EFFECTS OF FEED QUANTITY ON THE WEIGHT GAIN OF CARP JUVENILES REARED IN TANKS

MARKO STANKOVIĆ, VESNA POLEKSIĆ, MILAN SPASIĆ, DALIBOR VUKOJEVIĆ, NADA LAKIĆ, RENATA RELIĆ, ZORAN MARKOVIĆ
[1]*Institute of Animal Science, Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia*

UTICAJ KOLIČINA HRANE NA PRIRAST ŠARANSKE MLAĐI U TANKOVIMA

Abstrakt

Šaran se gaji u sva tri sistema: ekstenzivni, poluintenzivni i intenzivni. Za razliku od ekstenzivnog gde je prirast ribe isključivo zavistan od prirodne hrane, poluintenzivni i intenzivan sistem gajenja riba su bazirani na delimičnoj, odnosno potpunoj zavisnosti od dodatne hrane.

Kako tokom sezone gajenja, prirodna hrana u ribnjacima sa poluintenzivnim sistemom ima veoma izražen sezonalni karakter, u periodu sa optimalnim temperaturama za rast šarana (od sredine juna pa do kraja avgusta) prirast je u najvećoj meri zavistan od vrste i količine dodatne hrane. Sa ekonomskog, ali i ekološkog aspekta važno je obezbediti hranu koja će rezultirati niskim koeficijentom konverzije, visokim tempom rasta, dobrim zdravstvenim stanjem gajenih riba, visokim kvalitetom finalnog proizvoda, tj. ribljeg mesa i što manjim opterećenjem vodene sredine organskim materijama, fosforom i azotom. Od velike važnosti je i obezbeđivanje adekvatne količine dodatne hrane, odnosno ne dozvoliti da količina hrane bude manja od potreba gajene ribe, ali i ne preterati sa količinom koja od strane riba neće biti racionaln iskorišćena i time smanjiti profitabilnost gajenja riba. U cilju određivanja optimalnog procenta hrane u odnosu na ihtiomasu gajene mlađi šarana urađen je ovaj rad.

Eksperiment je realizovan u Centru za ribarstvo i primenjenu hidrobiologiju, Poljoprivrednog fakulteta, Univerziteta u Beogradu tokom 90 dana. Za prihranu šaranske mlađi korišćena je ekstrudirana hrana sa 38% proteina i 8% masti proizvođača Vetrinarski zavod «Subotica», veličine peleta 2 mm. Eksperiment je realizovan u 4 tretmana sa po 3 ponavljanja. Tretmani su se razlikovali po procentualnom učešću količine hrane u odnosu na ihtiomasu u tanku na početku svakog tridesetodnevnog perioda. U prvom tretmanu je dnevni obrok riba 2%, u drugom 3%, u trećem 4%, dok su ribe u tretmanu četiri hranjene sa 5% hrane u odnosu na ihtiomasu.

U svaki od 12 nezavisnih tankova nakon perioda adaptacije, nasađeno je po 40 jedinki šarana, prosečne mase 6,41 do 6,47 g. Hranjenje riba je obavljano svakodnevno upotrebom hranilica sa trakom.

Na osnovu prosečnih masa riba po periodima i na kraju eksperimenta, statističkom analizom je ustanovljeno da postoje vrlo značajne razlike u prirastu u zavisnosti od dnevnog obroka. Ribe hranjene sa 5% hrane u odnosu na ihtiomasu ostvarivale su statistički značajno veći prirast u odnosu na ribe hranjene sa 2, 3 i 4% hrane. Korišćenjem ovog rezultata se otklanja dilema koja je količina hrane za prihranu gajene šaranske mlađi optimalna tokom gajenja šaranske mlađi u prvoj godini. Pored najboljeg prirasta, šaranska mlađ hranjena sa 5% hrane je imala i najbolji faktor kondicije, specifičnu stopu rasta, kao i termalni koeficijent rasta. U odnosu na ribe hranjene sa 3 i 4% hrane, mlađ hranjena sa 5% je imala nešto veći koeficijent konverzije (za oko 10%), međutim imajući u vidu značajnu razliku u prirastu između svake od 4 hrane, ovo povećanje koeficijenta konverzije je ekonomski opravdano.

***Ključne reči**: šaranska mlađ, procenat hrane, prirast*

INTRODUCTION

Carp is cultured in all 3 systems: extensive, semiintensive and intensive. Contrary to extensive rearing where weight gain depends uniquely on natural food, semiintensive and intensive systems are based on partial or complete reliance on added feed.

During the rearing season the natural food in fish ponds with the semiintensive system has a prominent seasonality: in the period of natural food depression with optimal temperatures for carp growth (from mid June to end August) weight gain is primarily dependent from the type and quantity of added feed (Marković, 2010). From the economical, but also ecological point of view it is important to supply feed that will result in low feed conversion coefficient, high growth rate, good health condition, high quality of the final product – fish meat, and as low as possible load of the aquatic environment with organic matter, phosphorus, and nitrogen (Jahan et al., 2003). Of great importance is provision of adequate quantity of added feed, i.e. to prevent insufficient feed quantity, but also not exaggerate with added feed quantity and thus decrease production profitability (Bailey and Alanärä, 2006). In that aim this study was carried out.

MATERIAL AND METHODS

Study of the effects of feed quantity on weight gain of carp fry was performed in the Centre for Fishery and Applied Hydrobiology of the Faculty of Agriculture University of Belgrade. The study lasted 90 days, 2 month old carp (*Cyprinus carpio*) fry was used. Extruded feed with 38 % proteins, 8% lipids, pellet size 2 mm was used in 4 treatments in 3 repetitions. Treatments differed in feed quantity. The added feed was calculated as a percent of body mass of the fish and was recalculated at every 30 days, after the control measurement of the fish. In the first treatment daily diet was 2 %, in the second 3 %, in the third 4%, and in the fourth 5% of the fish total body mass in the tank. Each treatment was different in daily percent of added feed.

Experiment was carried out in plastic tanks 130 l with constant flow through of 0.51 l/min. Tanks were connected to the recirculation aquaculture system (RAS), where chemical, biological and microbiological purification of the used water was done. In the

frame of the RAS water heating and aeration provided identical conditions for experiment realization.

In every 12 independent tanks after the adaptation period 40 specimens of two months old carp fry were stocked, average weight 6.41 to 6.47 g. Fish was fed using belt feeder (AGK Kronawitter GmbH). Water quality and environmental conditions (water temperature, electroconductivity, dissolved oxygen, and pH) were measured in each tank every 3rd day using MULTI 340i/SET (WTW, Weilheim, Germany). Feed quantity, depending on treatment (2, 3, 4, 5 %) were measured daily using a digital balance Radwag (THB – 600, accuracy 0.01 g), while fish weight was measured in the 30 days periods.

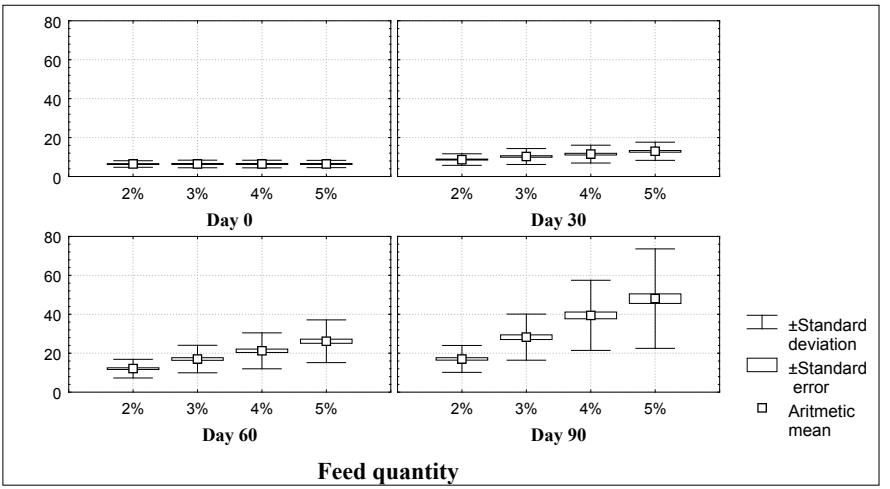
Following parameters for growth performances were calculated using equations: BWG (body weight gain) = final body weight (g) – initial weight (g); SGR (specific growth rate) = (ln final weight – ln initial weights) x (days of trial-1) x 100; FCR (Feed conversion ratio) = (feed intake, kg) x (wet weight gain, kg)$^{-1}$; TGC (Thermal Growth Coefficient) = [(final weight)$^{1/3}$ – (initial weights)$^{1/3}$] x (days x C^{o})$^{-1}$ x 1000; CF (Condition factor) = body weight (g) x (fork length, cm)$^{-3}$ x 100; LH (Relationship between length and body height) = body length / body height.

Statistical testing of the hypothesis was done using parametrical model of analysis of variance in the case of homogeneous data ($c_v \leq 30\%$) and sample variation. For sample with variable values ($c_v > 30\%$) and heterogenous variability a Kruskal Wallis model was employed. Individual comparison of average values were carried out using LSD test ($c_v \leq 30\%$) and Mann-Whitney-ev U test ($c_v > 30\%$).

RESULTS

At the start of the experiment results of Levene's test have shown that variation in tanks was not significantly different for measured parameters pointing out that the experimental setup was correct and that differences in further measurements are effect of different feed quantity.

Figure 1. Fish body mass related to feed quantity per examined period



After a 90 days period average fish body mass in tanks varied from 16.3

After a 90 days period average fish body mass in tanks varied from 16.36 g in tank N° 5 till 68.74 g in tank in tank N°12. Least average body mass had fish from the first treatment 17.08 g, and highest average body mass was reached in treatment 4 – 54.32 g.

Results of the Kruskal-Wallis test ($H = 139.87$; $p < 0.001$) confirm that the average fish body mass was significantly dependent on feed quantity (2, 3, 4, 5 %). According to the results of Mann-Whitney test it can be concluded that increased feed quantity affects average body mass. At experiment end, variances in fish body mass between tanks were significantly different. Kruskal-Wallis test ($H = 181.567$; $p < 0.001$) shows significant differences between average body mass. Mann-Whitney test demonstrates that fish fed 4 and 5 % body weight differ significantly in average body mass ($p = 0.017$). Other groups differ very significantly.

Table 1. Growth parameters, condition factor, and feed conversion ratio in different treatements (feed quantity)

Feed quantity	2%	3%	4%	5%
% weight gain	165.44	370.35	572.53	742.17
Condition factor	1.75	2.00	2.08	2.24
Relationship between length and body height	3.45	3.30	3.27	3.21
BWG- body weight gain	418.73	842.24	1338.21	1723.06
FCR- feed conversion ratio	1.57	1.37	1.39	1.54
SGR- specific growth rate	1.08	1.71	2.11	2.35
TGC- Thermal growth coefficient	0.37	0.65	0.84	0.98

Weight gain of fish during the experiment varied from 418.73 g (treatment 1); 842.24 g (treatment 2), over 1338.21 g (treatment 3), to 1723.06 g (treatment 4). Fish fed 5 % total body weight per tank achieved best weight gain, had best condition factor, and best SGR and TGC. Compared to fish fed 3 % and 4 %, fry fed 5% ichthyomass had slightly higher feed conversion ratio (for approximately 10%).

DISCUSSION

Presence and availability of natural food in the dominant semiintensive culture system affects significantly carp growth (Rahman and Verdegem, 2007). It represents almost irreplaceable set of essential matters for growth and development of cultured fish (Kirbia et al. 1997) because of its excellent protein, free amino acids and oligopeptides, lipids and fatty acids, vitamins, and minerals content. In periods of natural food depression or its insufficient development applying proper quantity and quality of feed is essential for maintenance of good growth rate. In order to assure optimal feeding and management of the semiintensive system, it is important to know nutritional requirements of different age categories of carp (Rahman et al., 2009). In the absence of natural food, in the intensive system growth is entirely dependent on added feed, its quantity and quality.

According to the results obtained it could be concluded that best weight gain was obtained with the treatment 5 % of ichthyomass, and worse with 2 %. Insufficient quantity of available feed in fish causes acute stress (Ruane et al., 2002). Although fish are acclimated to low feed intake, it affects other aspects of fish physiology besides weight gain (Ali and Wootten, 1999). This can be related to the fact that sub optimal feeding cannot recompense all the needs for growth and development, therefore growth is reduced. Compared with fish fed 4 and 5 % body weight, average body mass were very significantly different.

Despite the fact that feed conversion ratio in treatment 4 was 10 % higher than in treatment 2 and 3, the use of 5 % ichthyomass per tank demonstrates economic justification due to the big difference in weigth gain of carp fry. Average fish body mass from treatments 4 and 5 % differ for 25.7 %. By feeding fish with 3 and 5 % body weight, average body mass differed for 78.8 %, while fish fed 2 and 5 % body mass differed in weight gain for even 218 %

Weight gain (BWG) was significantly different in different study periods, as well as treatments. Since fish fed 5 % ichthyomass per tank had highest average body mass, as well as the weight gain. It was very significantly different from weight gain in other treatments, as well as in same tanks in the next study periods (in 30 days intervals). This confirms continuing growth and weight gain in fish fed with higher feed quantity (4 and 5 %). Fish fed smaller quantity (2 and 3 %) had weight gain significantly higher compared to the previous study period, but significantly smaller weight gain compared with treatment 3 and 4 (added feed quantity 4 and 5 %).

CONCLUSIONS

According to the results obtained in different study periods; at the end of the experiment; and by statistical analysis, it can be concluded that there are significant differences in average body mass depending on feed quantity. Fish fed 5 % of their body mass had best average body mass compared to fish fed 2, 3, and 4 % body mass. Besides, they had best weight gain significantly different from previous period (compared to the same tank or treatment). Results obtained using 5 % feed point out proper feed quantity in both the experiment beginning, when average mass was 6.4 g, and also later when average body mass was 54.3 g. This experiment results are solving one important dilemma concerning optimal feed quantity in carp fry nutrition during the first year of production.

ACKNOWLEDGEMENT

The present study is realized in the frame of the project "Improvement of production capacity of the carp (*Cyprinus carpio* L) by programs of nutrition and selective breeding" (N° TR 31075) financed by Serbian Ministry of Education and Science.

REFERENCES

Ali, M. and Wootten, R.J. (1999): Coping with resource variation: effect of constant and variable intervals between feeding on reproductive performance at first spawning of female three-spined sticklebacks, *J. Fish Biol.* 55, pp. 211–220.

Bailey, J. and Alanärä, A. (2006): Digestible Energy Need (DEN) of selected farmed fish species. Aquaculture, 251, pp 438-455.

Jahan, P., Watanabe, T., Kiron, V., Satoh, S. (2003): Improved carp diets based on plant protein sources reduce environmental phosphorus loading. FS, 69, pp 219-225.

Marković, Z. (2010): Šaran, Gajenje u ribnjacima i kaveznim sistemima. Prof. dr Zoran Marković, str 152.

Ruane, N.M., Huisman, E.A., Komen, J. (2002): The influence of feeding history on the acute stress response of common carp (*Cyprinus carpio*). Aquaculture 210, Issues 1-4, 245-257.