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Short Communication

Comparison of the survival and growth performance in rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta fario*) fry

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Rainbow trout is an intensively cultured species because of their more cultivable character than brown trout. Culture of brown trout could not be expanded due to low growth performance of brown trout compared to rainbow trout. This experiment was conducted in a commercial trout farm, Aegean area (Turkey). Growth performances and survivals of rainbow and brown trouts from fry to fingerling was observed for 155 days. Growth performances, feed conversion rates (FCR) and survivals were determined. Initial weights of rainbow and brown trouts were 0.1 ± 0.01 g. Final weights were 26.5 ± 5.19 and 12.97 ± 2.74 g, respectively at the end of the experiment. Survival and FCR of rainbow and brown trouts were 83.9, 80 and 0.59, 0.61% respectively. As a result, there is a similarity between these two trout species in point of survivals and FCR's although, growth performance was obviously better than brown trout in early development of rainbow trout.

Key words: Rainbow trout, brown trout, fry, growth, survival.

INTRODUCTION

The culture of rainbow trout is easy in comparison to that of other trout species. Advantages such as its ability of adaptation to the environmental conditions, resistance to low oxygen values and high temperature, easy acclimatization to the commercial feed, displaying a good development in terms of having feed actively and high feed consumption rate and having a shorter hatching period than brown trout (*Salmo trutta fario*) and brook trout (*Salvelinus fontinalis*) have always made rainbow trout outstanding. Since the market share cannot be increased in parallel to the production rate, it became necessary to develop alternative cultures.

Many stocks of brown trout have been reproduced in European hatcheries for several decades, mostly for the purpose of producing fry and fingerlings for stocking depleted populations, subjected to an intense sport fishery (Quillet et al., 1992). Brown trout is not endemic in Turkey, but is produced in some farms in the eastern Black Sea (Serezli et al., 2003). Its most important advantage is that the fry can begin feeding directly with starter feed. However, the propagation of brown trout is not as much as that of the rainbow trout under culture conditions due to some of their sensitive characteristics. Although, the slower development of brown trout than the rainbow trout restricts its production to become widespread; stocking and market demands besides the development of cultivation techniques enable the development of culture of brown trout to gain momentum. In this study, the survival and growth performances of brown trout and rainbow trout with consumed vitellus were observed for 155 days. Growth performances, feed consumption and survival rates were determined.

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MATERIALS AND METHODS

This experiment was conducted at a private trout farm (Izmir – Kemalpasa) and lasted for 155 days. Growth, feed conversion and survival of fry were compared between two species. Initial weights of rainbow and brown trouts were 0.1 ± 0.01 g. Hatchery troughs (180 x 40 x 40 cm) were used for on-growing and around 250 ml s^{-1} of freshwater was supplied initially. Stocking densities of rainbow and brown trout fry were 2.16 ± 0.08 kg m^{-3}. The fry were transferred to nursery ponds (6 × 1 × 0.5 m) after reaching about 1 g after which

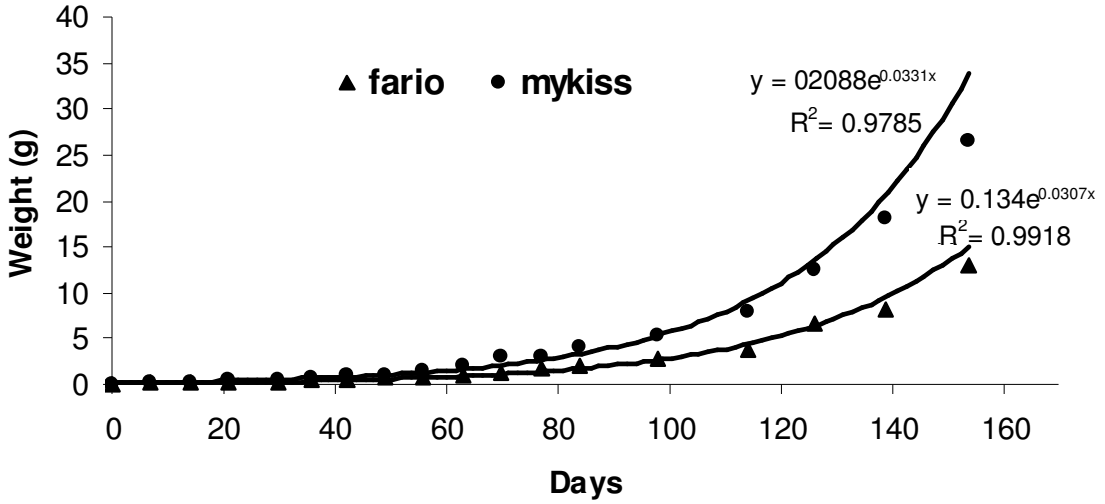

Figure 1. Growths of fry and relationship to time (days).

Table 1. Growth and survival data of rainbow and brown trouts.

Specie	Rainbow Trout	Brown Trout
Initial weight (g)	0.1 ± 0.01	0.1 ± 0.01
Final weight (g)	26.59 ± 5.2[a]	12.97 ± 2.74[b]
FCR	0.59 ± 0.03	0.61 ± 0.01
SGR (%)	3.63[a]	3.18[b]
Survival (%)	83.9 ± 0.7	80 ± 1.1

*Within the same rows, values with different superscripts are significantly different ($p < 0.05$). SGR, specific growth rates; FCR, feed conversion.

the experiment was carried out in three replicates.

Water temperature and dissolved oxygen were measured weekly with an oxygen meter (Oxyguard). Fish were weighed to the nearest 0.001 g and measured 1 mm after anaesthetization with clove oil (SIGMA). Fry were fed by hand a commercial extruded diet of 55% protein, 10% fat *ad libitum* and the amount of feed was recorded. Growth performances and specific growth rates [(SGR) (% day^{-1}) = ln (final mean weight) - ln (initial mean weight) / experimental days × 100)] were determined periodically.

All the means of data are expressed with their standard errors. Survival rates were compared using the Chi square test. Analysis of data was carried out using Statistical Package for the Social Sciences (SPSS). One-way analysis of variance (ANOVA) followed by the least significant difference (LSD) test used to determine significant differences among means. Statistically, significant differences were expressed as $p < 0.05$. The relationships between average weights and days were tested by regression and correlation analyses.

RESULTS AND DISCUSSION

Water temperatures and dissolved oxygens in culture circumstances for brown and rainbow trouts were measured between 10.3 to 12.9°C and 6.2 to 8.2 ppm throughout the experiment, respectively. Initial weights of rainbow and brown trouts were 0.1 ± 0.01 g. Final weights were 26.5 ± 5.19 and 12.97 ± 2.74 g, respectively, at the end of the experiment ($p < 0.05$) (Figure 1). Due to *ad libitum* feeding, the feeding rates varied by period within the growing process of trouts. The daily feeding rates in brown trout fry ranged from 0.39 to 5.26% by period whereas this rate ranged from 0.71 to 14.29% in rainbow trout. It can therefore be speculated that the brown trout grew less because they ingested less food. At the end of the growing study, the survival rates of brown trout and rainbow trout were 80.0 and 83.9%, respectively with no statistical significance between these species ($p > 0.05$) (Table 1).

Water temperature is a key factor controlling the rate of growth. In this study, water temperatures were between 10.3 to 12.9°C for both species. McCauley and Casselman (1980) suggested a range between 12 to 15°C for optimal growth, while Quillet et al. (1992) suggested 15 to 17°C. It was observed that the rainbow trout grew obviously more rapidly than the brown trout. Similar results were obtained when compared with Yanik et al. (2002), Kurtoglu et al. (1998) and Shepherd and Bromage (1988) for rainbow trout. According to Quillet et al. (1992),

brown trout is not a competitive species when compared with rainbow trout. Serezli et al. (2003) cited that the survival, weight gain, specific growth rate and feed conversion rate of brown trouts were significantly lower than rainbow trouts. In this study, no significant difference were observed between species with regard to feed conversion or survival of fry at the end of the 155 day trial, but weight gain and specific growth rate differed significantly ($p < 0.05$). The specific growth rates in this study (3.63% for rainbow trout and 3.18% for brown trout) were in accordance with the findings of Hisar et al. (2003) for brown trout (3.13%), but higher than that reported by Yanik et al. (2002) (1.67%), Uysal and Alpbaz (2002) (1.87 to 2.01%) for rainbow trout.

Brown trouts having a more sensitive structure to environmental factors, were unable to exhibit any aggressive feeding behaviour like rainbow trouts and chose to escape to the bottom of the troughs when fed. It seems essential to allow the feed to sink slowly in an elicoidal movement in order to make it available for the fry and fingerlings during a long period (Quillet et al., 1992). In spite of this, their feed consumption rates and desires are not as much as those of the rainbow trout. In connection to this, the extension of feeding time also appears as another disadvantage. The effects of feeding frequency upon the food intake and growth of salmonids appear to be highly dependent upon rearing conditions (Jobling, 1995). There was a difference even between individuals among brown trouts in terms of the desire and rate of feed consumption during feeding. Chevassus et al. (1991) also indicated that growing performance during the fresh water phase varies widely among the different populations. Although a selection likely to be made to this end will bear fruit years later, it is both possible to shorten the improvement time upon putting molecular genetic methods into action and to obtain brown trout having the feed consumption rates of rainbow trout. Application of selective breeding techniques seems to allow a rapid and substancial improvement of the rearing performances (Quillet et al., 1992). Moreover, intraspecific cross-breeding of selected salmonid populations may produce a faster growing breed with a higher survival rate for aquaculture (Hisar et al., 2003).

Finally, against the fact that the growth performance of rainbow trout fry was better than that of brown trout fry in early period, a similarity was found between both species in terms of survival and feed consumption rates. As a result of the studies to be made to this end in the future, the chance of brown trout to be included in the sector of trout growing as an alternative species will increase. In addition, dealing with the other trout species within this scope will contribute to the enlargement of the range of alternative species.

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