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EFFECT OF FEEDING FREQUENCIES ON CARP GROWTH RATE – PRELIMINARY RESULTS

M. STANKOVIC[1], Z. MARKOVIC[1], Z. DULIC[1], B. RASKOVIC[1], I. ZIVIC[2] and N. LAKIC[1]
[1] *University of Belgrade, Faculty of Agriculture, 11080 Belgrade, Serbia*
[2] *University of Belgrade, Faculty of Biology, 11000 Belgrade, Serbia*

Abstract

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The success of production in aquaculture depends on the water quality, the fish fry but also on the skillfulness of the producers in achieving a profitable production while applying the most optimal technology. One of the producer's dilemmas, when applying feed, is the dynamics of supplemental feeding of fish. This was the reason for carrying out an experiment at the laboratory for fish nutrition at the Faculty of Agriculture, University of Belgrade (Serbia). In three experimental groups, during 60 days, carp weight in correlation to the dynamics of feeding was studied. For the first group, feed was available to fish once a day, during 60 min, the second group had feed available twice a day, during 60 min, and the third group had feed available during 12 hours continuously. The results showed that there was a significant difference in the weight between the three experimental groups. The weight of fish from the first group was 41.47%, for the second group was 50.42%, and for the third 87.79%, respectfully, in relation to the stocking ichthyomass. According to the t-test the average weight of the first and second group was not statistically different but they were very significantly lower from the average weight of fish that had feed available 12 hours daily.

Key words: carp, feeding dynamics, growth rate

Introduction

Common carp is one of the most cultured fish in the world. This fish is omnivorous, resistant and tolerant to wide variations of abiotic and biotic factors of the environment. A lot of different fish feed available on the market are used for culturing carp. Nutritional requirements for growth, reproduction and normal physiology are similar to the requirements of other domesticated animals. However, fish mainly differ from other animals in their demand for proteins, so usually feed with 25 to 45% of row proteins are used (Murai, 1992). In this aspect, the efficiency and utilization of proteins are more important in fish.

Feeding presents the largest part of expenses in intensive and semi-intensive aquaculture, so fish feed must be of good quality to assure high utilization, high growth rate, and good health, and at the same time to protect the water environment. Fish feed is formulated to fulfill the requirements of fish in nutrients and energy. Since the feed covers 40 to 60% of the total expenses in production (Meyers, 1999; Aarseth et

E-mail: markos@agrif.bg.ac.rs

al., 2006), the prices present a very important factor in formulating fish diets. However, cheap alternatives to the most expensive fish feed, fishmeal, are found. Soy proteins are the most used substitution for fishmeal due to the high protein content and a similar amino acid composition, medium price and constant availability at the market (Storebakken et al., 2000). In the trend of global increase of production in aquaculture, there is a demand for introduction of new components in fish diets (Tacon, 2005; Kraugerud, 2008) and their maximal utilization. The diets are also enriches with feeding stimulants, flavors and emulators.

For some species and size categories of fish, an adequately composed diet (Watanabe, 2002; Ruohonen et al., 2004; Bruce et al., 1999) is the most important prerequisite for good growth. However, except the diet composition, very significant differences in feeding regimes are found (Yamamoto et al., 2007).

In the semi intensive system of culturing, the dominant type of carp production in Serbia, the fish feed mainly consists of row cereals. Nowadays, with gaining knowledge on the quality of compound feeds, producers are substituting cereals with pelleted feed and furthermore with extruded feed.

Since carp are usually cultured in rather big earthen ponds, fish are hand fed from the boat once, rarely twice a day. Aiming to increase the production, a small group of carp producers have installed feeders in earthen ponds that provide food for fish during the whole day.

The aim of this paper was to determine the interdependence between the growth rate of carp and different feeding frequencies using the same feed.

Material and Methods

The trial was conducted at the Laboratory for fish nutrition of the Faculty of Agriculture, University of Belgrade and lasted for 60 days. Two year old carp (*Cyprinus carpio*) used in the experiment were obtained from the fish farm DTD Ribarstvo "Jazovo". Fish were divided into three groups, with 19 fish per tank having average weight 159.2g. Extruded feed Soprofish 38/12 produced by "Veterinarian Institute Subotica" (Serbia) with 4 mm pellets was used for the experiment.

The rearing system consisted of plastic tanks, 120 l in volume, with a flow-through system of dechlorinated water (flow rate: 0.34 l min^{-1} in each tank). Oxygen concentration in tanks was regulated with aerators RESUN LP-60.

Every tank was equipped with a semi automated belt feeder AGK-Technology Gmbh (Germany). The first experimental group of fish had feed available for 60 minutes per day. The second group of fish had feed available twice a day, for 60 min., with a pause of 120 min in-between. The third group had continuously available feed during 12 hours per day. The amount of given feed in all tanks represented 2.5 % of the ichthyomass. Belt feeders were filled with feed every day at the same time.

Water temperature, oxygen concentration and saturation were constantly recorded (every 10 min) using an automatic recorder, Multi-Channel Dissolved Oxygen Meter (OxyGuard, Denmark). Electrical conductivity and pH were measured weekly using a field kit MULTI 340i/SET (WTW, Welheim, Germany). Body weight and feed were measured using digital balance KERN plus 2100-2 (accuracy 0.01g).

The results were analyzed using descriptive and analytical statistics. All statistical analyzes were conducted using statistical package Statistica 6.0. Of statistical measures of center, mean and median were applied. The variability of data was quantified using variation interval, standard deviation, standard error and variation coefficient. Furthermore, significant differences between average fish mass were tested. The homogeneity of variances was analyzed using Levene's test and then the parametric model of analysis of variances (ANOVA) and t-test was applied.

Results and Discussion

During the experiment, oxygen concentration was on average 5.5 mg/l with variations of ±1 mg/l per days, in every tank, as well as between tanks. Electrical conductivity was in the range from 510 to 514μS

Table 1

Minimal and maximal individual fish weight in groups at the beginning and the end of the experiment

Groups	Individual weight at the beginning		Individual weight at the end	
	min	max	min	max
I	89.8	219	160	290
II	118	206	155	325
III	122	195	250	350

cm^{-1}, with minimal daily variations. Water temperature was in the range from 21.5 to 22.5°C.

At the beginning of the experiment, the lowest weight of individual fish was 89.8 and the highest was 219 g, both measured in the first group of fish (Table1). At the end of the experiment the lowest weight had the individuals from the second group, 155g, and the highest had the fish from the third group, 350g.

The body weight varied the most at the beginning of the experiment in the first group, and at the end of the experiment in the second group (Figure 1). At the beginning and the end of the experiment, the longest interval of variation and the interquarter differences were found for the body weight of the third group of fish.

The fish in groups had homogenous weight (Cv <30%). Individuals from the first and third group had slightly more homogenous weight at the end of the experiment then fish from the second group at the beginning of the experiment (Figure 2).

At the beginning of the experiment the average weight of fish from all three groups differed slightly, 159.28 g, 159.31 g and 158.97 g. During the experiment, the average weight of fish from the group that had feed available for 60 min per day had increased for 66.036g or 44.46%. Fish from the second group that had feed available for 60min twice a day, had an increase of weight for 80.322g or 50.42% and the third group having the longest availability of food, for 12 hours per day, had an increase of weight for 139.556g or 87.79%. According to Levene's test, all the variances were homogenous (F=1.879; p=0.163),

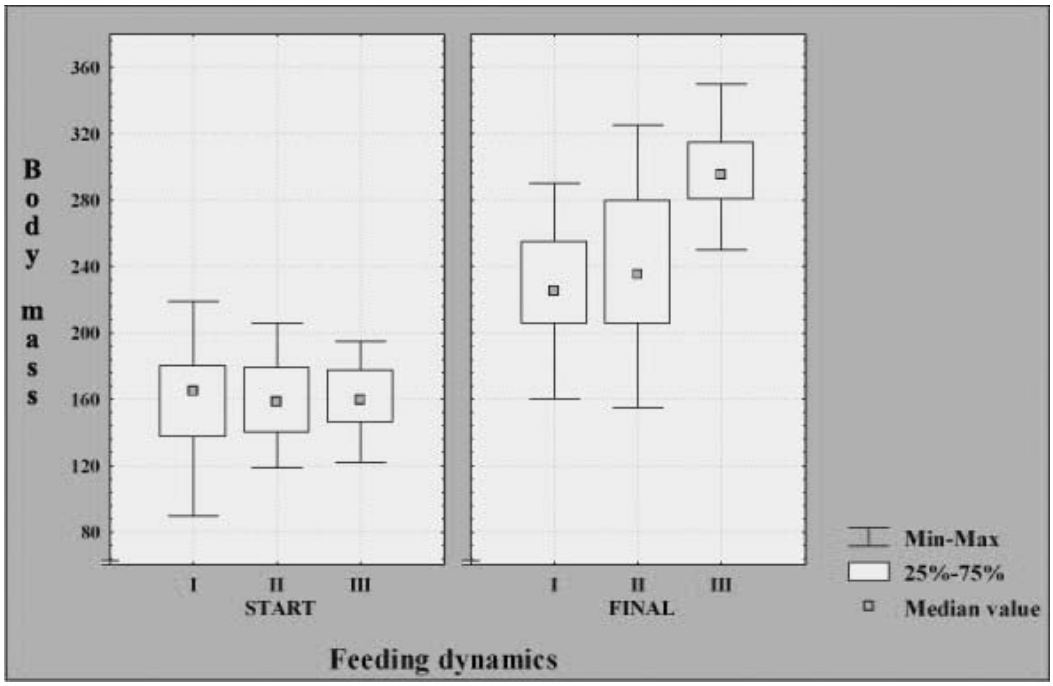

Fig. 1. Interval of variation, interquarter difference and median for the body weight of all three groups

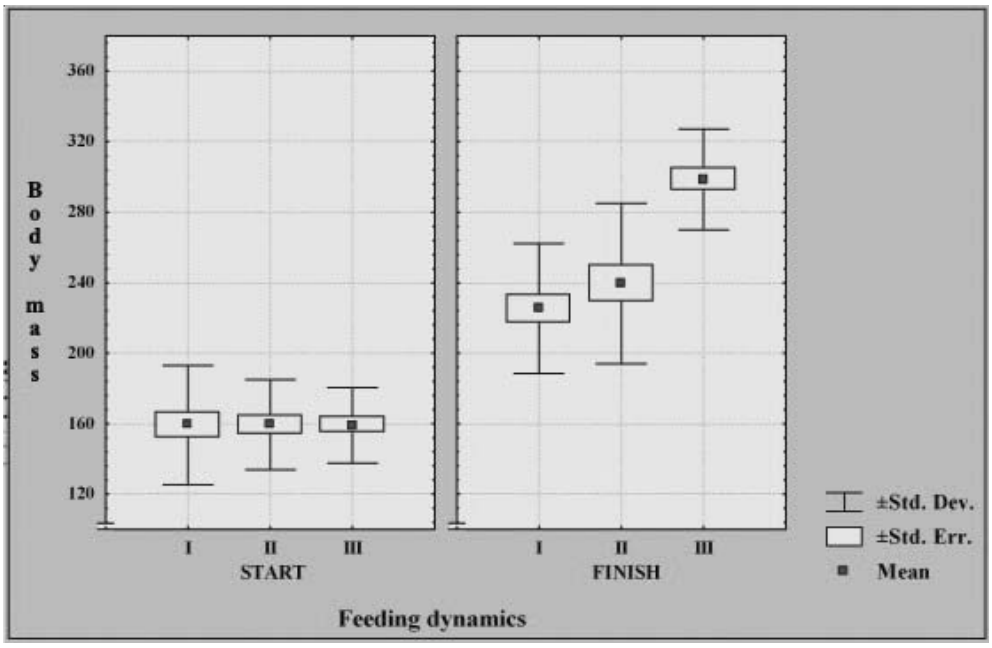

Fig. 2. Mean, standard deviation and standard error for the fish weight of all three groups

and the effect of feeding frequencies on the average fish weight was tested using ANOVA. The average weight of experimental groups at the end of the experiment were 225.316 g, 239.632 g and 298.526 g and were significantly different from each other ($F=20.191$; $p<0.001$).

According to the results of t-test, it can be concluded that the average body weight of the first and second group of fish were not significantly different, but they were statistically very significantly lower than the average fish weight of the third group.

Except the composition of the fish diet, very significant differences were found between feeding frequencies. Yamamoto et al. (2007), found better utilization of feed components (proteins, fats and starch) and better growth rate in carp that are fed continuously than those that were fed with breaks.

Between fish from I and II group that were fed once or twice a day no statistical differences were found, that was also concluded by Guinea (1997).

Table 2

Effect of feeding frequencies on the average weight of fish

Groups	Levene's test		t-test	
	F	p	t	p
I-II	0.935	0.340	-1 065	0.294
I-III	0.958	0.334	-6 838	0.000
II-III	3 763	0.060	-4 775	0.000

Conclusions

During the 60 day experiment, effect of feeding frequencies on the growth rate of carp was investigated. Three different types of feeding frequencies were applied to three groups of fish: the first group of fish was fed once a day for 60 min, the second group twice a day for 60 min., with a 120 min interval between the two feeding and the third group of fish that was fed continuously for 12 h per day.

According to the gained results, a statistically significant difference between fish growth using different feeding frequencies was found. The lowest growth of 41.46% was found in the first group of fish. Fish from the second group had better growth from the first group for 21.58%. The third group had the highest growth, 111.69% better than the first group and 74.12 % bet-

ter than the second group. The t-test showed that the average fish weight from the first and second group were not statistically different, but were significantly lower that the average fish weight of the third group that had feed available continuously for 12 hours per day.

These results are of great significance for the improvement of feeding regimes in carp culturing and in gaining higher growth with the same amount of feed.

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