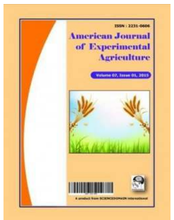

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Comparation of Diets Used for Larviculture of Meagre (*Argyrosomus regius* Asso1801)

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Authors' contributions

This work was carried out in collaboration between all authors. Author NG designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors HGD and MIG managed the experimental plans and studies. Authors OSK, UA and FY applied experimental studies and performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

This investigation compared the suitability of different diets for larviculture of meagre (*Argyrosomus regius*). For this purpose, wild fish were caught with longline and subsequently fed either a commercial diet or a mollusc diet. After two years, there was a significant difference between the two diets in the body weight but not the survival rate of the fish (*P*<0.05). Both the weight gain and the FCR were significantly higher in fish that were fed the commercial diet compared with those fed

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the mollusc diet. Three alga diets were used for the initial feeding of larvae: A_1, A_2 and A_3, consisting of 30/70, 60/40 and 50/50 *Nannochloropsis* sp./*Isochrysis* sp., respectively. There was a significant difference in larval survival rate among the alga diets (P<0.05). These results indicate that meagre readily tolerates commercial production systems, where it can grow rapidly and easily reproduce.

Keywords: Argyrosomus regius; larvae protocol; algal diets; survival rate.

1. INTRODUCTION

Meagre (*Argyrosomus regius* Asso1801) is a member of the Sciaenidae family, which lives in the subtropical waters of the eastern Atlantic, Mediterranean Sea, Black Sea and West Coast of Africa (65°N - 6°S, 23°W - 36°E) [1]. The fast growth rate of meagre makes it an attractive alternative to other fish for aquaculture. Also domestication of native species is essential to development aquaculture [2]. Larval production is very important for commercial aquaculture, and there are multiple factors affecting the growth and survival of fish larvae. One important factor affecting larvae is photoperiod [3-8]. Photoperiod affects feed intake, nutrient digestion and, hence, the growth of fish larvae, such as *Siganus guttatus*, *Dicentrarchus labrax*, *Lates calcarifer*, *Rhombosolea tapirina*, and *Pagrus auratus* [6,8-12]. Another important factor for larval production is the size of the mouth opening because mouth size can be used to predict the appropriate time to initiate feeding and the proper feed size and type. Additionally, the mouth size and total body length of fish are linearly related; for example, this relationship occurs in grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*) [13].

The aim of this study was to compare the efficacy of commercial and mollusc diets for rearing meagre to provide a foundation for creating a production protocol and improving meagre larviculture.

2. MATERIALS AND METHODS

2.1 Broodstock Management and Feeding

Fish ranging in weight from 50 to 100 g and averaging 66.13±0.70 g were caught with longlines in the Menderes Delta in Turkey (Fig. 1). The fish were stocked at an average density of 12 kg m^{-3} in 30 m^3 cylindrical fibreglass tanks kept filled with marine water using 50-mm PVC inlet and outlet pipes and a flow rate that averaged 6 L per hour. After stocking, the fish were separated into two groups; one group was fed the commercial diet (Table 1) [14,15] and the other group was fed the mollusc diet (octopus, shrimp, squid). Feeding of both groups was performed twice a day by hand to apparent satiety until gonadal maturation at approximately two years of age. Satiety was evaluated visually.

Fish were weighed monthly after a 2-day fast while anaesthetised with 1/10000 of tricaine methanesulphonate (MS-222; SIGMA, St Louis, MO, USA). After each monthly sampling period, the amount of feed given was adjusted according to the mean weight of the fish in each tank (150 fish per tank). From the results of the first and last sample, calculated the weight gain (WG = final weight−initial weight) and the food conversion rate (FCR = feed consumption/WG). The water temperature was stable for the entire period, ranging from 25.5 to 18.5°C. Salinity, dissolved oxygen and pH of the water were 36±0.5‰, 11.5±0.5 mg L^{-1} and 7.8, respectively. After the final weight determination, the fish were disinfected with 75 mg L^{-1} oxytetracycline and 0.1 mL L^{-1} formaldehyde for seven days and stocked at 1♂/3♀ in the hatchery system for spawning. Additionally, gonads were dissected from some of the fish at the end of the 2-year maturation period and weighed for calculation of the gonadal somatic index (GSI = gonadal weight/body weight). Once disinfected, the transferred fish were separated into two groups for ovulation and spawning. Fertilised eggs were gathered from the collection sump, and transferred to 1000 L cylinder conical tanks containing sterilised seawater (20 mg L^{-1} sodium hypochlorite added to the seawater for 24 h and then neutralised with sodium thiosulphate) for incubation in darkness [8,16].

2.2 Larval Feedings and Photoperiod

Hatching occurred approximately 72 h after fertilisation of the eggs, and then feeding of the larvae was started with algae.

Table 1. Formulation and chemical composition of the commercial feed

Ingredients (g kg^{-1})	
Fish meal	400
Soybean meal	220
Corn gluten	80
Wheat gluten	40
Wheat	158
Fish oil	79.75
DL-methionine	2
Antioxidant	0.25
Carboxymethyl cellulose	3
Vitamin mix[a]	3
Mineral mix[b]	2
Bio-Mos[c]	2
Chromic oxide[d]	10
Chemical composition (g kg^{-1})	
Dry matter (DM)	90.01
Protein	44.24
Lipid	12.51
Ash	8.20
Carbohydrate	24.39
Gross energy (kJ)	1.620

[a]Provided per kg of diet: 4500 IU retinyl acetate (Vit. A), 3600 IU cholecalciferol (Vit. D), 90 IU DL-α-tocopheryl acetate (Vit. E), 1.8 mg menadionesodiumbisulphate (Vit. K), 0.04 mg cyanocobalamin (Vit. B12), 90 mg ascorbylpolyphosphate (ascorbicacid), 25.2 mg D-biotin, 1800 mg cholinechloride, 1.8 mg folicacid, 18 mg niacin (nicotinicacid), 36 mg pantothenicacid, 9 mg pyridoxine, 10.8 mg riboflavin, 1.8 mg thiamin.

[b]Provided per kg ofdiet: 2.46 mg sodiumchloride (NaCl), 0.05 mg ferroussulphate ($FeSO_4$), 0.02 mg coppersulphate ($CuSO_4$), 0.07 mg manganesesulphate ($MnSO_4$), 0.008 mg potassiumiodide (KI), 0.01 mg zincsulphate ($ZnSO_4$).

[c]Bio-Mos, Alltech Inc., Nicholasville, KY, USA.

[d]Supplied by SIGMA, St Louis, MO, USA

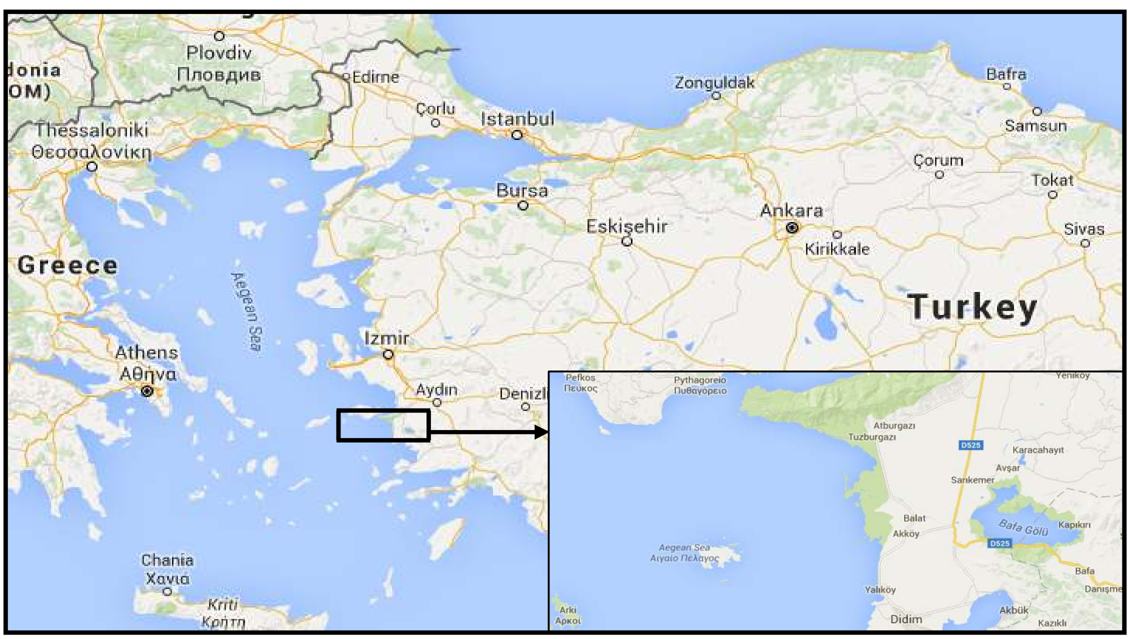

Fig. 1. Map of Menderes Delta in Turkey

One of three alga diets was initially fed to the larvae. These diets, designated A_1, A_2 and A_3, consisted of 30/70, 60/40 and 50/50 *Nannochloropsis* sp./*Isochrysis* sp., respectively. Later, Rotifera and then Artemia were added to the larval diet. The larvae were stocked at an average density of 55±5 per L, and their survival rates were recorded daily. The water parameters and photoperiod are given in Fig. 1.

2.3 Statistical Analyses

The mean and standard deviation of each measured parameter were calculated. All data were statistically analysed using one way analysis of variance (ANOVA) with SAS, version 6.07. Differences between means were compared with Duncan's multiple range test using P<0.05 to indicate significant differences [15].

3. RESULTS

At two years, there was a significant difference between the commercial diet and the mollusc diet (P<0.05) in the body weight of the fish but not in their survival rate. Mean individual body weight ranged from 4.700,00 to 2.100,00 g. The weight gain and FCR were significantly lower in fish fed the commercial diet compared to those fed the mollusc diet: 3.742,48±106,13 g and 1,84±0,01 for the commercial diet and 2.895,73±100,13 g and 2.10±0.05 for the mollusc diet, respectively (Table 2). Gonad weight ranged from 294,00 to 658,88 g. The GSI was 0,13±0,01 in all diet groups.

There was a significant difference in larval survival rate among the alga diets (P<0.05), with survival rates of 45, 65 and 57% for the A_1, A_2 and A_3 diets, respectively. Fig. 2 shows feeding regime by day after egg hatch for larvae fed the A_2 alga diet.

4. DISCUSSION

In the last decade, the developing aquaculture industry has sought alternative fish species appropriate for culture. Meagre has a high growth rate and a low mortality under culture conditions and is tolerant to a wide range of aqueous environments; for these reasons, it can be adapted easily to culture conditions [1,17-19]. The present study demonstrates that larviculture produces excellent growth and survival of healthy meagre; thus, this fish species is suitable for commercial production under aquaculture conditions. The commercial feed was more effective than the mollusc diet for the growth of meagre cultured in tanks or in cages. Chatzifotis et al. [19] used the same commercial feed for rearing meagre juveniles, but these authors obtained the best results with provision of a 17% crude lipid level for 110 days. Over a period of approximately two years, we obtained better results with a commercial diet containing a lipid level of 12,51 g kg^{-1} than with a mollusc diet. These contrasting results are difficult to compare, partly because of the difference between the studies in the duration of feeding. Interestingly, Jimenéz et al. [20] reported that sea cages and indoor tanks produced similar growth rates, but the FCR was higher in cages than in tanks. The study by Jimenéz et al. [20] and the present study observed similar growth rates, but the FCRs obtained in the present study with both the commercial and the mollusc diet were better than the FCRs reported by Jimenéz et al. [20]. The survival rate of the larvae fed the A_2 diet was better than that of the larvae fed the other alga diets (A_1 and A_3). Compared to the A_1 and A_3 diets, the A_2 diet is richer in *Nannochloropsis* algae, which contain a relatively large quantity of eicosapentaenoic acid (EPA) [21], an omega-3 polyunsaturated fatty acid. This result suggests that EPA may be effective in increasing the survival rate of the larvae.

Table 2. Growth parameters of fish after 2 years on experimental diets

	Diet	
	Commercial diet	**Mollusc diet**
Initial body weight (g)	66.13±0.70	66.13±0.70
Final body weight at 710th day (g)	3.808,61±40,00^a	2.961,86±34,00^b
Weight gain (g)	3.742,48±106,13^a	2.895,73±100,13^b
Food conversion ratio	1,84±0,01^a	2.10±0.05^b
Survival rate (%)	97.7	98.1

**The values are expressed as the means±SD (n=300 for growth parameters). Within rows, means with different superscripts are significantly different (P< 0.05)*

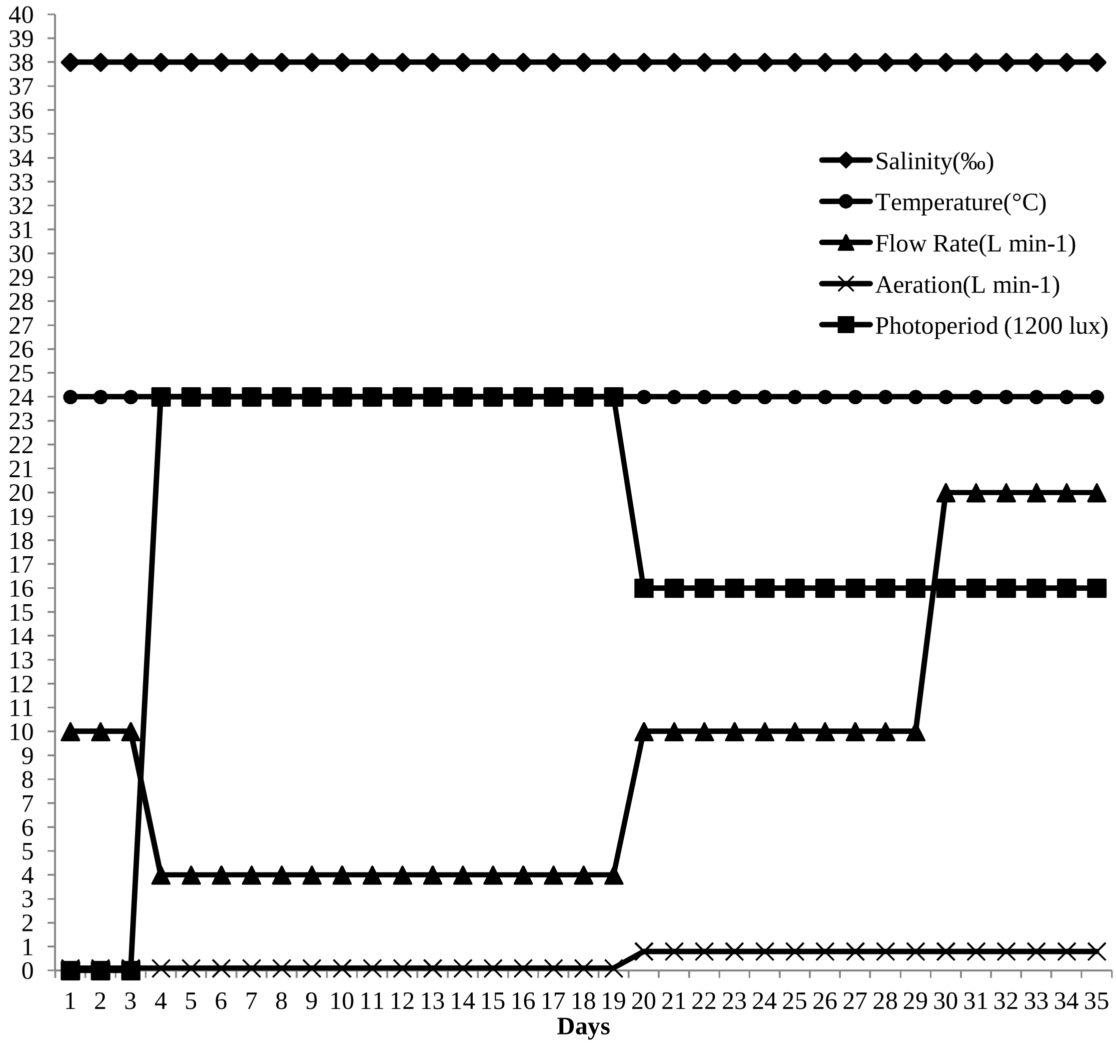

Fig. 2. Water parameters and photoperiod application during the initial days of larval development

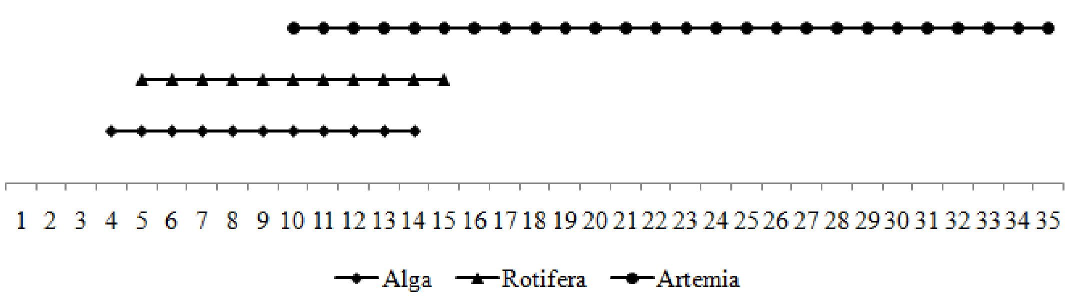

Fig. 3. Feeding regime by day after egg hatch for larvae fed the A_2 alga diet

5. CONCLUSION

In conclusion, meagre is very tolerant of aquaculture conditions and rapidly grows and reproduces in commercial production systems. For these reasons, dietary practices, and possibly hormone treatments, should be further researched for application in meagre aquaculture. EPA-rich feeds should be used for larviculture. Producers must be careful to avoid cannibalism during the larval feeding stage because the size of the mouth opening in meagre larvae is larger than that of other cultured fish.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Poli BM, Parisi G, Zampacavallo G, Iurzan F, Mecatti M, Lupi P, Bonelli A. Preliminary results on quality and quality changes in reared meagre (*Argyrosomus regius*): Body and fillet traits and freshness in refrigerated commercial-size fish. Aquaculture International. 2003;11:301-311.
2. Moroni FT, Ortega AC, Moroni RB, Mayag B, Jesus RS, Lessi E. Limitations in decision context for selection of amazonian armoured catfish acari-bodó (*Pterygoplichthys pardalis*) as candidate species for aquaculture. International Journal of Fisheries and Aquaculture. 2015;7(8):142-150.
3. Barnabe G. Rearing bass and gilthead bream. In: Barnabe G, (Ed.). Aquaculture. 1990;2:647-686.
4. Chatain B, Ounais-Guschmann N. The relationships between light and larvae of *Sparus aurata*. In: Lavens P, Sorgeloos P, Jaspers E, Ollevier F, (Eds.), Larvi '91—Fish and crustacean larviculture symposium, gent, Belgium. Special Publication of European Aquaculture Society. 1991;15:310-313.
5. Battaglene SC. Induced ovulation and larval rearing of Australian marine fish. PhD Thesis, University of Tasmania, Launceston, Tasmania; 1995.
6. Hart PR, Hutchinson WG, Purser GJ. Effects of photoperiod, temperature and salinity on hatcheryreared larvae of the greenback flounder (*Rhombosolea tapirina* Günther, 1862). Aquaculture. 1996;144: 303-311.
7. Boeuf G, Le Bail PY. Does light have an influence on fish growth? Aquaculture. 1999;177:129-152.
8. Fielder DS, Bardsley WJ, Allan GL, Pankhurst PM. Effect of photoperiod on growth and survival of snapper *Pagrus auratus* larvae. Aquaculture. 2002;211: 135-150.
9. Duray M, Kohno H. Effects of continuous lighting on growth and survival of first-feeding larval rabbitfish, *Siganus guttatus*. Aquaculture. 1988;72:73-79.
10. Barahona-Fernandes MH. Some effects of light intensity and photoperiod on the sea bass larvae (*Dicenntrarchus labrax* (L.)) reared at the Centre Oceanologique de Bretagne. Aquaculture. 1979;17:311-321.
11. Cerqueira VR, Chatain B. Photoperiodic effects on the growth and feeding rhythm of European seabass, *Dicentrarchus labrax*, larvae in intensive rearing. In: Lavens P, Sorgeloos P, Jaspers E, Ollevier F, (Eds.), Larvi '91—Fish and crustacean larviculture symposium, gent, Belgium. Special Publication of European Aquaculture Society. 1991;15:304-306.
12. Barlow CG, Pearce MG, Rodgers LJ, Clayton P. Effects of photoperiod on growth, survival and feeding periodicity of larval and juvenile barramundi *Lates calcarifer* (Bloch). Aquaculture. 1995;138: 159-168.
13. Dabrowski K, Bardega R. Mouth size and predicted food size preferences of larvae of three cyprinid fish species. Aquaculture. 1984;40(1):41-46.
14. Gültepe N, Salnur S, Hoşsu B, Hisar O. Dietary supplementation with Mannanoligosacchardies (MOS) from Bio-Mos enhances growth parameters and digestive capacity of gilthead sea bream (*Sparus aurata*). Aquaculture Nutrition. 2011;17:482-487.
15. Gültepe N, Hisar O, Salnur S, Hoşsu B, Tanrıkul TT, Aydın S. Preliminary assessment of dietary mannan-oligosaccharides on growth performance and health status of gilthead seabream *Sparus auratus*. Journal of Aquatic Animal Health. 2012;24:37-42.
16. Moksness E, Kjørsvik E, Olsen Y. Culture of Cold-Water Marine Fish. Blackwell Publishing Ltd. 2004;528.
    ISBN: 0-85238-276-6.
17. Quéro JC, Vayne JJ. Les poissons de mer des péches Francaises. Delachaux et Niestlé SA, Lausanne-Paris, France. 1997;304.
18. Quèmèner L. Le maigre commun (*Argyrosomus regius*). Biologie, peche, marche et potential aquacole. Editions Ifremer, Plouzané, France. 2002;31.

19. Chatzifotis S, Panagiotidou M, Papaioannou N, Pavlidis M, Nengas I, Mylonas CC. Effect of dietary lipid levels on growth, feed utilization, body composition and serum metabolites of meagre (*Argyrosomus regius*) juveniles. Aquaculture 2010;307:65-70.
20. Jimenéz MT, Pastor E, Grau A, Alconchel JI, Sánches R, Cárdenas S. Revisión del cultivo de esciénidos en el mundo, con especial atención a la corvina *Argyrosomus regius* (Asso, 1801). *Boletin Instituto Espanol De Oceanografia.* 2005; 21(1-4):169-175.
21. Sukenik A. Ecophysiological considerations in the optimization of eicosapentaenoic acid production by *Nannochloropsis* sp. (Eustigmatophyceae). Bioresource Technology. 1991;35(3):263-269.

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