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The Effect of Tank Volumes on Survival of Gilthead Seabream (*Sparus aurata* L., 1758) from Hatching to the First Grading in Intensive Culture Systems

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Özet: ***Yoğun yetiştiricilik sistemlerinde kuluçkadan ilk boylamaya kadar çipura (*Sparus aurata*, L., 1758) balığının yaşama yüzdesi üzerine tank hacminin etkileri.*** Bu çalışmada, çipura (*Sparus aurata* L.1758) larvalarının yaşama ve büyüme oranları üzerinde tank hacimlerinin etkileri, 0-38 günler için test edilmiştir. Döllenmiş yumurta oranı yüksek olup%90-95 arasındadır. Larvalar intensif koşullarda 5 ve 15 tonluk tanklarda 24 saatlik aydınlık periyotta yetiştirilmiş, ilk yem olarak rotifera daha sonra ise *Artemia* nauplii ve *Artemia* metanauplii ile besleme yapılmıştır. Yeşil su tekniği olarak *Chlorella* sp. ve *Isochrysis galbana* türleri 1x 10^6 hücre.ml^{-1} olarak kullanılmıştır. Yaşama oranları ve gelişim oranları 5 ve 15 tonluk tanklar için değerlendirilmiştir. Beş tonluk tanklardaki ortalama yaşama oranı (% 12,56±0,47) on beş tonluk tanklardaki yaşama oranından (% 9,83±0,76) önemli derecede yüksek bulunmuştur (P<0.05). Kuluçkalamadan sonraki 38. günde, 5 ve 15 tonluk tanklarda yetiştirilen larvalarda total boy ve en değerleri benzer bulunmuştur (Boy sırasıyla 10.35±0.22 mm; 10,14±0,52 mm ve en ortalamaları sırasıyla, 2.15±0.19 mm; 2.11±0.24 mm).

Anahtar Kelimeler: Tank hacmi, yaşama oranı, çipura, boy, büyüme

Abstract: In this study, the effect of tank volumes on survival rates, total length and total width of gilthead seabream (*Sparus aurata* L., 1758) larvae from hatching to the first grading were tested for periods of 0-38 days The percentage of fertilized buoyant eggs were generally higher than 90-95%. Larvae were reared intensively in 5 and 15 tons tanks under a constant photoperiod 24 h light, and fed initially on rotifers, followed by *Artemia* nauplii and *Artemia* metanauplii. A green water technique was applied using *Chlorella* sp. and *Isochrysis galbana* at a density of 1x 10^6 cells.ml^{-1}. Survival and growth rates were determined for all volumes in triplicate. Mean survival rates in 5 tons tank (12.56±0.47%) was significantly higher than that in 15 tons tank (9.83±0.76%) (P<0.05). Mean total length and width of the larvae at day 38 after were similar in both tanks (Mean length, 10.35±0.22 mm and 10.14±0.52 mm; width, 2.15±0.19 mm.and 2.11±0.24 mm, respectively).

Key Words: Tank volume, survival, length, growth, gilthead seabream

Introduction

The gilthead seabream, (*Sparus aurata* L. 1758), is an important species for mariculture because of its high economic value and its ability to adapt to environmental in salinity and temperature. Due to its importance in the Mediterranean aquaculture, gilthead seabream has been comprehensively studied under culture conditions (Divanch and Kentouri, 1983; Kolkovski *et al.,* 1993; Tandler and Helps, 1985; Para and Yufera, 2000; Person-le Ruyet and Veriiaud, 1980; Yufera *et al.,* 1993). The major barrier to successful mariculture of this species is its low survival in larval stages.

Larval rearing of seabream is usually performed in green water during the rotifer feeding stages. Algae in the larval rearing tank provide a constant light intensity and diffusion, resulting in reduced stress for the larvae, keep up the nutritional value of the rotifers and may have a positive effect on the water quality and the bacterial flora present (Naas *et al.* 1992, Wolf *et al.* 1995). It is notified that the green water techniques should be performed with large volume tanks. It is unknown that there is primarily concerns with laboratory conditions which has small volume tank (Kolkovski *et al.,* 1993; Tandler and Mason, 1982, 1985; Wolf *et al.,* 1995). Currently there seems to be lack of information regarding the volume of tanks for intensive culture systems with green water techniques (Cripps and Poxton,1992).

In this study, we aim to determine the effects of tank volume on the survival of larval gilthead seabream in intensive culture conditions.

Materials and Methods

The experiments were carried out in Sakran, Izmir, from September to December 2002. To determine the effects of tank volume on growth (total length and total width) and survival on gilthead seabream larvae, three cylindirical tanks with black walls of 5 and 15 tons each were used. Water temperature was controlled by pipe heating systems and automatic transformer equipment was calibrated at ±1°C.

Fertilized eggs were collected daily from the broodstock tank and were incubated in the larval rearing tanks. The incubation was performed in special meshed baskets (500 µm) equipped with independent airlift systems which kept the eggs in continuous motion. The use of these baskets made it possible to count accurately the hatched larvae before their introduction into the larval tanks. The hatching success in these baskets over 90%. The rearing tanks were stocked with approximately 0.5-2x10^6 newly hatched larvae (100-130 larvae lt^{-1}) each. Every day the tanks were cleaned of the detritus accumulated at the bottom.

In all the tanks, larvae were reared for 4 days from hatching at 18.0±0.5°C, then 8 days at 20.0±0.5°C, 14 days at 22.0±1°C, and finally for a further 12 days the larvae were maintained at 23±1°C. At the beginning of the experiments salinity was 40‰. After the sixth days, salinity was dropped to 25‰ in four days gradually. It was maintained at 25‰ for 6 days and then it was slowly increased to 40‰ in 16 days. Oxygen requirements in tanks were supplied by liquid oxygen systems with automatic check-valve and oxygen levels were maintained between 6.5 and 8 ppm.

Air and fresh sea water were introduced into the bottoms of the tanks to prevent water stratification. Everyday 5-10% of water was exchanged with green water. The tanks were homogeneously aerated. Illumination was provided by two fluorescent lamps (40 W) 100 cm above the water surface. Adjustment of the light intensity was provided by covering the light source with milimetric nets. All tanks were exposed to photoperiods of 24 h. The light intensity was measured just above the center of the tank surface. First three days, light intensity was maintained at 50 lux and then 150 lux in all tanks.

The feeding regime consisted of *Brachionus plicatilis* from day 4 to day 22, reaching a maximum concentration of 20 prey ml^{-1}, *Artemia nauplii* from day 17 onwards with a maximum density 2.5 prey ml^{-1} and *Artemia metanauplii* from day 25 with densities of about 1.5 prey ml^{-1}. Rotifers were reared on baker's yeast and enriched with a Selco (INVE products) prior to their transfer to the fish tanks. Two types of algae were used in the experiments, *Chlorella sp.* and *Isochrysis galbana* (1x 10^6 cells ml^{-1}). Estimation of numbers of rotifer and artemia were conducted by counting three 10 ml samples from each tank. From day 28 onwards, a microdiet containing 55% crude protein, 14% crude lipids, 12% ash and 7% moisture was offered to the larvae. The larvae were fed 10 times a day with maximum 40 g ton^{-1} of experimental microdiets per tank per day.

During the study, survival (%), total length and width were determined. Survival rates were estimated from the ratio between number of final survivors in each tank and the initial stocking rates. The treatments of the survival rates were tested in triplicate. Thirty larvae were sampled every alternate day for measurements of total length and width and measurements of total length and width were carried out under a binocular microscope with a calibrated micrometric eyepiece.

Mean survival rates were compared by Mann-Whitney U-test (SPSS version 9.0). The growth curves and comparisons in the length and width of the larvae were described with line graphs using Microsoft Office Excel 2000 programme.

Results

Survival rates of *S. aurata* larvae during first 38 days were seem to be affected by the tank volume (Table 1). Overall survival rates during the experiment ranged from 8.7 to 13.5%. Five tons tank resulted in a mean survival of 12.56±0.47%, with a maximum of 13.5%, which is higher (P<0.05) than that larger tanks (9.83±0.76%).

Table.1. The effect of tank volumes on survival (%) during the first 38 day- of *Sparus aurata* larvae.

Tank Volume (ton)	Survival (%)	Mean Survival* (%)±Se
5	12.0	
5	12.2	12.56±0.47
5	13.5	
15	9.5	
15	11.3	9.83±0.76
15	8.7	

**The effect of tank volume on survival is significant (P<0.05; Mann-Whitney U-test.)*

In 5 tons tanks, the newly hatched larvae of *Sparus aurata* had a mean total length of 3.26±0.02 mm and total width of 0.82±0.001 mm and attained total length of 4.17±0.04 mm and total width of 0.94±0.042 mm at day 10 after hatching. On day 20 after hatching, total length and total width reached 6.41±0.06 mm, 1.15±0.061 mm and on the 38th day 10.35±0.22 mm and 2.15±0.19 mm, respectively.

In 15 tons tanks, the newly hatched larvae had a mean standart total of 3.29±0.03 mm and total width of 0.83±0.002 and attained total length of 4.0±0.04 mm and total width of 0.80±0.04 at day 10 after hatching. On day 20 total length and total width were 5.31±0.18 mm, 1.09±0,06 and on the 38th day, 10.14±0.52 mm and 2.11±0.24, respectively.

Larval growth in total length and width attained on day 38 were similar for larvae reared in 5 tons tanks and 15 tons tanks. (Figure 1 and Figure 2).

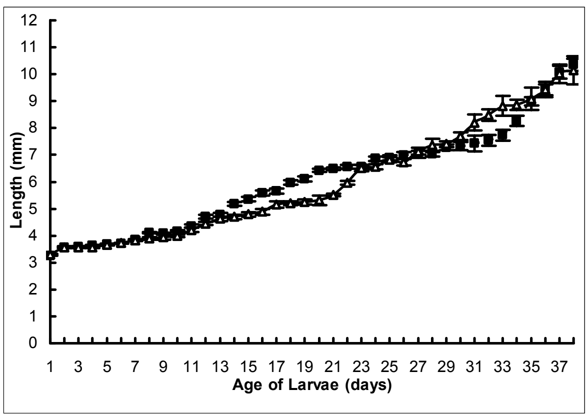

Figure 1. Mean standart lengths of the gilthead seabream larvae in 5 and 15 tons tanks. (∆) 15 tons tank; (■) 5 tons tank. Each point is the mean and standart error of 30 larvae.

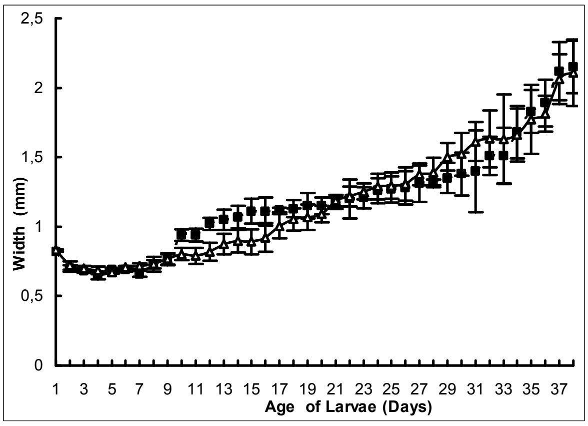

Figure 2. Mean standart widths of the gilthead seabream larvae in 5 and 15 tons tanks. (∆)15 tons tank; (■)5 tons tank. Each point is the mean and standart error of 30 larvae.

Discussion

As for many cultured finfish species, the successful culture of gilthead seabream depends on the improvement of both larval survival and growth. High mortalities early larval stages may be attributed mainly to nutritional and environmental factors (Divanch and Kentouri, 1983; Kolkovski *et al.*, 1993; Tandler and Mason, 1982; Tandler and Helps, 1985; Tandler *et al.*, 1989). Various types (as shape, colour, volume) of tanks have been used for aquacultural purposes, some of which have been based on sound hydrodynamic, water quality, biologic, economic or ergonomic principles (Cripps and Poxton, 1992; Kincaid *et al.*, 1976; Planas and Cunha, 1999).

Effects of available tank shapes have been studied by many researchers (Kincaid *et al.*, 1976, Planas and Cunha 1999). However, effects of the tank volumes are not investigated adequately. A combination of water exchange rate and photoperiod affected the growth rate of seabream in 3000 litre circular fibreglass tanks (Tandler and Helps 1985). Kincaid *et al.* (1976) showed that tank volume and available water limited the growth rate of rainbow trout, *Oncorhynchus mykiss*, in some situations in circular tanks. Although they have tried to study small tanks volume in the laboratory conditions, farmers have succesfully produced the gilthead seabream larvae in large tanks (5-15 tons), especially in Turkey (personal communication).

Although much work has been done and the current knowledge of larval rearing is considerable for this cultured species, more and new efforts must be undertaken to go further into the optimisation of culture. Studies show that it the small tank volume (24.6, 50, 100, 200, 600, 3000 litres) have been used in the study of the survival rates the larval rearing (Gonzales *et al.*, 1995; Kolkovski *et al.,* 1995; Tandler and Mason, 1982; Tandler and Helps, 1985; Tandler *et al.*, 1989). Pinosa *et al.* (1995) reported that the best larval survival rates were 37.4- 42.8% and obtained in the cylindrical tanks with 220 litres.

The present study has shown that better survival of *Sparus aurata* larvae can be obtained in relatively small tanks (5 tons) than in larger ones (15 tons). On the other hand, growth in total length was not affected by tank volumes. These results were exposed to following advantages and disadvantages.

For 5 tons tanks;

-Supply for larval rearing conditions are more comfortable.

-Although it gives higher survival rates, it requires more labour (in comparison to 15 tons tanks).

For 15 tons tanks;

-The amount of total production is higher at the same time period.

-Relatively less labour (compare to 5 tons tanks).

The risk of the lossing the stocks in large volume tanks are higher than smaller volumes.

In conclusion, we suggested that the best survival rates were obtained in the 5 tons tanks. The survival rates in larval rearing are one of the most important issues for hatcheries. In addition, the cost of the investment and the expenditure in the 5 tons tanks are lower than those of to 15 tons tanks.

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