Italian Journal of Animal Science

ISSN: (Print) 1828-051X (Online) Journal homepage: http://www.tandfonline.com/loi/tjas20

The influence of different dietary energy content and feeding regimes on growth and feed utilization of European sea bass (Dicentrarchus labrax, L.)

Alessio Bonaldo, Anna Badiani, Paolo Fagioli, Ramon Fontanillas, Wolfgang Koppe, Lorenzo Mariani & Pier Paolo Gatta

To cite this article: Alessio Bonaldo, Anna Badiani, Paolo Fagioli, Ramon Fontanillas, Wolfgang Koppe, Lorenzo Mariani & Pier Paolo Gatta (2009) The influence of different dietary energy content and feeding regimes on growth and feed utilization of European sea bass (Dicentrarchus labrax, L.), Italian Journal of Animal Science, 8:sup2, 842-844, DOI: 10.4081/ijas.2009.s2.842

To link to this article: https://doi.org/10.4081/ijas.2009.s2.842

Published online: 07 Mar 2016.

The influence of different dietary energy content and feeding regimes on growth and feed utilization of European sea bass (*Dicentrarchus labrax*, L.)

Alessio Bonaldo[1], Anna Badiani[1], Paolo Fagioli[1], Ramon Fontanillas[2], Wolfgang Koppe[2], Lorenzo Mariani[3], Pier Paolo Gatta[1]

[1] DIMORFIPA, Università di Bologna, Italy

[2] Skretting Aquaculture Research Centre, Stavanger, Norway

[3] Laboratorio di Acquacoltura, Polo Scientifico-Didattico di Cesena, Università di Bologna, Italy

Corresponding author: Pier Paolo Gatta. DIMORFIPA, Facoltà di Medicina Veterinaria, Università di Bologna. Via Tolara di Sopra 50, 40064 Ozzano dell'Emilia (BO), Italy - Tel. +39 051 2097396 - Fax: +39 051 2097373 - Email: pierpaolo.gatta@unibo.it

ABSTRACT - The growing importance of European sea bass (*Dicentrarchus labrax*) in aquaculture underlines the need to optimize the feeding strategy for this fish species. The aim of the present study was to assess the effect of dietary energy content and feeding regime on growth performance, feed utilization and feeding costs for European sea bass. Seven hundreds and forthy four fish (average initial body weight 68g) were randomly allocated into twelve tanks 800 l in a closed recirculation system (water temperature: 22°C; dissolved oxygen ≥90% of saturation). Three isoproteic (47% crude protein) extruded diets were formulated with different lipid levels i.e. 16% (diet D16), 24% (diet D24) and 32% (diet D32) and each diet was fed at two different feeding regimes (satiation and 80% satiation) according to a bifactorial experimental design. Feed intake (FI) was recorded daily. After 77 days, fish were bulk weighed and growth, SGR and FCR were calculated. Feeding regimes affected all the analysed parameters (P<0.05), whereas diet influenced only FCR, FI, protein and lipid intake and the economic efficiency ratio (EER). Fish fed the lowest energy content diet (D16) to satiation resulted in the highest feed intake, a FCR similar to that of fish fed diets D24 and D32 and in the lowest EER.

Key words: European sea bass, Energy, Feeding regime, Growth.

Introduction - European sea bass production in Europe doubled in the last decade reaching more than 100000 mt in 2008 (F.E.A.P., 2008) with a continuous increase year by year. In order to maximize productions and mitigate the environmental impact, it is important to satisfy nutritional requirements of fish through the optimization of feed formulation and feed management. In Europe salmonid farming has played the main role in aquaculture industry and hence most nutritional studies have been focused on these species. Because of the existence of several differences between salmonids and European sea bass, the importance of specific research on sea bass nutritional requirements is highlighted (Ballestrazzi *et al*., 1994; Oliva-Teles, 2000; Lupatsch *et al*., 2001; Boujard *et al*., 2004). The aim of this study was to demonstrate the influence of dietary energy content and feeding regimes on growth and feed utilization in European sea bass.

Material and methods - Three isoproteic (47% CP) extruded diets with a pellet diameter of 4 mm were formulated in order to contain three different lipid levels by replacing fish oil with wheat starch: 160 g kg^{-1} (D16), 240 g kg^{-1} (D24) and 320 g kg^{-1} (D32). The fish were fed twice a day, six days a week and once on sunday by automatic feeders. Each diet was randomly assigned to four groups of fish. Of these four groups, two were fed approximately 20% in excess of satiation level (satiation group). After each single meal, uneaten feed was collected from the outlet water in plastic strainers and weighed after drying in a stove overnight at 105°C in order to determine the daily feed consumption. The other two groups received a feed ration equivalent to the 80% average feed intake of the fish fed to satiation during the previous 24h (80% satiation group). The experiment was carried out at the Laboratory of Aquaculture, University of Bologna, Cesenatico, Italy. Ongrowing European sea bass were acclimated for four weeks before the experiment. Seven hundreds and forthy four fish were randomly distributed into twelve square tanks 800 l with a conical bottom (62 fish per tank). Tanks were provided with natural seawater and connected to a closed recirculation system consisting of a mechanical sand filter, an ultraviolet light and a biofilter. Water exchange rate was 100% $hour^{-1}$. Temperature was kept constant at 22±1°C throughout the experiment and photoperiod was fixed at a 12-h day length (350 lx at the water surface — Delta Ohm luxmeter HD-9221; Delta-Ohm, Padua, Italy). Oxygen level was equal to or above 90% of saturation. Ammonia (≤0.1 mg L^{-1}), nitrite (≤0.2 mg L^{-1}) and nitrate (≤50 mg L^{-1}) were determined spectrophotometrically once a week (Spectroquant Nova 60, Merk, Lab business) at 12.00 a.m. At the same time, pH (7.8–8.0) and salinity (25–31 g L^{-1}) were also determined. The fish were bulk weighed at the start of the experiment and after 77 days (end of the experiment). The data obtained were used to calculate Specific Growth Rate (SGR), Feed Conversion Rate (FCR) and Feed Intake (FI). The experimental diets were analyzed for dry matter (drying to constant weight in a stove at 105°C), crude protein (Nx6.25, determined by the Kjeldahl method), crude lipid (Folch et al., 1957) and ash content (incineration to constant weight in a muffle oven at 450°C). Intake of protein (g kg^{-1} day^{-1}) and lipid (g kg^{-1} day^{-1}) as well as Economic efficiency ratio (€ kg^{-1}) were calculated as described in the table footnotes. Unitary costs of feed used in the formula were provided by Skretting Italy, Mozzecane VR, Italy (D16, 1.015 €/kg; D24, 1.200 €/kg; D32, 1.385 €/kg). All statistical analyses were performed using Prism 4.0 package (Graphpad, Usa). Arcsine √ transformations of percentage data were performed to achieve homogeneity of variance. The effects of the feeding regime (satiation, 80% satiation), the dietary composition (D16, D24, D32) and their interactions were tested using a two-way analysis of variance (ANOVA). Where appropriate (P<0.05), the Tukey's multiple range test were used to detect intergroup significant differences. Tank-based bulk weight of fish and feed consumption were used as the experimental unit to determine growth performance and feed utilization. Data are presented as mean ±SD.

Results and conclusions - Results are shown in Table 1. Fish easily adapted to experimental conditions and the survival rate was almost 100% as only one fish died during the experiment. Feed intake was statistically influenced by diet and, obviously, by feeding regime. Within satiation groups the highest feed consumption was found in fish fed D16. Statistical differences between groups were found for SGR and FCR too. In the first case only feeding regime was determinant while both factors were involved in FCR. When fish were fed to satiation, FCR was similar between treatments (P>0.05). Protein and lipid intake as well as EER were also statistically different on grounds of both feed composition and ration. On the basis of these data both variables firmly influenced growth and feed efficiency in ongrowing European sea bass. D16, the diet with the lowest energy level, was very well accepted and utilized by fish within groups fed to satiation. These data are in accordance with the findings of Peres and Oliva-Teles (1999) on juvenile European sea bass fed diets with different lipid levels (from 12 to 30% DM). On the other hand restricted feeding regime showed a lower FCR in D24 and D32 groups than in D16. Those results are most probably related to the dietary energy content and DP/DE ratio requirements in European sea bass at the size studied. Interestingly, EER scored the best values in fish fed D16, both in satiation and in 80% satiation groups. Within the same feeding regime, fish fed D24 and D32 gave similar results for SGR, FCR, FI, with an EER increase when we consider the highest lipid level diet. In conclusion, European sea bass, at the size range of this experiment (70-

145g) seems to prefer lower energy diet (16% of lipid) when fed to satiation . Restricted feeding regime positively influenced feed utilization but reduced SGR. The importance of this finding increases if we consider that feeding costs are directly related to the dietary oil content and hence the use of D16 can also contribute to reduce production costs.

Table 1. Growth performance and feed utilization of European sea bass fed experimental diets for 77 days.

	IBW g	FBW g	SGR % day^{-1}	FCR	FI % day^{-1}	Prot In g kg^{-1} day^{-1}	Lip In g kg^{-1} day^{-1}	EER €/kg
SAT								
D16	69.9±0.8	145.4±3.0^{a}	0.96±0.00^{a}	1.40±0.07^{a}	1.28±0.07^{a}	6.04±0.26^{a}	2.11±0.09^{c}	1.42±0.08^{bc}
D24	69.5±0.7	134.1±4.7^{a}	0.85±0.03^{b}	1.30±0.02^{ab}	1.08±0.05^{b}	5.09±0.23^{b}	2.51±0.12^{b}	1.57±0.02^{b}
D32	69.9±0.4	135.3±0.4^{a}	0.86±0.03^{b}	1.30±0.02^{ab}	1.07±0.04^{b}	5.03±0.17^{b}	3.49±0.12^{a}	1.79±0.04^{a}
80% SAT								
D16	67.8±1.8	112.5±1.3^{b}	0.66±0.02^{c}	1.32±0.00^{b}	0.85±0.00^{c}	4.00±0.00^{c}	1.40±0.00^{d}	1.33±0.04^{c}
D24	67.5±2.0	117.4±6.4^{b}	0.72±0.03^{c}	1.21±0.05^{c}	0.84±0.01^{c}	3.97±0.00^{c}	1.96±0.01^{c}	1.44±0.07^{bc}
D32	67.3±1.5	116.6±0.1^{b}	0.71±0.03^{c}	1.21±0.05^{c}	0.83±0.00^{c}	3.90±0.01^{c}	2.70±0.01^{b}	1.65±0.06^{ab}
D	ns	ns	ns	*	*	*	*	*
F	*	*	*	*	*	*	*	*
DxF	ns	*	*	ns	*	*	ns	ns

*Values are mean ± standard deviation. *indicates statistical differences, respectively for diet composition (D), feeding regime (F) and their interaction (DxF). Values with different superscript letters in the same column are significantly different (P≤0.05) according to Tukey's multiple range test. IBW=Initial body weight; FBW=final body weight; SGR=Specific growth rate=((ln final body weight-ln initial body weight)/number of days)x100; FCR=feed conversion rate=g dry feed given/g live weight gain; FI=Feed intake=((Total Feed intake/Mean weight)/days)x100; Protein or Lipid intake=(C_{diet}*Total feed intake)/Mean weight/days, where C_{diet} is the content of the nutrient in the diets; EER=Economic efficiency ratio=(kg^{-1})feed offered (kg)_feed cost (kg^{-1})/weight gain (kg).*

We wish to thank Skretting for supporting this research.

REFERENCES - **F.E.A.P.** 2008. Production and price reports of member associations of the F.E.A.P. 2001 - 2008, http://www.aquamedia.org/production. **Ballestrazzi**, R., Lanari, D., D'Agaro, E., Mion, A., 1994. The effect of dietary protein level and source on growth, body composition, total ammonia and reactive phosphate excrection of growing sea bass (*Dicentrarchus labrax*). Aquaculture 127, 197-206. **Oliva-Teles** , A. 2000. Recent advances in European sea bass and gilthead sea bream nutrition. Aquaculture International 8, 477-492. **Lupatsch**, I., Kissil, G., W., Sklan, D., 2001. Optimisation of feeding regimes for European sea bass *Dicentrarchus labrax*: a factorial approach. Aquaculture 202, 289-302. **Boujard**, T., Gélineau, A., Covès, D., Corraze, G., Dutto, G., Gasset, E., Kaushik, S., 2004. Regulation of feed intake, growth, nutrient and energy utilisation in European sea bass (*Dicentrarchus labrax*) fed high fat diets. Aquaculture 231, 529-545. **Folch**, J., Lees, M. & Sloan-Stanley, G.H., 1957. A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Chemistry 226, 497–509. **Peres**, H., Oliva-Teles A., 1999. Effect of dietary lipid level on growth performance and feed utilisation by European sea bass juveniles (*Dicentrarchus labrax*). Aquaculture 179, 325-334.