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Tilapia, *Oreochromis niloticus* (Linnaeus, 1758) and Himri Barbel, *Carasobarbus luteus* (Heckel, 1843), Duoculture in Net Cages

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Abstract: Himri Barbel fry, *Carasobarbus luteus* (Heckel in 1843) were introduced to tilapia duoculture in net cages. Five treatment groups were designed according to different stocking proportions of tilapia and himri and each treatment were triplicated. The study was carried out for 60 days by using 500 L net cages and fish were fed 2 times a day by commercial carp diet. Five stocking treatments were as follow: S1 (100% tilapia), S2 (75% tilapia+25% himri barbel), S3 (50% tilapia+50% himri barbel), S4 (25% tilapia+75% himri barbel) and S5 (100% himri barbel). Polyculturing with tilapia had no adverse effects on himri stocks however total biomass at harvest and feed conversion ratio were negatively affected with increasing himri in tilapia stocks.

Key words: Himri barbel, tilapia, polyculture, cage culture, growth

INTRODUCTION

The barbs (*Barbus* sp.) are an important group of cyprinids and about 30 known species of *Barbus* are distributed in the middle-east region. Himri barbel is indigenous cyprinid in the basin of mesopotamia and highly valuable as food in the region. It is an omnivorous species that feeds mainly on detritus (Epler *et al*., 2001). Its adaptation to earthen ponds has been noticed when it pumped accidentally into carp fishponds located near the Euphrates river (Al-Daham *et al*., 1991) therefore, himri barbel could be considered as a new species for the regional aquaculture (Al-Hazza and Hussein, 2003a, b).

Polyculture aims to increase productivity by a more efficient utilization of the ecological resources in the aquatic environment (Lutz, 2003). Thus stocking two or more complementary species can increase the maximum standing crop of a pond by allowing a wider range of available foods and ecological niches (Da Silva *et al*., 2006). Cyprinids are one of the most important groups of teleost fish quantitatively cultivated by polyculture worldwide (Kaushik, 1995).

Natural stocks of himri barbel have been decimated to a large extent in the last few years resulting in an immediate need for conservation of the fish. Some studies have been done on the biology of Himri Barbel in the Iraq, Syria and Turkey (Epler *et al*., 1996; Szypula *et al*., 2001; Al-Hazza, 2005; Gokcek and Akyurt, 2008) but the aquaculture potential of the fish has been identified only recently (Al-Hazza and Hussein, 2003a, b; Gokcek and Akyurt, 2007; Gokcek, 2008; Gokcek and Tepe, 2009a). Also, Himri Barbel was successfully produced with mirror carp as an alternative polyculture species in laboratory conditions (Gokcek and Tepe, 2009b). The aim of the present study was to evaluate the effect of duoculture on growth, feed conversion ratio and survival of Himri Barbel and Tilapia in the cage culture.

MATERIALS AND METHODS

Source of fingerlings: Himri Barbel fingerlings were produced from broodstock kept in captivity in the aquaculture unit of Mustafa Kemal University, Hatay, Turkey. After initial nursing, the fingerlings were kept in cages for an adaptation period of 2 weeks. Tilapia fingerlings were obtained from a local fish hatchery and acclimatized to the net cages.

Diet: A commercial carp diet obtained from Camli Yem A.S., Izmir, Turkey was used during the 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 (Helrich, 1990). Analysis results were found as 12% moisture, 12% crude lipid, 40% crude protein, 3% crude cellulose, 13% crude ash, 35% nitrogen free extracts with gross energy 20.50 MJ kg^{-1}.

Experimental design: The experiment was conducted in a reservoir lake (mean depth 3 m) over a period of 60 days in Dortyol, Hatay. Fifteen cages (1×1×0.75 m) were made of 7 mm mesh polyethylene netting and wooden frames. The submerged volume of each cage was 0.5 m^3 and 20 fish were stocked in each cage. Plastic receptacles (65 L) were attached to the four sides of each cage as floats. The fingerlings were treated with a formalin solution (200 ppm) for 3-5 min before being stocked in to the experimental cages.

Treatment groups were designed according to different stocking proportions of tilapia and himri and named as S1 (100% tilapia), S2 (75% tilapia and 25% himri), S3 (50% tilapia and 50% himri), S4 (25% tilapia and 75% himri) and S5 (100% himri). Five treatments held in triplicate. Fingerlings with the average weight of 25.1 g were stocked into the cages and fed with a 3 mm commercial carp diet 2 times a day (07:30 and 19:30) with 3% body weight per day throughout experimental period. The cages were stocked in 10th August 2010 and harvested in 13th October 2010. Fish from each cage were weighted separately by the species at biweekly intervals and their average weights were recorded.

Water quality parameters of Dissolved Oxygen (DO) and temperature by YSI-55 model O_2-meter, pH by Hanna model pH-meter were monitored daily, 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 (Boyd and Tuker, 1998). The Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) were estimated by using the following equations:

$$\text{Specific growth rate (\%)} = \frac{100\ (\ln \text{final weight} - \ln \text{initial weight})}{\text{Time (days)}}$$

$$\text{Feed conversion ratio} = \frac{\text{Dry feed intake (g)}}{\text{Wet weight gain (g)}}$$

Fish Survival rate (S) was calculated as the Number of fish harvested (Nf) as percentage of the number of fish stocked (Ni):

$$S = \left(\frac{Nf}{Ni}\right) \times 100$$

Statistical analyses: 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 System for Windows, Version 13.0). Duncan test was used to determine the differences among treatment means when F-values from the ANOVA were significant.

RESULTS

Water temperature, pH, dissolved oxygen, TAN and Un-ionized Ammonia Nitrogen (UIA-N) are shown in Table 1.

The production parameters are shown in Table 2. No mortality was observed during the study. The FCR values of all treatments except S4 and S5 were different from each other ($p<0.05$). SGR (%) values were calculated separately from each fish species in each treatment. The comparison of the average SGR values were made on species base within the same treatment and other treatments and found significant differences in each comparison. SGR values of himri barbel were different for each treatment and the lowest value of 0.72 obtained from S4 and the highest value of 1.65 obtained from S2. Although, the SGR values of tilapia was slightly increased with decreasing tilapia ratios in S2, S3 and S4 groups however, there was no significant differences between tilapia stocks ($p>0.05$) except between S1 and S2 ($p<0.05$).

Final weights of the fish were compared between the treatments within the same species (Fig. 1-3). Individual weight of tilapia increased with decreasing stocking ratios in cages however, there was no significant differences between S1 and S4 ($p>0.05$). The lowest average final weight of tilapia was obtained from S2 with the values of 79.56 g and the highest value of 91.50 g was obtained from

Table 1: Water quality parameters during the experiment period

Days	pH	Oxygen	Temperature	TAN	UIA-N
0-15	8284±0.26	6.36±0.86	33.75±0.59	0.3222±0.013	0.1215±0.0081
15-30	8.85±0.29	5.34±1.12	32.05±0.62	0.3619±0.079	0.1773±0.0012
30-45	8.80±0.41	5.41±1.15	31.09±0.83	0.4572±0.053	0.1550±0.0126
45-60	9.07±0.13	6.68±1.35	30.01±0.80	0.6727±0.009	0.3014±0.0079

Table 2: Growth, feed conversion ratio and survival of tilapia and himri barbel during 60 days at different stocking densities (±SD)

	S1	S2		S3		S4		S5
Parameters	Tilapia	Tilapia	Himri	Tilapia	Himri	Tilapia	Himri	Himri
Proportions of stocks	100%	75%	25%	50%	50%	25%	75%	100%
Initial mean weight /fish (g)	25.12±0.18	24.87±0.20	24.87±0.99	25.07±0.15	25.10±0.30	24.60±0.72	25.02±0.10	24.88±0.14
Final mean weight /fish (g)	91.50±1.15^{a}	79.56±3.66^{b}	67.13±6.96^{w}	85.50±2.85^{c}	45.43±1.99^{x}	91.27±1.21^{a}	38.42±0.84^{y}	49.50±1.54^{x}
SGR (%)	2.16±0.01^{a}	1.94±0.09^{b}	1.65±0.14^{w}	2.05±0.05^{ab}	0.99±0.07^{x}	2.19±0.06^{ac}	0.72±0.03^{y}	1.15±0.06^{z}
Biomass at harvest (g)	1830.00±23.07^{a}	1529.00±26.21^{b}		1309.33±11.59^{c}		1032.67±10.79^{d}		990.00±30.79^{e}
FCR	1.27±0.02^{a}	1.48±0.04^{b}		1.71±0.02^{c}		2.43±0.07^{d}		2.39±0.15^{d}
Survival (%)	100	100		100		100		100

In all lines, means with different superscripts are significantly different from each other ($p<0.05$); a-d were used for tilapia; w-z were used for himri barbel

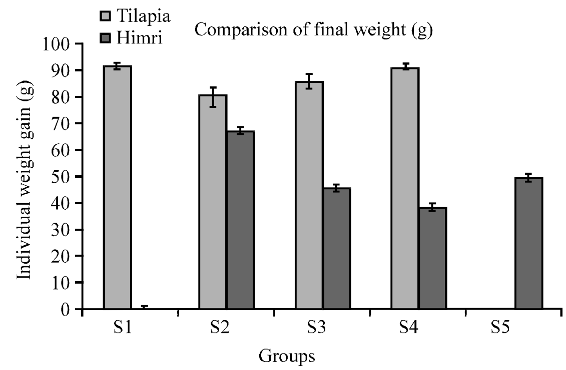

Fig. 1: Mean final weights of tilapia and himri barbel at different densities

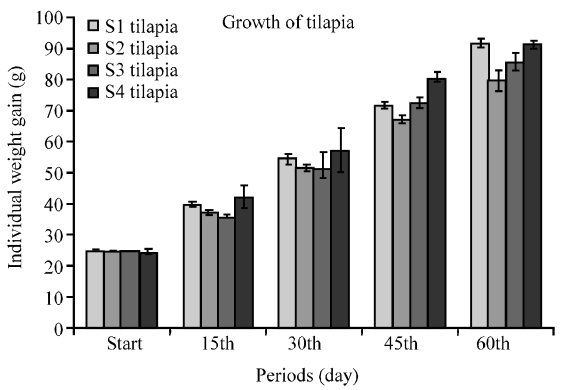

Fig. 2: Individual weight gains of tilapia at different densities

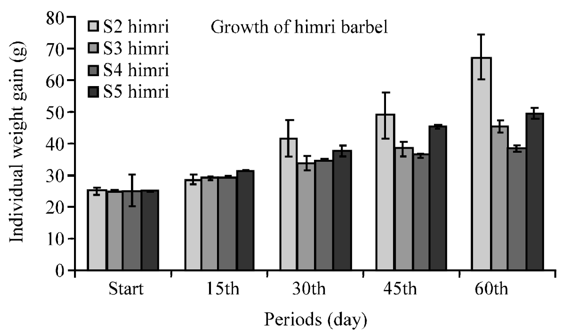

Fig. 3: Individual weight gains of himri barbel at different densities

S1. The average final weight of himri barbel from S2 was significantly higher than those all other groups on the other hand, S2 and S4 was similar ($p>0.05$). Total biomass at harvest from himri barbel only treatment was significantly lower than those all other treatments with the value of 990.00 g. The highest total biomass of 1830.00 g obtained from S1 which is only tilapia stocking treatment ($p<0.05$).

DISCUSSION

In the present study, monitored water quality parameters remained within the optimum range for culture but the water temperature was monitored above 30°C due to the extremely hot weather conditions during the experiment period. Gokcek and Akyurt (2007) observed similar water quality values during the nursing of himri barbel fingerlings in cages.

A few studies had been done about polyculture of barb species with other fish species. For example, a synergistic interaction between silver barb (*Barbodes gonionotus*), a bottom feeder and common carp has been reported by Haque *et al.* (1998). Azim *et al.* (2004) reported that silver barb competed with both native and exotic common carp in earthen ponds. Jena *et al.* (2001) reported that although, a certain extent of competition of silver barb with mrigal, *Cirrhinus cirrhosmus* was evident, competition with catla, *Catla catla* was not perceptible. Gokcek and Tepe (2009a, b) reported that the polyculture of himri barbel with mirror carp was positively affected the growth performance of each species in laboratory conditions. The best total yield and FCR was achieved from the 25% of himri barbel in the total biomass of carp polyculture stocks. In the present study, duoculture negatively affected the total yield and the FCR. The total yields of duoculture stocks were decreased and also FCR values were increased with increasing himri barbel stocking ratio in tilapia cages. In nature, himri barbel is a bottom feeder that feeds on detritus, plants and zooplankton but also migrates throughout the water column to feed (Naama and Muhsen, 1986). Tilapia is a surface feeder and feeds mainly on phytoplankton and also migrates throughout the water column to feed in cages. In this experiment, submerged feed was used as experiment diet, so the decrease in the harvesting weight, growth rate and yield from the less dense stocks of tilapia might be the result of competition between tilapia and himri since himri is a bottom feeder and tilapia feed more aggressively on the surface layers than himri. During the feeding activity, some of the submerged feed might be lost from the bottom meshes of cages so duoculture of these species in tank or pond culture systems may cause better results by using of experiment feed more efficiently than the cage culture system. On the other hand, the high FCR values might be caused because of the high water temperature above 30°C during the experiment period. Gokcek and Akyurt (2007) observed similar FCR vales during nursing himri in cages at high water temperature. Although, the total yield and FCR were negatively affected by increasing himri stocks in tilapia cages, the denser stock of tilapia at polyculture stocks positively affected the individual growth performance of himri by competition for food. In the presence of himri barbel, no significant variations in the survival of tilapia among the treatments suggest possible compatibility among the species. Further, the high survivals of himri barbel promise us to ease of culture condition. High survival of himri barbel was also recorded by Gokcek and Akyurt (2007), Gokcek (2008) and Gokcek and Tepe (2009a, b) in different culture conditions.

CONCLUSION

The low growth performance and feed efficiency of himri indicated that present commercial diet was unable to meet with the nutritional requirements of this species. Since the nutritional requirement of this species is still unknown, himri barbel may require lower or higher levels of protein and energy for optimal growth. On the other hand, the mechanism for food selectivity of the experimental fish species is also unexplored. Before introducing this species for wider commercial application in semi-intensive or intensive polyculture with fertilizers and supplemental feed, all these unknown characteristics of himri should be clarified.

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