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Effect of Feeding Frequency on the Growth and Survival of Himri Barbel *Barbus luteus* (Heckel, 1843), Fry under Laboratory Conditions

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Abstract: The effect of feeding frequency on the growth performance, feed conversion ratio and survival of Himri Barbel, *Barbus luteus*, was investigated. Thirty fry (0.26±0.03 g) were stocked in 12 (80-L) (80×40×40 cm) aquaria and fed 3, 4, 5 and 6 times a day respectively for 60 days. Final body weights and SGR were measured significantly lower at D (6 times/day) and C (5 times/day) than B (4 times/day) and A (3 times/day) treatments ($p<0.05$). There were no significant differences for the FCR and survival rates ($p>0.05$). The results showed that weight gain and growth performance of Himri Barbel, *B. luteus*, fry were decreased with increased feeding frequency.

Key words: Himri barbel, *Barbus luteus*, feeding frequency, growth, survival ratio

Introduction

Fish farmers investigate alternative fish species which are suitable for aquaculture. Intensive aquaculture of freshwater fish farmers targets species of high market value that are easy to domesticate and rear. Himri Barbel is indigenous cyprinid in the basin of Mesopotamia and highly valuable as food in the region. Some observations indicate to promise possibility of being used for aquaculture in polyculture ponds, since it is omnivorous and detritus feeder (Epler *et al.*, 2001). Adaptation to earthen ponds with common carp, *Cyprinus carpio* and other cyprinids has been noticed when it entered accidentally with water flux to ponds nearby Euphrates River which could consider it is a new species for the aquaculture (Al-Hazza and Hussein, 2003b).

One problem facing fish culturists is the need to obtain a balance between rapid fish growth and optimum use of the supplied feed. When fish are fed with a suitable feeding frequency, growth and feed conversion ration are expected to improve because regulating their feed intake in relation to their energy demand (Kaushik and Meadale, 1994) and their feeding rhythms (Boujard and Leatherland, 1992). Time of feeding and feeding frequency have been reported to affect feed intake and growth performance in goldfish, *Carassius auratus* (Noeske and Spieler, 1984), Indian catfish, *Heteropneustes fossilis* (Sundararaj *et al.*, 1982), channel catfish, *Ictalurus punctatus* (Noeske *et al.*, 1985), rainbow trout, *Oncorhyncus mykiss* (Reddy *et al.*, 1994) and African catfish, *Clarias gariepinus* (Hossain *et al.*, 2001). So far, few studies have been done on the biology of this species in the Iraq, Syria and Turkey (Epler *et al.*, 1996; Szypula *et al.*, 2001; Epler *et al.*, 2001; Al-Hazza, 2005), but there is little information on culture (Al-Hazza and Hussein, 2003ab; Gokcek and Akyurt, 2007).

Table 1: Feeding frequency and timing in different treatments over the experimental periot

Treatment	Feeding frequency	Timing
A	3	08:00-12:00-16:00
B	4	08:00-11:00-14:00-17:00
C	5	08:00-10:00-21:00-14:00-16:00
D	6	08:00-09:30-11:00-12:30-14:00-15:30

Over exploitation of natural stocks, because of high demand and the deteriorated environmental conditions, have resulted in marked decline of Himri Barbel in wild population. Recent studies have been instigated to attempt to propagate this species artificially for conservation and aquaculture purposes (Gokcek and Akyurt, 2007). The aim of this study was to determine the optimum feeding frequency of the Himri Barbel *Barbus luteus* fry under culture conditions.

Materials and Methods

Source and early history of fry: Himri Barbel larvae (mean weight 0.26 g) were obtained from Mustafa Kemal University Aquaculture Research Facility broodstock pond, Turkey. Poultry manure was used to fertilize the nursery pond and larvae were fed for a month after hatching. Then, larvae weaned over a 30-day period by substituting plankton with a commercial trout diet ground and sieved to 250 µm (Çamli Yem A.S., Izmir-Turkey).

A commercial trout diet was used during experiment. The diet was made from cereal grains, fish products, oil seed products, land animal product oils, fats and minerals. Proximate composition of the fish diet was analyzed according to Official Methods of Analysis (A.O.A.C., 1990). The fish diet contained %12 moisture, 12% Crude Lipid (CL), 45% Crude Protein (CP), 3% Crude Cellulose (CC), 13% Crude Ash (CA) with digestible energy 3573.8 kcal/kg (Çamli Yem A.S., Izmir-Turkey).

Table 2: Growth, feed utilization and survival of fish during experiment. Values within the same line followed by the same superscript are not significantly different (p>0.05)

	A	B	C	D
Individual initial weight (g)	0,26±0,01	0,25±0,11	0,26±0,09	0,26±0,10
Final weight (g)	1,21±0,12[a]	1,24±0,86[a]	1,07±0,23[b]	1,09±0,54[b]
SGR (%)	2,52±0,08[a]	2,56±0,07[a]	2,29±0,03[b]	2,28±0,03[b]
FCR	2,24±0,12[a]	2,20±0,13[a]	2,33±0,01[a]	2,31±0,01[a]
Survival rate (%)	97,77±3,87[a]	96,67±3,35[a]	96,67±5,77[a]	94,47±3,87[a]

Table 3: Water quality parameters of Himri Barbel fry during the experiment. Values within the same line followed by the same superscript are not significantly different (p>0.05)

Parameters	A	B	C	D
Temperature (°C)	26.2±0.92	26.3±0.14	26.4±0.26	26.4±0.33
DO (mg L^{-1})	7.05±0.13[a]	6.59±0.23[b]	6.25±0.29 [b]	6.01±0.71[c]
pH	7.77±0.31[a]	7.82±0.13[a]	8.13±0.24 [b]	8.25±0.51[b]
TAN	0.097±0.003[a]	0.102±0.012[a]	0.237±0.007 [b]	0.243±0.021[b]
UIA-N (mg NH_3-N L^{-1})	0.0022±0.0002[a]	0.0032±0.0017[a]	0.0166±0.0049[b]	0.0197±0.0042[b]

Experimental procedure: The experiment included four feeding frequency treatments were evaluated with a 4×3 factorial arrangements. Fish were fed 3, 4, 5 and 6 times a day as described in (Table 1). The feeding protocol of the experiment was described by Hossain *et al.* (2001). Initial body weight averaged 0.26±0.03 g (n = 30) fry were stocked in 12 (80-L) (80×40×40 cm) stagnant aquaria and fed for 60 days. Fish were fed with 1 mm trout pellets at 15% and 10% of the body weight in the first and second months, respectively. Feces and uneaten feed were removed from the aquarium daily before feeding. Water quality parameters of Dissolved Oxygen (DO) by YSI-52 model O_2-meter, pH by Hanna model pH-meter, Total Ammonia Nitrogen (TAN) by spectrophotometer were monitored weekly. Un-ionized Ammonia Nitrogen (UIA-N) concentrations were calculated from TAN measurements using pH and temperature values.

The Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) were estimated by using the following equations:

Specific Growth Rate (%) = 100 (ln final weight-ln initial weight)/times (days)

Feed Conversion Ratio = dry feed intake (g)/wet weight gain (g)

Data analysis: A one-way analysis of variance (ANOVA) was used to compare growth rate, feed conversion ratio and survival among treatments. All data were analyzed by using SPSS computer program (SPSS, 2000, System for Windows, Version 10.0). Duncan test was used to determine the differences among treatment means when F-values from the ANOVA were significant.

Results

Feeding frequency significantly affected the weight gain, but did not affect FCR and survival (Table 2). Fish in the B (4 times/day) groups showed the best performance. Weight gains and SGR in the A and B treatments were significantly higher than in the C and D treatments. There was no significant differences observed on the FCR and survival rates (p>0.05). Survival of the fish during the experiment was not affected by the feeding frequency (p>0.05).

The water quality parameters except temperature vary significantly among treatments (p<0.05) (Table 3). The average TAN concentrations were 0.097, 0.102, 0.237 and 0.243 mg/L for A, B, C and D treatments, respectively. The average TAN concentrations were significantly increased by increased feeding frequency (p<0.05). The average UIA-N concentrations were increased with increasing pH and found 0.0022, 0.0032, 0.0166 and 0.0197 mg NH_3/L, respectively.

Discussion

Effects of feeding frequency on growth of fish reveal different results for different species (Cui *et al.*, 1997). Optimum feeding frequency was reported as once in two day for estuary grouper *Epinephelus tauvina* (Chua and Teng, 1978); once a day for stinging catfish *Heteropneustes fossilis* (Marian *et al.*, 1981); twice per day for day channel catfish *Ictalurus punctatus* (Andrews and Page, 1975; Webster *et al.*, 1992), rainbow trout *Oncorhynchus mykiss* (Crayton and Beamish, 1977); three times per day for fry of common carp *Cyprinus carpio* (Charles and Sebastian, 1975); six time per day for hybrids of Nile tilapia *Oreochromis niloticus*×blue tilapia *O. aureus* (Tung and Shiau, 1991) and continuous feeding 24 $h.day^{-1}$ for white sturgeon *Acipencer transmontanus* (Cui *et al.*, 1997). Oymak *et al.* (2000) observed that *B. luteus* does not possess a stomach like carps and the gut length is one and half times longer than the total body length. This may cause that food goes through the guts and out even if the food is not digested. On the other hand, other researchers reported that when feeding frequency was restricted, fish required higher energy diet (Minton, 1978). This may also indicate that excess dietary energy is not utilized by Himri fry, it may be stored as body fat. In addition, the proper feeding frequency for maximum growth will differ with fish size. In the future, more studies on the relationship between feeding frequency and fish sizes or dietary protein and energy levels should be investigated.

Furthermore, TAN was measured higher at C and D treatments than A and B. Although significant amount of uneaten feed were siphoned by drainage pipes, this might have been caused deterioration in water quality, leading to stressful conditions. Thus, lower levels at dissolved oxygen were measured at high feeding frequency. Total ammonia actually exists in water as two forms, the ammonium ion (NH_4^+) and un-ionized ammonia (NH_3), with relative concentrations being pH and temperature dependent (Boyd and Tucker, 1998). The un-ionized form is most toxic due the fact that it is uncharged and thus traverses biological membranes more readily than the charged and hydrated NH_4^+ ions (Wuhrmann and Woker, 1948; Downing and Merkens, 1955). Significantly lower growths have been observed at feeding frequency treatments C and D. Proper cause of this lower growth might be high concentration of TAN meeting with high levels of pH at this feeding level. UIA-N ratios in TAN were elevated with increasing feeding frequencies which also stimulate pH values to increase. In summary, the results of this study suggest that there isn't a benefit in feeding fry *B. luteus* more than 3 times a day in terms of growth performance. In contrast to general view, over feeding may cause waste of feed and labor cost.

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