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Preliminary evaluation of protein requirements of Dover sole (*Solea solea*) juveniles

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RIASSUNTO – Studi preliminari sui fabbisogni proteici negli avannotti di sogliola comune (*Solea solea*).

Sono state formulate tre diete isolipidiche (15% s.s.), caratterizzate da livelli crescenti di proteina (A: 55; B: 60

C: 65% s.s.) che si utilizzarono in due prove condotte la prima presso uno stabilimento commerciale, (peso inizia

le: 2,5±1,32 g) e la seconda (peso iniziale: 0,79±0,03 g) presso gli acquari del DIAN. In quest'ultima venne anche provato un mangime commerciale. Ogni dieta venne testata con 4 ripetizioni per tesi e l'alimento veniva distribuito tre volte al dì. Nella I prova, il peso vivo finale (4,4; 4,5 e 6,1 g) e il TAS (1,0; 1,1 e 1,6%), migliorarono (P<0,05) al crescere del tenore proteico, mentre la % di sopravvivenza (97,54%) non ne risentì. Nella seconda non si notarono differenze significative tra le tre diete che diedero prestazioni significativamente peggiori della dieta commerciale. Dai risultati ottenuti il livello proteico ottimale sembra collocarsi attorno al 65% s.s. per avannotti di 2,5 g di peso.

Key words: solea, fingerlings, protein, requirements.

INTRODUCTION – The introduction of new species in aquaculture requires a research support in order to establish nutrient requirements, optimal environmental conditions and rearing techniques. Common sole is a fish well known in the European market and the interest in farming has been stimulated largely by the desire for the existing marine fish farming industry to diversity (Howell, 1997). This species proved relatively easy to rear through the larval stages and many scientific papers have considered this topic. On the contrary, the knowledge concerning feed formulation for the juvenile and ongrowing stages are quite limited and data on growth rate of juveniles with artificial diets are scarce (Day *et al.* 1997). The present research was performed in order to gather a first set of information on protein requirements of this species.

MATERIAL AND METHODS – Three isolipid diets (15% on d.m.) characterized by growing levels of protein (A: 55; B: 60 and C: 65% on d.m.) were studied. Diets were prepared as moist paste, that was passed through a meat mincer with 3mm holes die. The product was thereafter dried at 60°C and then ground and sieved to obtain particles of 0.5-0.8 mm size. Diets were tested in two trials. In the first one 284 sole juveniles of about 220 dah of age, initial live weight 2.5±1.32 g, were selected from a larger batch at the hatchery of the farm "Orbetello Pesca Lagunare" and distributed among 12 cages, (35x35 cm, 40 cm high) built with a wood frame. The sides were covered with net and the bottom with a plancton net. The cages were kept inside 1m x 1m fiberglass tank, four cages per tank. Each tank had a water flow rate (3.7% salinity) of 20 l m^{-1}, aerated b means of porous stones. In the second trial 465 sole fingerlings, initial live weight 0.79±0.03 g, were distribute among 15 pvc tanks and fed the three diets (four replicates for diet) and a commercial extruded diet (three replicates). PVC tanks had the bottom partially substituted for a net and were located inside larger fiberglass tanks in close circuit plant. In both trials feed was distributed manually three times a day *ad libitum*. Fish were adapted to the experimental diets for 2 weeks before beginning the trials, that lasted 61 and 45 day respectively. Growth rate was measured fortnightly by bulk weighing each tank. In both experiments mortality

was controlled daily and water chemical and physical characteristics were checked weekly. Diet chemical composition was determined according to AOAC (1990) methods.

RESULTS AND CONCLUSIONS – Diets composition and chemical characteristics are reported in Table 1. Protein in diet A and fat in diet C resulted in values higher and lower than expected respectively; EPA plus DHA content of the diets were over 2% of the dry diet and sufficient to cover requirements for flat fish (Halver, 2002).

Table 1. Composition and chemical characteristics of the experimental diets.

	Diet A	Diet B	Diet C	Diet D
Items (%)				
Krill meal	56.00	54.00	53.00	
Fish meal, Chile	12.00	16.00	2.00	
Wheat gluten meal	1.00	9.00	35.00	
Brewery yeast	20.00	12.00	1.00	
Fish oil + soy lecithin	5.00	5.00	5.00	
Vitamin and mineral supplement	2.03	2.03	2.03	
Binder	3.50	1.50	1.50	
Glycine and betaine	0.47	0.47	0.47	
Chemical composition (% on d.m.)				
Crude protein	56.85	60.20	65.20	60.40
Crude fat	15.19	15.50	14.00	21.70
Fatty acid content (% of crude fat)				
Linoleic acid	2.90	4.90	8.70	11.50
Linolenic acid	0.70	1.00	1.10	1.70
EPA	8.70	7.80	7.50	5.10
DHA	8.20	8.70	7.20	9.20

In both trials problems were encountered in measuring feed intake and consequently in calculating feed conversion rates, either because of the bottom feeding behavior of fish and because of the facilities used. So feed conversion ratios data are not reported. In the first trial water oxygen content was always close to 85% saturation. Water temperature decreased from 22°C of the preliminary period to 20°C in the first and to 18 and 17°C during the second and third period respectively. Survival rate was high (mean value 97.54%) with no significant differences among diets. Data on juveniles performances are summarized in Table 2. In the first trial final live weight almost doubled in fish fed diets A and B and tripled with diet C. Specific Growth Rate (SGR) was high during the first and second period and decreased during the third one when water temperature reached the lowest point. Sole juveniles fed the diet with the highest protein content had significant higher SGR values during the first and third period and during the whole trial in comparison with fish fed the other

two diets. In the second trial water temperature was constant (22°C). Salinity was 2.5%, NH4 and NO_2 were

0.05 and 0.08 mg l^{-1} respectively. Survival rate was high and significantly affected by diets. The commercial die

(D), gave better results (Table 2) than the ones observed with the test diets, where Diet B, gave the lowes