Int Aquat Res (2010) 2: 163-166
(Special Issue of AquaMedit 2010 Conference, Greece)
ISSN 2008-4935
Available online at www.intelaquares.com

International
Aquatic Research

Partial replacement of fresh algae with dry, in intensive seabream larval production

Dimopoulos Dimitrios, Panagiotaki Panagiota*, Golomazou Eleni, Malandrakis Emmanuil, Dadali Olga, Martsikalis Petros, Exadactylos Athanassios, Klaoudatos Spyridon, Neofytou Christos

Department of Ichthyology and Aquatic Environment, University of Thessaly, Fytoko, N. Ionia, Volos, Greece

Abstract

Green water technique was developed in order to improve survival and growth rate of post hatched gilthead seabream (*Sparus aurata*) larvae intensively produced. In parallel, this created the need of algal cultivation in hatcheries, a fact that elaborated complicated procedures and increased the cost of larval production. Recently, world aquaculture, in order to minimize the production cost, seems to have bypassed the hatching procedure of fresh algal cultivation by substituting them with commercially produced dry algae. In the present study, the hypothesis that a 50% substitution fresh algae with dry, can improve survival, growth and malformation rate in commercial scale, was investigated. Simultaneously, a feeding frequency of 3 and 5 *Artemia* sp. meals per day was studied. Four treatments were established and quadruplicates were maintained for each treatment. Treatments included: a) 50% replacement of fresh algae with dry (SanolifeALG, INVE) and 3 daily feedings (SL 3T), b) 50% replacement of fresh algae with dry and 5 daily feedings (SL 5T), c) 5 daily feedings (M 5T) control group and d) 3 daily feedings (M 3T) control group. Samples of larvae were measured for length at days 5, 13, 19, 25, 32 and 40 post hatching. Partial substitution (50%) of fresh algae with dry provoked no difference in growth, survival and malformation rate, reducing algal production cost by 8%. Moreover, risk of pathogen contamination is reduced and the nutrition quality of live prey is stabilized. Feeding frequency affected significantly larval growth rate (5 feedings compared 3 feedings), when either fresh or dry algae were used. From the present study it appears that partial substitution of dry algae with fresh, can sustain low larval production cost and secure a standard procedure, main points of interest for a commercial hatchery. Dry algae, based on technology achievements, are strongly recommended for use as a "rescue plan", in case that fresh algal cultures collapse. More research is needed, in order to improve aquaculture techniques and develop qualified products – in collaboration with hatcheries – so as to achieve total substitution of fresh, by dry algae.

Keywords: *Sparus aurata,* Green water technique, Dry algae, Fresh algae, Feeding frequency, Larvae

Introduction

Gilthead sea bream is one of the most important species with high economic impact for Mediterranean aquaculture. In the last decades, phytoplankton, through green water technique has led to the enhancement of intensive rearing of seabream larvae (Morreti et al. 1999; Muller-Feuga et al. 2003a,b).

It is well established that green water technique has promoted the intensive rearing of gilthead sea bream larvae. Nevertheless, this method demanded a parallel culture of fresh algae. This technique improves growth and survival

* Corresponding author. Email: ppanag@uth.gr. Tel: +24210 93070, Fax: +24210 93071.

rate as well as food ingestion (Oie et al. 1997; Reitan et al. 1997). These improvements, concerning larval quality, have been noted previously by various researchers (Mofat 1981; Makridis and Olsen 1999; Naas et al. 1992, 1996).

In the present study, the hypothesis that partial substitution (50%) of fresh algae with dry, can affect survival, growth and malformation rate in commercial scale cultivation, was investigated. Simultaneously, taking into account the need for understanding the possible influence of 3 and 5 *Artemia* sp. meals per day, data is presented for both feeding frequencies as well as for partial substitution.

Materials and methods

According to the sampling procedure, samples were collected during the 2008-2009 production period by the hatchery of DIAS AQUACULTURE SA in Central Greece. Fertilized eggs derived from a gilthead sea bream broodstock, were transferred into the 10 m^3 polyester cylindrical-conical tanks. Each tank was filled with bore water under two different temperature regimes: 20.5 ± 1 ^oC and 15 ± 0.5 ^oC. Both water supplies were adequately filtered not only with UV filters (100 mJ/cm^2) but also with mechanical filters (100 μm and 5 μm).

The study included four treatments: a) 50% replacement of fresh algae with dry (SanolifeALG, INVE) and 3 daily feedings (SL 3T), b) 50% replacement of fresh algae with dry and 5 daily feedings (SL 5T), c) 5 daily feedings control group (M 5T) and d) 3 daily feedings control group (M 3T). Quadruplicate tanks were employed for each treatment. Samplings were collected at 5, 13, 19, 25, 32 and 40 days post hatching and total larval length was measured.

According to the standard procedure, once a day, 300 L of fresh algae (Isochrysis sp., Chlorella sp.) were supplied to fish at a concentration of 20 × 10^6 cells/ml, approximately. As far as the 50% replacement is concerned, 150 L of fresh algae were supplied to the fish in the two experimental groups, this being accomplished with 50 g SanolifeALG (5 g/m^3/day) in two daily doses, according to the manufacturer's guides. The duration of the experiment was 52 days, a time period during which a first measurement of total length and survival rate of the fish took place. This developmental stage seems have been crucial due to the fact that it can provide sufficient information about fish malformations.

Statistical analysis of the results was achieved using statistical software SPSS 17 for Windows. The Kolmogorov–Smirnov test was performed in order to check normality for length's measurements. Furthermore the mean values were compared according to the Student *t*-test. In order to compare the slopes of linear regressions which concern the growth of experimental fish, the Tukey test was utilized according to Zar (1996).

Results

According to the results of the present study, during the first 25 days post hatching (dph), the amendment of the feeding frequency, provoked no effect on total length ($P > 0.05$). However, statistical analysis of the total length measurements revealed that total length was greater in the case of the 5 time feeding frequency (5T) compared to the 3 time feeding frequency (3T) case ($P < 0.05$). This result was demonstrated at 32 dph and was kept until 40 dph. Concerning the larval growth of the highest feeding frequency group (5T), this was significantly higher ($P < 0.05$) compared to the 3 time feeding frequency group (3T), when both fresh (Fig. 1) and supplement algae (Fig. 2) were used.

There was a fluctuation of the survival rates between 11% and 17% for each experimental group. Moreover, an increase was noted in the survival rate regarding the 5 feedings groups (5T) compared with the 3 feedings groups (3T). Furthermore, taking into the obtained results, it seems that both control groups had higher survival rates regardless of the feeding frequency.

An important outcome of the present study is the fact that partial substitution of fresh algae with dry provoked no difference in fish growth (Figs. 3 and 4) and malformation rates, as checked in 52 dph. The major finding of this study concerning economic outcome, is the fact that partial substitution of fresh algae with dry, can reduce the cost in larval production. Specifically, the price of the product was 240 €/kg and production cost of fresh microalgae in the hatchery was 93 €/m^3. The financial benefit, taking into account the 50% substitution of fresh algae with dry, was estimated at 2.48 €/tank/day.

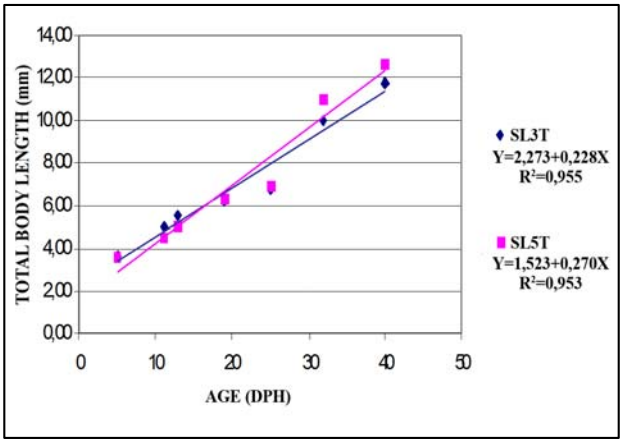

Fig. 2. Larval growth of experimental groups (ANCOVA, $P < 0.05$)

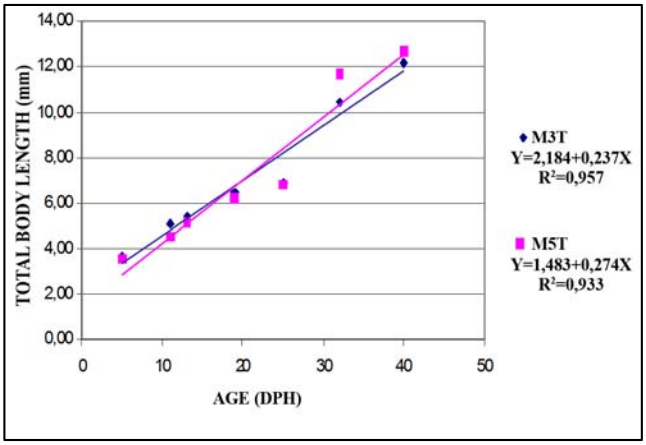

Fig. 1. Larval growth of control groups (ANCOVA, $P < 0.05$)

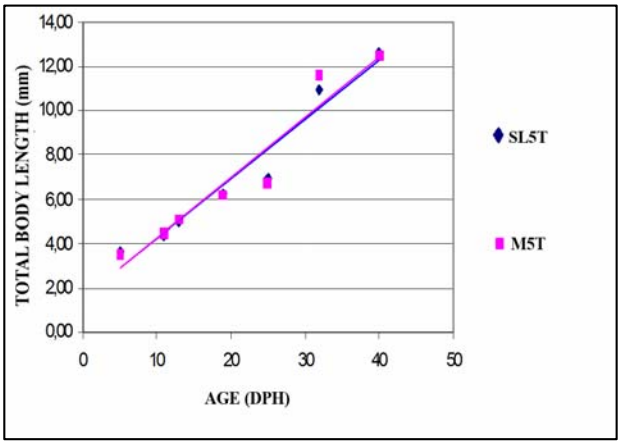

Fig. 3. Larval growth of SL5T versus M5T (ANCOVA, $P > 0.05$)

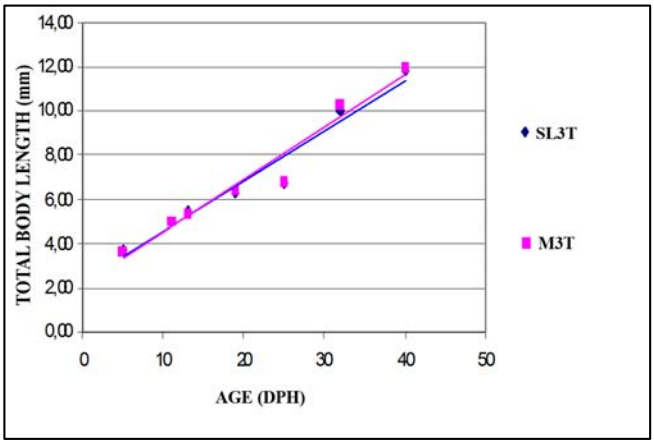

Fig. 4. Larval growth of SL3T versus M3T (ANCOVA, $P > 0.05$)

Discussion

Several studies in the international literatures have examined the positive effect that green water technique has in seabream larval production (Muller-Feuga et al. 2003a,b; Morreti et al. 1999). However, production is burdened with the parallel conservation and cultivation of fresh algae (Morreti et al. 1999).

In recent years, several efforts have been made, in order to attain the substitution of fresh algae with dry ones. This observation suggests a possible decrease of cost production and also simplifies and improves production procedure. In tanks, where larval production took place, the 50% substitution of fresh algae with dry one (SanolifeALG) revealed no difference in growth rate. In the current study it was obvious that the increase in the number of *Artemia* feedings of sea bream from 3 to 5, positively affected the growth rate. These results are in agree with those of Tucker et al. (2006).

The 50% substitution of fresh algae with dry showed negative influence to the survival rates in contrast with previous researches (Navarro and Sarasquete 1998; Canavate and Fernandez-Diaz 2001). Furthermore, it was detected that a decrease of feeding frequency negatively influenced the survival rate of larvae.

The knowledge of financial status is important for profitable management in a hatchery. High survival rate, low malformation rate, expeditious growth as well as the decrease of the cost, which comes from both energy and labor

wages, consist with the factors that ameliorate production indices (Moretti et al. 1999; Shields 2001). SanolifeALG and indiscriminately dry algae are the products that are being used to decrease the production cost. The results of this study strongly suggest that the 50% substitution of live algae with SanolifeALG, did not reduce growth rate and did not influence malformations adversely. However, further studies are needed to establish this view, as in the present research, the survival rates could not be checked in a statistically acceptable way.

Finally, the product's high price in combination with partial substitution indicates that there is no notable decrease in production cost. Nevertheless, it is expected that in the near future, increased application of similar products, could bring a noteworthy depression in the cost of production.

Acknowledgements

We would like to thank DIAS AQUACULTURE SA and INVE HELLAS SA for providing facilities and experimental material. George Bourgos is acknowledged for his constructive comments.

References

Canavate JP, Fernandez-Diaz C. 2001. Pilot evaluation of freeze-dried microalgae in the mass rearing of gilthead seabream *Sparus aurata* larvae. Aquaculture 193: 257-269.

Makridis P, Olsen Y. 1999. Protein depletion of the rotifer *Brachionus plicatilis* during starvation. Aquaculture 174(3-4): 343-353.

Moffatt NM. 1981. Survival and growth of northern anchovy larvae on low zooplankton densities as affected by the presence of a *Chlorella* bloom. In: The Early Life History of Fish: Recent Studies (Eds. R. Lasker and K.Z. Sherman), 178: 475-480.

Moretti A, Pedini Fernandez-Criado M, Cittolin G, Guidastri R. 1999. Manual on hatchery production of seabass and gilthead seabream. FAO, Rome, Italy 1: pp 194.

Muller-Feuga A, Moal J, Kaas R. 2003a. The microalgae of aquaculture. In: Live feeds in marine aquaculture (Eds. J.A. Støttrup and L.A McEvoy), Blackwell Publishing, Oxford.

Muller-Feuga A, Robert R, Cahu C, Robin J, Divernach P. 2003b. Use of microalgae in aquaculture. In: Live feeds in marine aquaculture (Eds J.A. Støttrup and L.A McEvoy), Blackwell Publishing, Oxford.

Naas KE, Næss T, Harboe T. 1992. Enhanced first feeding of halibut larvae (*Hippoglossus hippoglossus* L.) in green water. Aquaculture 105: 143-156.

Naas KE, Huse I, Iglesias J. 1996. Illumination in first feeding tanks for marine fish larvae. Aqua Eng 15(4): 291-300.

Navarro N, Sarasquete C. 1998. Use of freeze-dried microalgae for rearing gilthead seabream, *Sparus aurata*, larvae: I. Growth, histology and water quality. Aquaculture 167 (3-4): 179-193.

Oie G, Makridis P, Reitan KI, Olsen Y. 1997. Protein and carbon utilization of rotifers (*Brachionus plicatilis*) in first feeding of turbot larvae (*Scophthalmus maximus* L.). Aquaculture 153(1-2): 103-122.

Reitan KI, Rainuzzo JR, Oie G, Olsen Y. 1997. A review of the nutritional effects of algae in marine fish larvae. Aquaculture 155(1-4): 207-221.

Shields RJ. 2001. Larviculture of marine finfish in Europe. Aquaculture 200(1-2): 55-88.

Tucker BJ, Booth MA, Allan GL, Booth D, Fielder DS. 2006. Effects of photoperiod and feeding frequency on performance of newly weaned Australian snapper *Pagrus auratus.* Aquaculture 258(1-4): 514-520.

Zar JH. 1996. Biostatistical Analysis. Prentice Hall, Englewood Cliffs, New Jersey. pp 718.