

Original scientific paper

UDC 597.5 : 639.3.043 (0 : 597.5)

**EFFECT OF FEEDING TIME ON GROWTH AND DEPOSITION  
OF MESENTERIC FAT IN JUVENILE SEA BASS,  
*DICENTRARCHUS LABRAX* LINNAEUS, 1758**

UTJECAJ VREMENA HRANJENJA NA RAST I ODLAGANJE  
MEZENTERIČKE MASTI KOD MLAĐI LUBINA *DICENTRARCHUS*  
*LABRAX* LINNAEUS, 1758

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The paper describes the results of the experiment of three feeding schedules on juvenile sea bass (*Dicentrarchus labrax*). Fish were fed either in the morning (7.30) or in the afternoon (15.30) with a single daily meal or a half ration both in the morning and in the afternoon.

There was no significant difference in growth, mesenteric fat quantity and hepatosomatic index between juvenile sea bass fed two times a day and those fed a single meal either in the morning or in the afternoon.

INTRODUCTION

Effect of feeding time on different physiological functions was mainly studied in higher vertebrates. In mammals timing of food affects weight-gain, lipogenesis and food conversion (Nelson et al., 1975). Rats fed a single meal daily showed intensified lipogenesis in comparison with those fed several times a day (Hollifield and Parson, 1962).

However, studies with fish are relatively rare. It has been established so far that feeding time affects weight-gain (Brett, 1979). Different fish species differently respond to varying feeding regimes. Major part of already studied fish species showed better growth if fed two meals a day in comparison to those fed a single meal (Grayton and Beamish, 1977; Andrews and Page, 1975). Some species such as *Pleuronectes platessa* grew similarly nevertheless fed one or two times a day (Jobling, 1982). Some however, like channel catfish, *Ictalurus punctatus* Raf., showed better growth and storage of less mesenteric fat if fed only in the morning. At the same time, fish fed two times a day store more fat than fish fed single meal, irrespective whether fed in the morning or in the afternoon (Noeske-Hallin, et al., 1985).

Feeding time and its effect on physiological processes, particularly on weight-gain and lipogenesis, are of a considerable significance for aquaculture. Optimization of timing of food intake may considerably affect economizing of food, better food conversion, labour saving in fish farms which all may result in better commercial effects of fish culture.

This paper describes the effect of feeding time on growth and storage of mesenteric fat in juvenile sea bass, *Dicentrarchus labrax*, one of the commercially most interesting species in intensive mariculture in the Mediterranean.

### MATERIALS AND METHODS

Twenty-five specimens of laboratory hatched juvenile sea bass (Katavić, 1986) of six months of age were placed in each of six concrete aquarium basins of 200 l volume with continuous flow-through sea water. Temperature variations during experiment are presented in Fig. 1. Salinity ranged between 37 and 38‰ and fish were kept under natural light conditions.

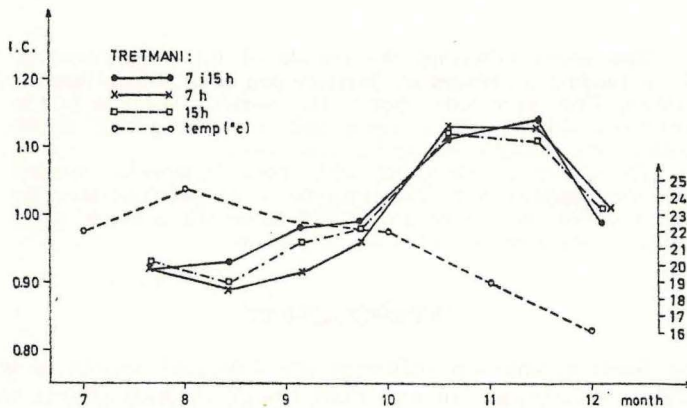


Fig. 1. Effects of time of day and frequency of feeding on juvenile sea bass condition factor

One fish group was fed only in the morning (at 7.30) with a single meal. The second group was fed only in the afternoon (3.30) with daily meal and the third group a half ration both in the morning and in the afternoon. The animals were fed dry pellet (»Trowit«) and daily ration was 15% of body weight. Meals were readjusted to the total fish biomass every three weeks.

After 3, 6, 9, 12, 15 and 18 weeks on the feeding regimen fish were measured for the total weight ( $l_t$ ) increment, weight ( $W_g$ ) gain, Condition factor was calculated, as well.

At the end of the experiment 20 fish of each group were sacrificed for mesenteric fat and hepatosomatic index measurements. Data were analyzed by one-way analysis of variance (ANOVA).

## RESULTS

There was no significant difference in growth of juvenile sea bass between fish fed two times a day and those fed a single meal either in the morning or in the afternoon (Fig. 2). Better condition factor in fish fed two times a day was recorded only during summer, that is during the first nine weeks of the experiment (Fig. 1).

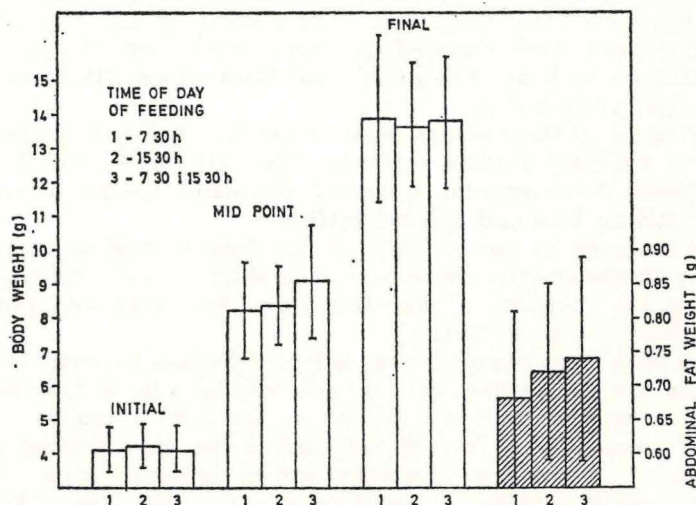


Fig. 2. Initial, midpoint and final mean body weight (g) (□) and mesenteric fat quantity (■) on different daily feeding schedules. Fish were fed either in the morning (07.30) or in the afternoon (15.30), or a half rations at both times of day. Vertical lines represent standard deviation from means. Each of three feeding regimens was replicated so that the total number of fish in each group was 50.

Fish fed two times a day had slightly higher mean weight of mesenteric fat than those fed a single meal. However, the difference is not statistically significant (Fig. 2).

Hepatosomatic index was lower ( $2.18 \pm 0.46$ ) in fish fed an early meal than in fish fed in the afternoon ( $2.54 \pm 0.76$ ) and two times a day ( $2.55 \pm 0.66$ ). However, neither these differences were statistically significant for the tested level ( $P \leq 0.05$ ).

## DISCUSSION

Effects of timing the daily meals proved no significant differences in growth increment and mesenteric fat storage in juvenile sea bass. The relative of our sea bass, the american striped bass, *Morone saxatilis*, 10 weeks old, showed better growth already after four weeks if fed two times a day in relation to fish fed a single meal nevertheless in the morning or in the afternoon.

However, when fish used in the experiment were 62 weeks old there was no significant difference in growth increment (Klar, unpublished data).

Jobling (1982) reported similar growth in *P. platessa* fed frequently and those fed once a day. On the contrary, Noeske-Hallin *et al.* (1985), found that juvenile channel catfish fed only in the morning had higher body weights, lengths, food conversion efficiencies and reduced mesenteric fat than those fed only in the afternoon or two times a day.

Sing and Srivastara (1985) established the best growth in *Heteropneustes fossilis* fed two times a day and poorest in fish fed a single meal daily. Similar results were reported by Andrews and Page (1975) for channel catfish as well as Grayton and Beamish (1977) for rainbow trout (*Salmo gairdneri* Rich.).

The variety of all these results point to the fact that each species responds differently to different feeding regimens. The differences may be recorded in the different developmental stages of the same species as well as are the cases of striped bass and channel catfish.

These differences in the response of the fish to feeding frequency can be attributed to the specific physiology of feeding of each individual species dependent on the structure of digestive tract, food type and physiological response of different age categories.

It should have been expected that different feeding regimens would have affected more the carnivorous species with shorter guts and higher rate of digestion. However, this was not proved in sea bass, a typical carnivorous species. Fish seemed to be rapidly adapted to the new feeding conditions compensating it by better food conversion and lower digestion rate. This could account for a slight decrease of condition factor in fish group fed a single meal daily at the beginning of the experiment.

Better condition factor in fish fed two times a day was recorded only during summer at temperatures of 22-24°C. After Ravagnan (1978) these are the optimum conditions for sea bass rearing.

Practical application of these results in intensive culture is still uncertain since additional studies with other age groups and experiments in cage cultures are called for. These preliminary researches in aquaria had some shortcomings. Food that was not consumed fell to the bottom of the tanks. This allowed fish to consume it over a longer time which would not be possible in cages. However, apart from this, the results are indicative of the necessity of further studies of feeding time effects on not only the sea bass but also on other commercially interesting fish species. This may significantly add to the cost reductions in commercial fish rearing.

#### ACKNOWLEDGEMENTS

This research has been financed in part by a grant made by the United States Department of Agriculture, Office of International Cooperation and Development, authorized under Public Law 480.

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Accepted: September 12, 1987

#### UTJECAJ VREMENA HRANJENJA NA RAST I ODLAGANJE MEZENTERIČKE MASTI KOD MLAĐI LUBINA *DICENTRARCHUS* *LABRAX* LINNAEUS, 1758

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#### KRATKI SADRŽAJ

Utjecaj vremena hranjenja i broja obroka na rast i odlaganje mezenteričke masti ispitan je u tri skupine mlađi lubina starih pola godine. Ribe su hranjene pastrvskim peletom u dnevnim obrocima koji su iznosili 15% tjelesne težine, i prilagođavani su svaka tri tjedna. Prva skupina riba hranjena je u 7.30 h s cijelim dnevnim obrokom, druga skupina u 15.30 h s cijelim dnevnim obrokom, a treća skupina u 7.30 i 15.30 h s pola dnevnog obroka.

Totalna dužina, težina i indeks kondicije određivani su 3, 6, 9, 12, 15 i 18 tjedana nakon početka pokusa. Na kraju pokusa po 20 riba iz svake skupine je žrtvovano za utvrđivanje količine mezenteričke masti i hepatosomatskog indeksa. Podaci su obrađeni jednostrukom analizom varijance.

Tokom pokusa nije nađena statistički značajna razlika u rastu riba podvrgnutih različitim tretmanima ishrane.

Značajno bolji indeks kondicije kod skupina riba hranjenih dva puta dnevno utvrđen je samo tijekom ljetnog perioda pri optimalnim temperaturnim uvjetima.

Srednja težina mezenteričke masti bila je nešto veća kod riba hranjenih dva puta dnevno u odnosu na one koje su hranjene jedanput, bilo ujutro ili popodne. Međutim razlika nije statistički značajna. Isto tako nije utvrđena statistički značajna razlika u hepatosomatskom indeksu između skupina riba podvrgnutih različitim tretmanima.