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Suitable Live Weight for Transferring Rainbow Trout *Oncorhynchus mykiss* (L., 1758) (Actinopterygii: Salmonidae) from Concrete Ponds to Earthen Ponds for Faster Growth and Better Feed Performance

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Abstract: Growth rate and feed performance were compared between rainbow trout fry with an average live weight of 2.01 ± 0.02 g, which were transferred to earthen ponds at 10, 50 and 100 g average live weight and rainbow trout grown in a concrete pond. The best average weight gain was obtained in the group that was transferred to earthen ponds at 10 g average live weight ($P \leq 0.05$).The feed performance of the fish that were transferred to the earth ponds at 10 and 50 g were statistically significantly different from the control fish and the ones transferred at 100 g average live weight ($P \leq 0.05$).

Key words: Rainbow trout, *Oncorhynchus mykiss*, earthen pond transfer, comparative growth performance.

Introduction

According to TÜİK (2017), the rainbow trout production in Turkey has exceeded 107,000 tons and a significant part of it is being exported. In recent years, as global fish meal prices have risen considerably, the use of earthen ponds in rainbow trout breeding has increased as well as in breeding of marine fish such as sea bream and sea bass (Hepher 1988,Tacon & De Silva 1997, Korkut et al. 2017). This aquaculture model is based on the principle of transferring the trout at various times after hatching from the concrete ponds to earthen ponds and feeding them with commercial feeds administered from outside, as well as with live food from the pond until they reach marketing size. According previous studies, fish grow faster when using this method and meat quality is very similar to those in nature (Boaru et al. 2009, Azis et al. 2012). In this study, the growth rate and feeding of rainbow trout fed in concrete ponds in fully commercial production conditions are compared to those of rainbow trout transferred at different average live weights to earthen ponds.

Materials and Methods

Fish, ponds and feeds used in the experiment

This study was carried out in a private rainbow trout farm in the province of Mugla, Fethiye District. Four hundred thousand rainbow trouts with an av. live weight 2.01 ± 0.02 g were obtained from the hatchery of the same farm and from the same batch. Four experimental groups were used: (1) control group grown in concrete ponds (CG); (2) experimental group transferred to earthen ponds at 10 g live weight (EP10); (3) experimental group transferred to earthen ponds at an av. live weight 50 g (EP50); (4) experimental group transferred to earthen ponds at av. live weight 100 g (EP100). The fish were randomly selected and placed in concrete ponds with a volume of 99 m^3 in order to work in two replications, with equal number of fish in each pond. The fish were fed 5 times a day *ad libitum* with extruded feeds obtained from a private fish feed plant. Fish in concrete ponds were fed 3 times a day during the growing period and fish in the earth ponds were fed 2 times a day *ad libitum*. The given feed was recorded

for each experimental group. The nutritional composition of the feeds is presented in Table 1.

The study started in July and was terminated in February when the first group reached an average live weight of 200 g, which is the marketing weight determined by the farm. The experiment duration was 228 days.

Trial plan

When fish exceeded the average live weight of 10 g, 50 g and 100 g, they were transferred from the concrete ponds (151 m^3) to the earthen ponds (450 m^3). Except for the first group (10 g), which was transferred to the earthen ponds, the fish were fed until they reached the required average live weight and only then were transferred to the concrete ponds. These ponds were used until the end of the study. During the trial, a water flow of 7 dm^3/s was provided to both the concrete and the earthen ponds. Daily average water temperatures, dissolved oxygen and pH values of the water in the ponds were measured with the YSI Multiparameter Instrument.

Live weight, feed evaluation and specific growth rates

The average live weight gain (± 0.01 g)of 80 randomly taken from the pondsfish was monitored every 15days, after the fish was anesthetized. The mean Feed Conversion Rate (FCR) and Specific Growth Rate (SGR) of fish were calculated as monthly means and at the end of the study, using the following formulas:

FCR = Feed given (kg) / Animal weight gain (kg)

SGR = ln(final weight.g) – ln(initial weight.g) x100) / t (in days)

Statistical analyses

Weight gain, FCR and SGR were studied using one-way Analysis of Variance and Tukey's HSD Test for comparison of treatment mean values, using the Statistical Package for Social Science (SPSS for Windows; v19.0, USA) Statistical significance was set at $P \leq 0.05$.

Results

Water temperature, dissolved oxygen and pH values

The average water temperature was 14.46 ± 2.37°C, the hottest was August with 18.2°C and the coldest was January with 12.27°C (Fig. 1). Throughout the study, the measured dissolved oxygen level was on average 6.74 ± 0.39 $mg/dm^3$and pH value had an average of 7.73 ± 0.37 (Fig. 1).

Growth and development of fish

Experimental group reached an average live weight of 200.81 ± 1.87 g, EP50 – 189.06 ± 1.21 g and EP100 – 181.78 ± 1.23 g. The group with the lowest live weight gain was the control group, which was grown in concrete ponds from the beginning of the study, with an average live weight of 177.97 ± 1.85 g. The weight gain recorded by the EP10 was significantly different from the one of all the other groups ($P \leq 0.05$). The results for EP50 were statistically significant ($P \leq 0.05$) as compared to EP100 and the control, whereas the difference between the EP100 and the control was not significant ($P \geq 0.05$). Monthly changes related to live weight development are given in Fig. 2.

Feed evaluation and specific fish growth rate

Regarding feed conversion rates, EP10 reached an average FCR of 0.82 ± 0.23, EP50 of 0.92 ± 0.20, EP100 of 1.02 ± 0.3 and the control group of 1.03 ± 0.35. Differences between EP10 and EP50 were not significant ($P \geq 0.05$), whereas the difference was significant ($P \leq 0.05$) when FCR of these two groups were compared to the ones for EP100 and the control. The difference between EP100 and the control was also statistically insignificant ($P \geq 0.05$). The FCR change between the groups is shown in Fig.3.

The results for the evaluation of the specific growth rates were similar. The average SGR change of was 1.90 ± 0.85, 1.87 ± 0.84, 1.82 ± 0.73, 1.81 ± 0.74, respectively, for EP10, EP50, EP100 and the control. The difference between EP10 and EP50 was statistically insignificant ($P \geq 0.05$), as well as the differences between these two groups and EP100 and the control ($P \leq 0.05$), whileEP100 and the control were not-significantly different ($P \geq 0.05$). The SGR change between the groups is shown in Fig.4.

Stocking density variations

Considering the live weight gain and the number of fishes kept in the ponds from the beginning of the experiment, it can be stated that the average stocking density in the control group was9.42 kg/m^3, in EP10 it was 4.11 kg/m^3, in EP50 - 5.06 $kg/m^3$and in EP100 it was 5.78 kg/m^3.The changes are given in Fig.5.

Discussion

Very little is known on aquaculture applications for rainbow trout outside concrete ponds and tanks. Dekamin et al. (2015), while assessing life cycle of rainbow trout in Iran, inflow-through, recirculating and semi-closed re-circulating culturing systems, found differences between in terms of water dependence, land competition, feed production processes

Table 1. Nutritional composition of commercial feeds of the trial (provided by the feed company)

Nutritional composition (%)	Fry (1-1.5 mm)	On-growing (2-3 mm)	Growing (4 mm)
Crude protein	54	46	43
Crude fat	14	19	22
Crude cellulose	1.5	2	2.5
Crude ash	11	11	11

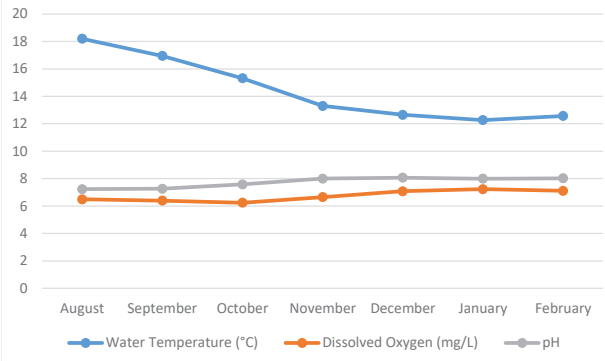

Fig. 1. Water temperature, dissolved oxygen and pH changes.

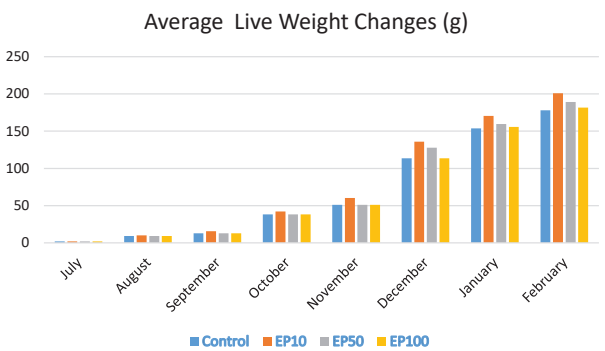

Fig. 2. Average monthly live weight changes within the experimental groups.

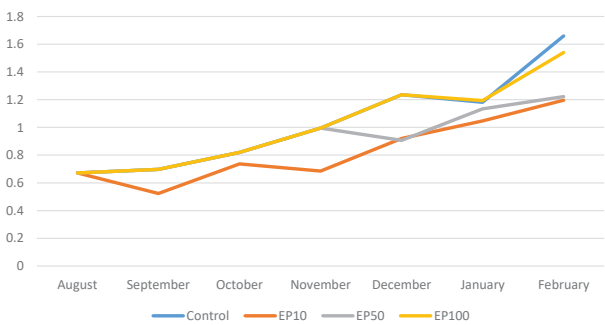

Fig. 3. Monthly FCR changes of the experimental groups.

and energy use. Feed production was found to be the major contributor to the potential impacts such as climate change and acidification in all three systems due to variable feed conversion ratios: FCR = 1.15, 1.47 and 1.57 in flow-through, re-circulating and semi-closed re-circulating systems, respectively. In

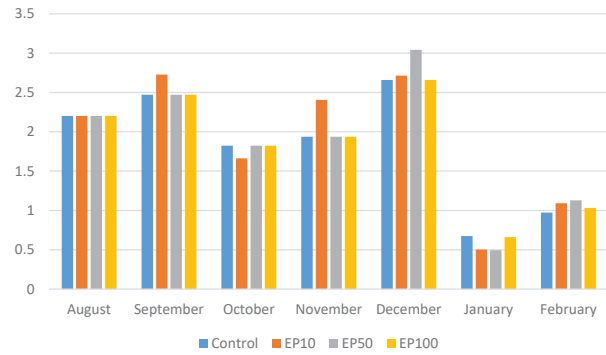

Fig. 4. Monthly SGR changes of the fish groups.

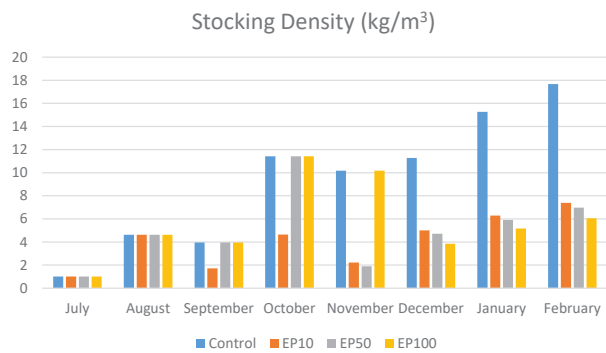

Fig. 5. Monthly stocking density changes (kg/m^3).

another study, the effects of commercial production conditions of aquaculture using extruded and pelleted feed in rainbow trout farming were determined: FCR was 0.93 in fish fed with extruded feed based on 10,000 fish (Kheyrabadi et al. 2014). It is generally known that trout demonstrate good growth and development at concentrations of dissolved oxygen of about 5-6 mg/dm^{3}and pH = 6.5-8 (Woynarovich et al. 2011). The values obtained in this study confirm these results. Considering the average stocking densities from the beginning to the end of the experiment, the lowest stocking density was achieved in the EP10 group with the best growth, development and feed assessment rate. According to North et al.(2006), Ellis et al.(2006) and Laursen et al.(2015),t excessive densities could cause welfare problems, although individual responses indicate that water quality (oxygen level and water replacement) are perceived to be more significant than density *per se*.

Conclusions

This work is likely one of the first studies on the transfer of commercial rainbow trout of different live weights to earthen ponds. Growth rates and feed evaluation were compared between the rainbow trout grown in concrete ponds for a period of 228 days and the fish transferred to earth ponds at 10, 50 and 100 average live weight. The most important live weight gain and rapid growth rate were observed for fish transferred to earth ponds at an average live weight of 10 g. FCR and SGR values of the fish transferred at 50 g average live weight did not show any significant difference with the EP10, however, their growth rate was lower. The similarity of the growth, development and feed evaluation for experimental group EP100 to the control group fed continuously in the concrete pools suggests that the earth pond cultivation does not make a significant difference in live weight after 50 g. In the future it is recommended to study the effects of nutritional content of the earthen ponds environment and the fish welfare.

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References

Azis A., Khan F., Rab A. & Ramzan M. 2012. Development of least-cost fish feed for rainbow trout form indigenous ingredients at Juglote, Gilgit, Pakistan, Punjab University Journal of Zoology 26: 53-58.

Boaru A., Bud I., Petrescu, I. V., & Hegedus C. 2009. Study on factors influencing feeding behaviour of culture trout with the aim of streamlined target. Bulletin UASVM Animal Science and Biotechnologies, 66 (1-2).

Dekamin M., Veisi H., Safari E., Liaghati H., Kroshbakht K. & Dekamin M. G. 2015. Life cycle assessment for rainbow trout (*Oncorhynchus mykiss*) production systems: A case study for Iran. Journal of Cleaner Production 91: 43-55. https://doi.org/10.1016/j.jclepro.2014.12.006.

Hepher B. 1988. Nutrition of Pond Fishes.Cambridge University Press.UK, 388 pp.

Korkut A. Y., Kop A., Saygi H., Göktepe Ç., Yedek Y. & Alkan T. 2017. General Evaluation of Fish Feed Production in Turkey. Turkish Journal of Fisheries and Aquatic Sciences (17-1): 223-229. https://doi.org/10.4194/1303-2712-v17_1_25.

Laursen D. C., Larsen B. K., Skov P. V. & Höglund E. 2015. Improved growth performance in rainbow trout Oncorhynchus mykiss reared at high densities is linked to increased energy retention. Aquaculture 442: 69–73. https://doi.org/10.1016/j.aquaculture.2015.02.035.

North B. P., Ellis T., Turnbull J. F., Davis J. & Bromage N. R. 2006. Stocking density practices of commercial UK rainbow trout farms.Aquaculture 259 (1–4): 260-267. https://doi.org/10.1016/j.aquaculture.2006.05.043

Kheyrabadi, E.; Farsani,A; &Kuchaksaraei, B.2014.A Comparison on FCR in fish ponds of Rainbow Trout (Oncorhynchus mykiss) fed by extruder food and pelleted food. Iranian Journal of Fisheries Sciences 13(1): 503-507.

Woynarovich, A., Hoitsy, G.; &Poulsen, M.T. 2011.Small-scale rainbow trout farming.FAO Fisheries and aquaculture technical paper.Volume 561, Rome.81 pages.

Tacon, AGJ.&De Silva S.S. 1997. Feed preparation and feed management strategies within semi-intensive fish farming systems in the tropics. Aquaculture 15: 379-404.

TÜİK (Turkish Statistical Institute) 2017. Fisheries and Aquaculture Statistics. http://www.tuik.gov.tr (Accessed November, 1, 2017).

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