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Effects of protein and lipid content of three artificial foods on survival and growth of common dentex during the on-growing phase (*Dentex dentex* Linneaus, 1758).

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ABSTRACT:

The purpose of this work is to highlight the effects of three different foods containing protein and lipids on the survival and growth of common dentex during the on-growing phase.

Common dentex fingerlings weighting 5-6g were grown for one year in polyester tanks. Three diets were used (A_1, A_2 and A_3), respectively, had a protein content of 55%, 45%, 33% and lipid level of 10%, 15% 23%. At the end of the experiment, fishes have reached a weight of 310.20 ± 7.76, 406.24 ± 11.01, 230.20 ± 6.41g, respectively, for A_1, A_2 and A_3. The respective survivals were of 60%, 80% and 88%. The specific growth rates were of 1.04, 1.13 and 1.04 while the respective food conversion rates were of 1.45, 1.30 and 2.0. Diet containing 45% protein and 15% lipid gave the highest specific growth rate and the lowest food conversion rate with an intermediate survival of 80%.

Results obtained during this phase are encouraged to undertake large-scale farming in sea cages, knowing that to transfer the fries into cages must have a weight greater than 6g. This study showed that during one year common dentex reached commercial size despite a thermal profile whose values have not reached the optimum temperatures for the majority of sparidae.

Keywords:

Common dentex, nutrition, protein, lipid, specific growth rate.

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INTRODUCTION

The common Dentex (*Dentex dentex*) is a fish with high commercial value. It is considered as a potential candidate for aquaculture, (Conides et al, 1996, Conides and Nengas 1998, Rueda and Martinez 2001). Captive breeding have been undertaken since twenty years ago; high growth was observed during larval phase (Abellan et al, 1997, Tulli et al, 1997, Koumoundourous et al, 2004, Ait Ali et al, 2007), fingerlings stage and larger fishes (Efthimoiou et al, 1994, Company et al, 1999, Katavic et al, 2000, Koumoundourous et al, 2004, Ait Ali et al, 2008). The Dentex's fingerling feeding requirements have been studied (Tibaldi et al, 1996, Cardenete et al, 1997a, b, c, Company et al, 1999) using pellet's diets for juveniles weighing 10 - 30 g, but dietary lipid and protein still needs improvement. Riera et al, 1993 have achieved experimental Dentex's fingerlings grow-out in sea cage feeding on natural food and obtained adult fish weight of 830 g in 16 - 17 months, widely superior to growth of cultured Sea bass and gilt-head bream. Preliminary studies have shown that common dentex have rapid growth rates, both juveniles and larger fish (Riera et al, 1993, 1995, Efthimiou et al, 1994, Company et al, 1999, Katavic et al, 2000). Nutrient requirements for growth of dentex's juveniles (10–30 g initial live weight) have been studied (Tibaldi et al, 1996, Cardenete et al, 1997a,b,c, Company et al, 1999) using pellet diets, but little information exists concerning optimum dietary protein and lipid levels for fingerlings weighing less than 10 g (Jover et al, 1998). The aim of this study was to determine the optimum of protein and lipid level to have optimum growth.

MATERIEL AND METHODS

Frie's culture

Locally hatchery produced fingerlings of common dentex have been used in this experiment. They were reared during one year in six fibreglass cylinder-conical tanks of volume $2m^3$. After being sorted and selected to constitute homogeneous groups, 25 fishes were initially stocked in each tank in such way to have equal biomass in the six tanks. Initial average weights of these fingerlings were ranged between 5.85±0.2 and 6.55±0.2 g. Seawater flow-through system was used with a renewal rate maintained around 4 - 5 times a day. Oxygenation was provided by two air diffusers and Dissolved Oxygen (DO) was over saturation during the entire period of the experiment. Temperature (17.5 - 22° C), salinity (36 - 38‰) and photoperiod conditions were natural. Light intensity was kept around 600 (lx) during the whole experiment. Feeding frequency was twice a day and Dentex's fingerlings were fed handly to satisfaction.

Survival, length and weight assessment

Estimation of survival rate was based on daily counting of dead fishes and final remaining number of live fishes at the end of experience. Common dentex's fingerlings were measured individually for their total length on the following days (d_1, d_8, d_{15}, d_{22}, d_{35}, d_{48}, d_{69}, d_{129}, d_{156}, d_{192}, d_{219}, d_{262}, d_{295}, d_{370}). They were anaesthetized using phenoxy-2-éthanol (0.1 mL per liter seawater). Total length was first assessed using a gradual table from the snout point until the longest beams point of the caudal fin when this one is aligned with the main axis of the body. Then, individual body weight was taken using an electronic balance. Fingerlings were thereafter put back in their respective rearing tanks.

Experimental diets and their composition

Three diets were experimented. A dry pellet (A_1) which was locally manufactured, an imported dry pellet (A_2) basically conceived and used for sea bass, and a moist pellet (A_3) locally prepared using trash fish and fish meal (**Table 1**).

Sampling and biochemical analysis

Biochemical analysis was made upon diets. Diet samples were taken one time from locally (A_1), imported dry pellets (A_2) and moist pellet (A_3) feeding stocks. All samples were frozen before freeze-drying.

Proteins, humidity and ashes were determined using standard method (AOAC 2000). Total lipids were extracted and measured gravimetrically according to using dichloromethane instead of chloroform.

Statistical analysis

Total length and body weight were compared by one-way analysis of variance (ANNOVA) followed by Newman-Keuls test. A significant level of 5% was used for both tests (Sokal et al, 1981). Statistical study was done by STATITFC (ITFC 4.0, 1988); total lengths and weights of fingerlings were submitted to a logarithmic transformation, while the survival rates are treated after an angular transformation.

RESULTS

Temperature and salinity of breading

Water temperature was included between 17°C and 22°C; salinity was of 36-38 ppm (**Fig. 1**).

Table1. Composition of the three experimental diets (A_1 and A_2 compositions are given following manufacturers' technical sheet). DM = dry matter; WM = wet matter.

Diet	A_1[a]	A_2[b]	A_3
Ingredients			
Dry matter (%)	92	90	66
Fish meal, (%WM)	---	---	34
Fresh fish (%WM)	---	---	48
Sardine oil (%WM)	---	---	14
Premix vit[c] (%WM)	---	---	4
Crud protein (%DM)	55	45	---
Crud lipid (%DM)	12	14	---
Crud fiber (%DM)	1.5	1.2	---
Ash (%DM)	11	9.8	---
Carbohydrates(%DM)	14.5	---	---
Vit A	5000 IU Kg-1	20000 IU Kg^{-1}	---
Vit D	1000 IU Kg-1	3000 IU Kg^{-1}	---
Vit E	180 mg Kg-1	250 mg Kg^{-1}	---
Vit C	---	350 mg Kg^{-1}	---
Analysed composition (%DM)			
Crud protein	55	45	33
Crud lipid	10	15	23
Ash	11.0	9.60	8.50
Energie brute (MJ kg^{-1})	21.10	21.80	23.00
Prot/énergie (mg/Kcal)	26.06	20.63	14.34

[a]Ingredients: fish products, seed oil products and by-product set, cereal seed products, vitamins and minerals, antioxidants : ethoxyquin.
[b]Ingredients: fish meal, soybean, horse bean, pea, fish oil, rapeseed, maize gluten, rapeseed oil, weat, vitamins and minerals, antioxidants : ethoxyquin.
[c]Premix (dose kg^{-1}): Minerals, 75% ; Phosphor, 3 – 4% ; Calcium 25 – 30%, Vitamin A, 2.000000 IU ; Vitamin D3, 400000 IU ; Thiamine B1, 500 mg ; Riboflavin B2, 1.000 mg; Calcium pantothenate B3, 7500 mg; Pyridoxine B6, 500 mg; Vitamin B12, 1.5 mg; Tocopherol Acetate E, 2500 mg; Nicotinic Acid PP, 10000 mg; Cholin (Chloride), 50000 mg.

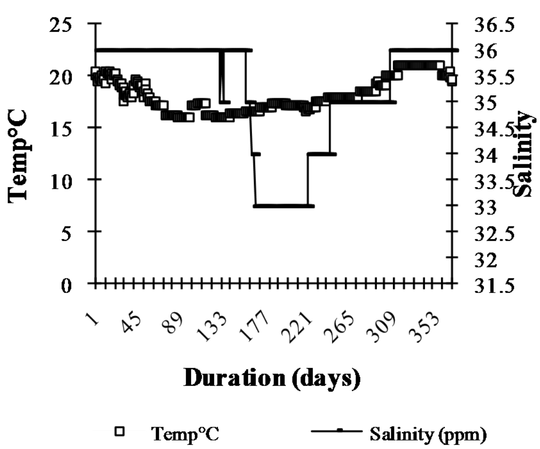

Fig. 1. Temperature and salinity during the on-growing period

Survival

Common dentex's survival for the three diets were of 60% for A_1 diet, 80% for A_2 diet and 88% for A_3 diet. Mortality starts at d_{35} because of flexibacteriosis disease (Fig. 2).

Growth

The initial weight of dentex's fingerlings was of 6g. A_2 diet, containing 45% CP and 15% CL gave a best growth results (final live weight and SGR) followed by A_1 and finally A_3 which gave the lowest growth (Table 2). In early, A_1 gave a high growth compared to A_2 but from d_{200} A_2 showed superior growth (Fig.3). Probably it should use in first stage a protein level of 55% and use after six months a protein level of 45% during the on-growing phase of common dentex.

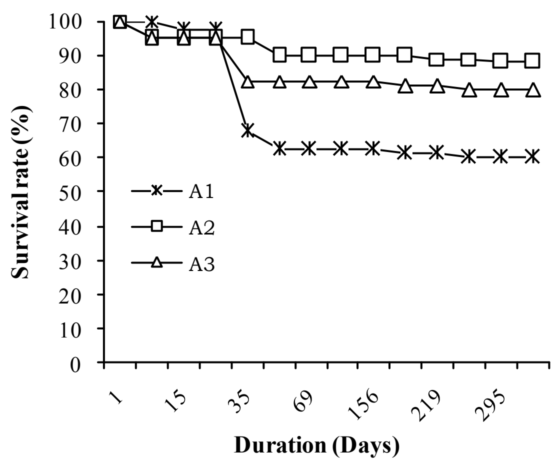

Fig. 2. Common dentex's survival. There is a significant difference between survivals of the three diets according to Neuwman Keuls test.

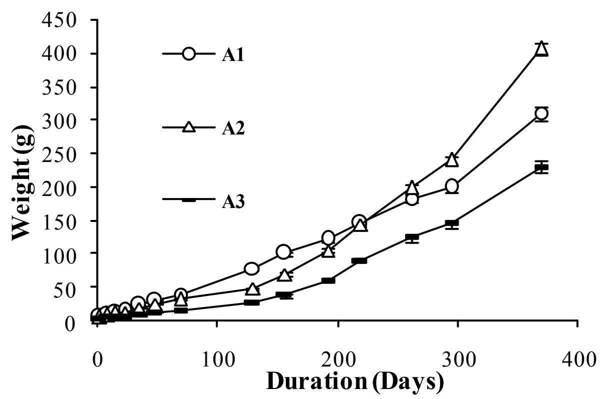

Fig. 3. Weight growth of common dentex. Bars indicates means±SD. There is significant difference (P<0.01) according to Neuwman Keuls test (n=25).

Concerning weight-length relation, correlation of Pearson was very significant (**fig. 4**) (n=336)

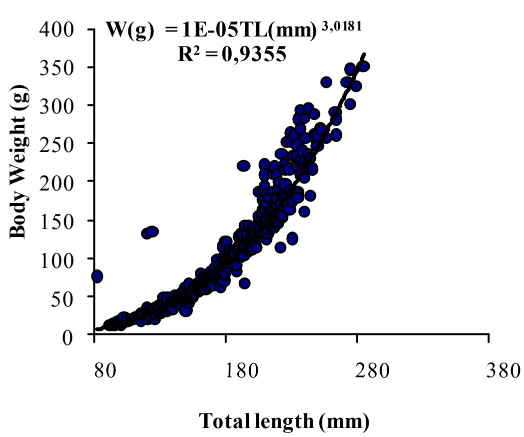

Fig.4. Weigh-length relation of common dentex.

Specific growth rate (SGR) and food conversion ratio were a quadratic function of protein level, of the form SGR = - 0.3212 + 0.066 PL - 0.0007 PL^2 (fig. 5); FCR = 8.875 - 0.3183 PL + 0.0033 PL^2 (fig. 6). The optimum protein level was 45%; lipid level had only a linear effect on specific growth rate and food conversion ratio.

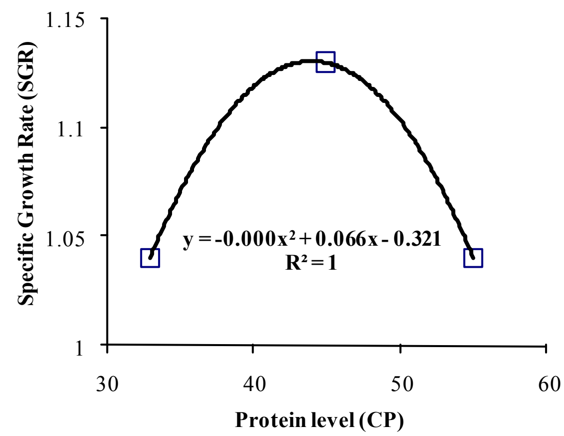

Fig. 5. Plot regression of specific growth rate (SGR) to protein level

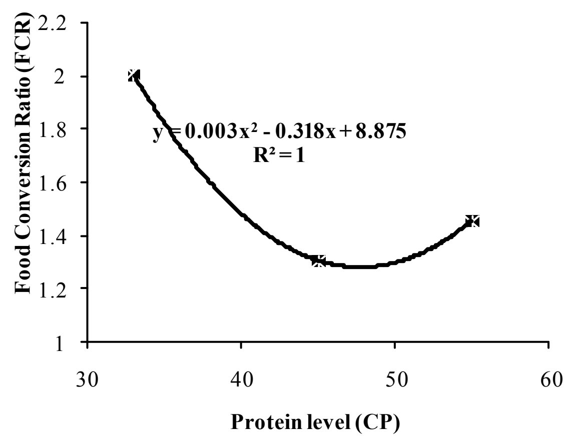

Fig. 6. Plot regression of food conversion ratio (FCR) to protein level

DISCUSSION

During this work, the results in terms of survival have been between 60% and 88%, these results are similar to those obtained by Espinos et al. (2003) using juvenile dentex initial weight of 2.5 g for six weeks. These results also are consistent with those reported by Ait Ali et al. (2008) for fries have reached 40 g using two diets (47%, 10% and 45% and 21% protein and lipid) for ten weeks. The survivals obtained still higher than those obtained by Efthimiou et al.(1994) but lower than for the

Table2. Biological parameters for the three used diets

Diet	A_1	A_2	A_3
Initial weight (g)	6.55±0.20	6.12±0.20	5.85±0.16
Final weight (g)	310.20±7.76	406.24±11.01	230.20±6.41
Survival	60%	80%	88%
FCR	1.45	1.30	2.0
SGR	1.04	1.13	1.04

same species by Company et al.(1999) but for fishes weighing between 10-20 g. Koumoundouros et al. (2004) worked on fish larger but survivals were lowest (On 9300 fishes transferred to sea cages, only 1346 have survived after a month of rearing). In comparison with the results obtained during this work.

The specific growth rate (SGR) are relatively low, the maximum SGR obtained during this work (1.13) is lesser than the SGR obtained for the same species by Ait Ali et al, 2008 (1.7% 2.4% and 2.7% d-1) but to fish smaller, they are also lower than those obtained by Company et al, 1999 and Cardenete et al, 1997a. These results are identical to those reported by Tibaldi et al, 1996. However, they are higher than those cited by Cardenete et al, 1997d. Some lower SGR were obtained in other species such as sea bass: 07-08% d^{-1}, 0.4-0.5% d^{-1} (Dias et al, 1998; Métailler et al, 1981) and sea bream. More optimum temperature for this species is not achieved and more experience in the fishes was large (in our case up to 400g) more SGR is down accordingly.

The food conversion ratio (FCR), whose values are included in this work between 1.30-2.0 are similar to those contained by Tibaldi et al, 1996 and in the same game values (1.3-1.8) reported by Ait Ali et al, 2008 (1.06-1.14) by Company et al, 1999 and (1.5-2.2) by Espinos et al, 2003. Similar results were obtained for other fish species such as sea bass: 1.4-2.2 (Perez et al, 1997), 1.3-1.7 (Diaz et al, 1998), 1.5-1.6 (Hidalgo and Alliot 1988) and seabream: 1.4-1.6 (Vergara et al, 1996), 1.1 (Calduch-Giner et al, 1998). The optimum growth was obtained with a protein content of 45%, in spite of lipid levels (Fig.5). The protein content of 55% and 33% lipid gave lower results in terms of SGR and final weight. Company et al. (1999) obtained similar growth using two diets protein content of 45% and 55%, Jover et al, 1998 did not obtain differences between fish dentex (1.5 to 98g) fed with extruded feed containing 45% or 50% CP. Differences in the results quoted by various authors regarding the optimum protein and lipid can be explained by the energy level and protein / energy ratio. During this work, the optimum energy that gave best results was obtained with food containing between 21.10 and 21.80 MJ kg^{-1} and these results are similar to those cited by Espinos et al, 2003 and Tibaldi et al, 1996. During this work, the CP/GE successful is 20.63 g MJ^{-1}; lower values have yielded poor results. Espinos et al. (2003) reported that the values of CP/GE ratio lower than 21 g MJ^{-1} gave lowest growth, the same remarks were cited by Tibaldi et al, 1996 for values of CP/GE ratio lower than 23 g MJ^{-1}. The protein and lipid content which gave best results during this work (45 CP/15 CL) were identical to the results obtained by Company et al, 1999 (46 CP/17 CL). Recent work has confirmed that the best protein level for optimum growth of dentex juveniles seems to be around 50% and 12% (Tomás et al, 2009).

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