.32 ^b	2.53±0.80 ^a
Body length increased (cm)	0.70±0.01 ^c	1.43±0.30 ^b	1.63±0.60 ^b	2.33±0.30 ^a
Specific growth rate for weight (BW day ⁻¹ (%))	0.63±0.03 ^d	0.88±0.02 ^c	1.18±0.50 ^b	1.39±0.19 ^a
Feed conversion ratio (%)	1.83±0.05 ^a	1.66±0.11 ^a	1.36±0.05 ^b	1.30±0.12 ^b
Feed conversion efficiency (%)	0.55±0.01 ^a	0.61±0.01 ^a	0.73±0.03 ^b	0.77±0.06 ^b
Daily growth rate (g)	0.40±0.01 ^c	0.50±0.17 ^c	0.90±0.11 ^b	1.30±0.06 ^a
Survival rate (%)	92.12±3.71 ^b	92.28±2.28 ^a	94.18±4.18 ^a	98.09±3.18 ^a

Groups with different alphabetic superscripts differ significantly at $p < 0.05$ (ANOVA)

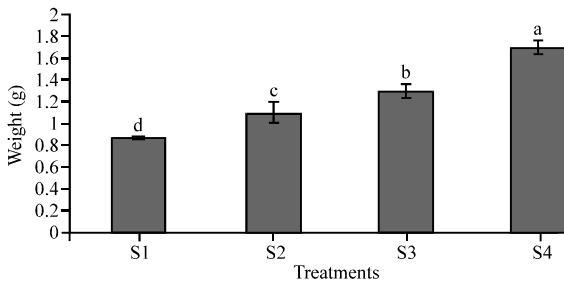


Fig. 1: Average body weight (±SD) of Texas cichlid larvae placed on different feeding frequency

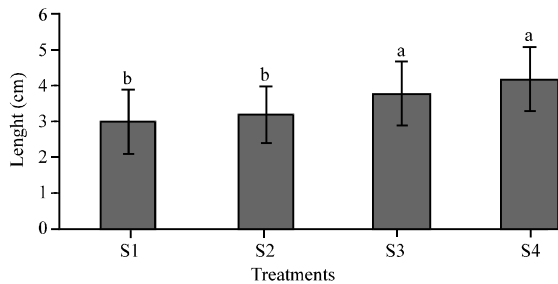


Fig. 2: Average body length (±SD) of Texas cichlid larvae placed on different feeding frequency

Feeding frequency in this study did not frequency effect on survival rate ($p > 0.05$). However, this factor in S4 (98.09±3.18) was higher than S3 (94.18±4.18), S2 (92.28±2.28) and S1 (92.12±3.71) treatment. Some researchers also reported no effects of feeding frequency on survival rate. Golden (1997), Aydin *et al.* (2011) and Kasiri *et al.* (2011) reported feeding frequencies did not significantly affect in survival rates on sea bream (*Sparus aurata*), juvenile black sea turbot (*Psetta maxima*) and angel fish (*Pterophyllum scalare*), these results agree with this founding. Fish age, size and culture conditions including food quality, amount of feed provided and water temperature affect the optimum feeding frequency for maximum growth of fish (Kestemont and Baras, 2001). Studies conducted on other fish species have shown that feed consumption and growth generally increased with feeding frequency up to a given limit (Bascinar *et al.*,

2007; Wang *et al.*, 1998). This is in agreement with the findings in this study that feeding frequency had a significant effect on feed conversion ratio and growth in the Texas cichlid.

The optimum feeding frequency may vary with species and size of fish (Goddard, 1996). For instance, Andrews and Page (1975) reported that the channel catfish *Ictalurus punctatus* (53 g) grew more slowly when fed to satiation once per day than when fed 2 or 4 times, however no differences was detected in the food conversion ratio.

CONCLUSION

It can be said that increasing frequency in the fish feeding results in a better food accessibility reducing feed competition stress leading to a better growth performance. The success of Texas cichlid culture depends on effective feeding frequency. A feeding frequency of 2 and 4 times a day compared to other experimental groups in the study seemed sufficient for effective growth and nutrient utilization.

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