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Effect of starvation period on growth performances and survival of *Cyprinus carpio* (Linnaeus, 1758)

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ABSTRACT:

Starvation is one of the problems that the fish may encounter in course of its life. This study was conducted for six weeks at two groups and three replications as follows: Group A: Starvation in six weeks and Group B: Feeding in six weeks with three times a day at 08:00, 12:00 and 16:00 h. Feeding rate was equal to 10 % of body weight for group A. The physical and chemical factors were so controlled through the experiment that the amount of dissolved oxygen was fixed up to 6 ppm, the temperature 28 ± 2°C and pH 7.8 to 8.1. Results showed significant effects in Specific Growth Rate (SGR), Body Weight Index (BWI %), Growth Rate (GR), Feed Conversion Ratio (FCR), Condition Factor (CF) and survival ($P<0.05$). The results showed that there are significant differences with regard to the amount of body weight and body length of fingerlings in two groups ($P<0.05$). Result of this study showed that increasing of starvation period decrease growth and survival in *Cyprinus carpio.*

Keywords:
Cyprinus carpio, growth performances, survival, starvation.

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INTRODUCTION

Understanding of natural foods and dietary habits of fish culture could be an important factor in providing effective method of nutrition (Mohammad Nejad Shamoushaki, 2012). Starvation is one of the problems that the fish may encountered in course of its life. Starvation is an experienced and endured situation by many fish species in the natural environment (Larsson and Lewander, 1973; McLeese and Moon, 1989; Navarro and Gutiérrez, 1995; Olivereau and Olivereau, 1997; Bélanger *et al*., 2002; Furné *et al*., 2008). The condition of fish may affect the probability of their endurance since fish are more vulnerable to predation, disease and unfavorable environmental conditions in poor condition. In addition, they are less efficient in foraging (Amara and Galois, 2004; (Islam and Tanaka, 2005). Fish alternate periods of feeding and fasting in response to several factors (such as temperature, spawning migration, reproduction, etc., in their natural environment. Cultured fish also experience such situations derived from these same factors and also imposed by routine aquaculture procedures. To overcome these food restrictions, fish mobilize their energy reserves, which impose metabolic adjustments that are species dependent. Intraspecific adjustments to these conditions also depend on different factors as fish age, nutritional state, etc. (Navarro and Gutiérrez, 1995; Pérez-Jiménez *et al*., 2007). In the wild, fish may have a mortality rate despondent on predation, starvation or limited food resources and oceanographic conditions that may transport fish to an unfavorable environment (Olson and Olson, 1989; Anil *et al*., 1995; Alexander and Roughgarden, 1996; Anil and Dattesh, 1997). Due to the spatial and temporal patchiness of food in nature, periods of food deprivation are common in the lives of many animals (Mehner and Wieser, 1994). Since the rate of mortality of fish exists in natural conditions because of poor endurance of starvation, many investigations have focused on fish starvation or food limitation. In marine invertebrates, investigations on larval starvation or food limitation have mainly been on crustaceans (e.g., Paul and Paul, 1980; Olson and Olson, 1989; Qiu and Qian, 1997). There have also been many studies on mollusks (Roberts *et al*., 2001; Takami *et al*., 2002; Moran and Manahan, 2004), polychaetes (McEdward and Qian, 2001; Pechenik and Cerulii, 1991) and echinoderm larvae (Fenaux *et al*., 1994; Olson and Olson, 1989). In contrast, few studies investigated in vertebrates, especially fish. However, the effect of experimental starvation on red sea bream (Pagrosomus major), Japanese flounder (Paralichalmus olivaceus), Chinese sturgeon (Acipenser sinensis) and yellow sea bream (Dentex tumifrons) larvae were investigated recently (Bao *et al*., 1998; Zhuang *et al*., 1999; Xie *et al*., 2004; Sheng *et al*., 2007).

Cyprinus carpio belongs to Cyprinidae is one of the most economically important and valuable telostei in the Caspian Sea. No paper has described the effect of starvation or limited food on the growth and survival of *Cyprinus carpio*. Up to now, the effect of starvation on the *Cyprinus carpio* has not been reported, but it is necessary and important for the aquaculture of these species. Therefore, the present study aimed to examine the effect of starvation on growth performances and survival of *Cyprinus carpio.* In this study, we examined the effect of prolonged starvation on growth performances and survival in the *Cyprinus carpio.*

MATERIALS AND METHODS

Fish supply and experimental design

This study has been carried out in Sijual bony fishes reproduce and cultivate center (Gorgan, Golestan, Iran) on 2011 summer. This study was operated as long as six weeks and two groups with 90 numbers of fish in each group and three replicate as: Group A: Starvation in six weeks and Group B: Feeding in six weeks with three times a day at 08:00, 12:00 and 16:00 h. Initial body weight and length average of Cyprinus carpio were

3.243±0.132 gr and 5.8±0.303 cm respectively. Fishes in group A were fed SFC (starting food carp) commercial food during (six week) of the study. The feed was administered only during daylight hours. Pertinent characteristics of this feed were: 32% crude protein; 10.5% crude fat; 11.2% ash and 8.7% moisture. Given the importance of the physical and chemical factors and their impact on water supply and ultimately the fish growth, these factors were so controlled through the experiment that the amount of dissolved oxygen was fixed up to 6 ppm, the temperature 28±2°C and pH 7.8 to 8.1. Fish were sampled every week to evaluate growth in weight and length, for this purpose 10 numbers of fish in each replicate were captured, weighed and measured. After each sampling period the amount of feed given was adjusted according to mean weight in each aquarium (Only for group B). Feeding rate which paid attention to live weight and in different times and after each biometry, equal 10 % of body weight is calculated and was intered to each aquariums of group B.

Growth performances assay

From results of the last sample fish performances were evaluated in terms of Feed Conversion Ratio (FCR), Specific Growth Rate (SGR, gr d-1), Body Weight Index (BWI %), Growth Rate (GR, gr d-1), Condition Factor (CF, gr/Cm) and Survival (%). These performance indices were calculated as follows (Hung *et al*., 1989; Ronyai *et al*., 1990; Biswas *et al*., 2010; Mohammad Nejad Shamoushaki, 2012):

• FCR= Total feed intake/ total biomass gain

• SGR= [(In final weight−ln initial weight)/ rearing duration in days] ×100

• BWI= [(Body weight final−body weight initial)/ body weight initial] ×100

• GR= (Body weight final−body weight initial)/ rearing duration in days

• BWI= [(Body weight /total length^3)] ×100

• Survival= (Number of fish harvested/number of fish stocked) ×100

Statistical analysis

For all data analysis SPSS version 13 was used and for drawing graphs. Excel 2003 was used. All data were ensured to normality with the Shapiro-wilk test. Normal distribution of data using one-way analysis of variance test (Oneway ANOVA) in the overall differences between groups were determined at 95% confidence level.

RESULTS AND DISCUSSION

Final weight and length of *Cyprinus carpio* in two groups were shown in figures 1 and 2. The results showed that starvation and feeding have effects on increasing body weight and body length of *Cyprinus carpio* and there is a need full difference in this respect among two groups ($p < 0.05$). There were significant difference among the starvation and feeding

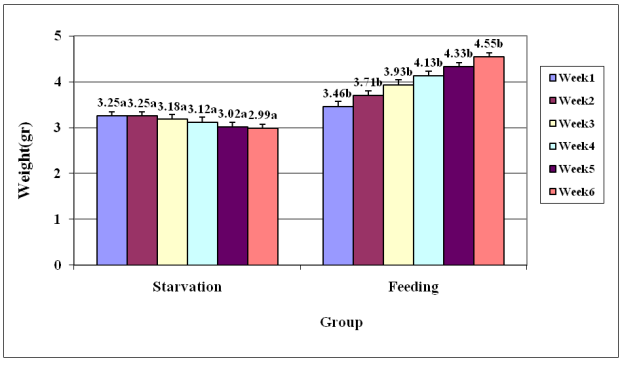

Figure 1.The average of body weight of *Cyprinus carpio* in two groups

- **The Latin letters show that there are significant differences among two groups**

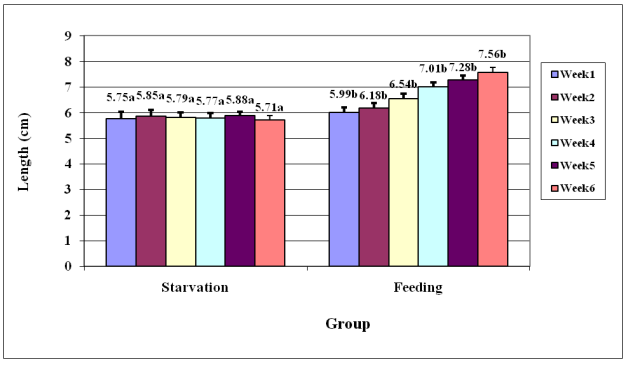

Figure 2.The average of body lenght of *Cyprinus carpio* in two groups

- **The Latin letters show that there are significant differences among two groups**

groups of *Cyprinus carpio*, and the body length in feeding group was the higher than starvation group. Body weight in starvation group was less than the feeding group. Obtained results in this study showed that increasing of starvation period decrease body weight and body length but feeding increase body weight and body length of *Cyprinus carpio*.

Comparison of average growth performances on *C. carpio* growth during test period are shown in table 1. Results showed that had significant effects in BWI, SGR, GR, FCR, CF and survival in two groups ($P < 0.05$) (Group A has not been feeding fish because the FCR was calculated for it). In the present research, the result showed that starvation period for *Cyprinus carpio* could also influence their growth performances, and during the periods of 1-6 weeks of starvation, the growth greatly reduced (Table 1). The survival in starvation group with an increase of starvation period was significantly lower from that of the feeding group (Table 1).

The survey results showed that starvation strongly affects the growth and survival of fish. Moreover, fish mortality will be increased during starvation. Also, results showed that with increasing duration of starvation mortality have increased and fishes were extremely thin and if the fish do not find to get enough food may increase the mortality and must find a solution to this problem. Therefore, one way to encounter starvation in fish is compensatory growth (not investigated in this study). Also, it should be considered the mortality will increase if enough food is not provided after starvation. McEdward and Qian (2001) also suggested that starvation reduces growth rates largely by increasing the duration of the fish period relative to the opportunities for acquiring food. Some studies have reported the recovered growth rates of fish following short periods of starvation. Growth rates for starvation groups of prosobranch gastropod (*Crepidula fomicata*) appear to bounce when food was resumed (Pechenik *et al*., 2002). McEdward and Qian (2001) suggested four possible explanations. Firstly, they thought that larvae might grow efficiently on egg reserve. Therefore, they will be larger and have a greater capacity to feed when food is available compared to the larvae offered food postpartum. Secondly, early starvation in life might cause significant mortality and select for very hardy larvae that have inherently greater capacity for feeding and growth. Thirdly, larvae might respond by feeding more vigorously (either at higher rates or more continuously, i.e. compensatory growth) after initial starvation; therefore, acquire more food during the same potential feeding period. Finally, fish might respond to food density by altering the allocation of resources between growth and development (Sheng *et al*., 2007).

Table1. Comparison of growth performances in two groups at six weeks

Growth performances	Starvation	Feeding
FCR	-	4.15±1.214
SGR (gr d−1)	-0.195±0.0156[b]	0.804±0.028[a]
BWI (%)	-7.763.±0.588[b]	40.18±1.677[a]
GR (gr d−1)	-0.0061±0.00046[b]	0.011±0.004[a]
CF (gr/Cm)	1.6±0.062[b]	1.053±0.021[a]
Survival (%)	51.67±2.887[b]	88.33±2.7[a]

- **The small Latin letters show that there are significant differences among different treatments**

CONCLUSION

In conclusion, this investigation demonstrates that starvation affects the growth and survival rate of the *Cyprinus carpio*. These results can help the conservators of *Cyprinus carpio* to decide when they should release (*Cyprinus carpio*) to the sea. In addition, these results indicate the farmers' knowledge of feeding status of *Cyprinus carpio*. However, we did not investigate the effects of compensatory growth on the *Cyprinus carpio* in this study and it is a part of our future work.

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