# EFFECT OF SELECTED LEVELS OF DIETARY PROTEIN ON THE GROWTH AND FEED EFFICIENCY OF MULLET *LIZA MACROLEPIS* **FRY**

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ABSTRACT

In the experiment conducted in laboratory for a period of 45 days to evaluate the effect of selected dietary protein levels (30%, 35%, 40%, 50%, 60%) on survival, growth, conversion efficiency and protein efficiency ratio in the fry of the mullet *Liza macrolepis,* using purified diets, the high protein levels 40% to 60% gave better results on survival rate (69% to 87%). Maximum gain in length and relative growth (56.6%) was at 40% protein level. However, low conversion efficiency (2.41 and high protein efficiency ratio (1.388) were at 30% protein diet. The maximum body proteins in the fish coincided with 35% protein diet and 40% protein diet and the minimum body protein was at 30% protein diet and again at 60% protein diet.

Although the minimum conversion efficiency and maximum protein efficiency ratios were observed at 30% protein level, data on survival, growth and body protein content indicate that for the fry of *Liza macrolepis* the optimum protein level in the diet is 40%.

## INTRODUCTION

While formulating practical diets for finfish, protein assumes greater importance because of the level and quality of protein greatly influencing the cost of feeds. So the protein content has to be carefully adjusted in feeds, bearing in mind that the dietary protein in excess to that required for growth is only catabolized (Cowey 1979) and that protein inadequacy leads to poor growth and feed inefficiency. As the dietary protein quality and quantity are major determinants of growth, many investigations have been carried out to find the optimum protein requirements of finfish species, both in temperate and in tropical countries. These have been reviewed by Cowey and Sargent (1972), Halver (1972) Cowey (1979) and Millikin (1982). The present study was conducted in the laboratory to ascertain the effect of selected dietary protein levels on the growth and feed efficiency of the fry of the mullet *Liza macrolepis*, an important cultivable species in the Indian coastal saline water bodies.

## MATERIAL AND METHODS

*Experimental diets:* Five experimental diets with protein levels ranging from 30% to 60% were formulated using semi-purified ingredients (Table 1). Casein and dextrin were respectively used for protein and carbohydrate sources. A mixture of codliver oil and gingilly oil was used for lipid source. The mineral mixture USP XIV supplied by SISCO Laboratories, Bombay, and vitamin pre-mix prepared according to Halver's H-440 test diet for finfish (Castell and Tiews, 1980) were used. Carrageenan was used as the binder.

TABLE 1. *Composition of the test diets* (g|100g).

| Ingredients | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Casein | 30 | 35 | 40 | 50 | |
| Dextrin | 42.5 | 36.87 | 31.25 | 20.0 | |
| Lipids | 5 | 5 | 5 | 5 | |
| Mineral Mixture | 2 | 2 | 2 | 2 | |
| Vitamins mixture | 2 | 2 | 2 | 2 | |
| Cellulose | 18.5 | 19.12 | 19.7 | 21 | |
| Carrageenan | 5 | 5 | 5 | 5 | |
| Energy* (Kcal\|kg) | 3500 | 3500 | 3500 | 3500 | |

Dextrin-E. Merk|India; Casein-Sisco; Lipids-Codliver oil: Gingelly oil 2:1 ratio; Mineral mixture - SISCO|USP XIV; Vitamins mixture: Halvers H-440 (Castell and Tiews, 1980)

* Carbohydrate 4 Kcal|kg, fat, 9 Kcal|kg and Protein, 4.5 Kcal|kg.

The individual ingredients were weighed, powdered and mixed (Table 1). Water was added at the rate of 400 ml/100 g of diet and the contents were mixed well in a high-speed blender for 2 min. and heated over a water bath at 80°C. Carrageenan was added in small quanties, mixing constantly. After cooling to room temperature, the diet was freeze-dried. The dried diets were powdered and sieved to obtain particles of 150 *M-*

*Feeding experiment:* Fry of *L. macrolepis* were collected from the Karapad creek, Tuticorin, with a screen net, and transported in plastic buckets to the laboratory and acclimated to the experimental conditions for 15 days.

Experiments were coducted in 10 fibreglass beakers, each containing 8 fry. Experiments were conducted in duplicates. Diet particles of < 150 *fi* were given to the fry at the rate of 10 per cent body weight once daily in the morning and the leftover food was removed after 1 h, by which time the fry appeared to be fully fed. Water was aerated throughout and changed every morning. Salinity of the water was maintained at 31 + \%₀. The water temperature ranged from 30° to 33°C during the experimental period of 45 days.

Total length and weight of the fry were noted at the onset of the experiment as well as by sampling on every fifteenth day. Dry weight of fish (n = 12) belonging to the same size group was recorded at the beginning of the experiment. After completion of the experiments, dry weights of all the surviving fish were noted. Body protein content of these experimental fishes was determined using Micro-kjeldahl method. Conversion efficiency, relative growth and protein efficiency ratio were determined as suggested by Castell and Tiews (1980).

Growth in terms of percentage body weight per day was calculated following Winberg (1956) as per the formula:

$$G = 2AB/n ( Wn + Wo) * loo$$

Where: AB is increase in live weight in n days (45); Wo and Wn, live weight during zero day and 45th day respectively.

RESULTS

*Survival and growth:* Survival rates (Fig 1) were higher (69% to 87%) in the fish fed on high-protein diets (40% to 60% protein). And the Survival was lowest in the fish fed on the diet containing 30% protein. Thus, survival increased with increasing protein level, up to 50% protein (Table 2).

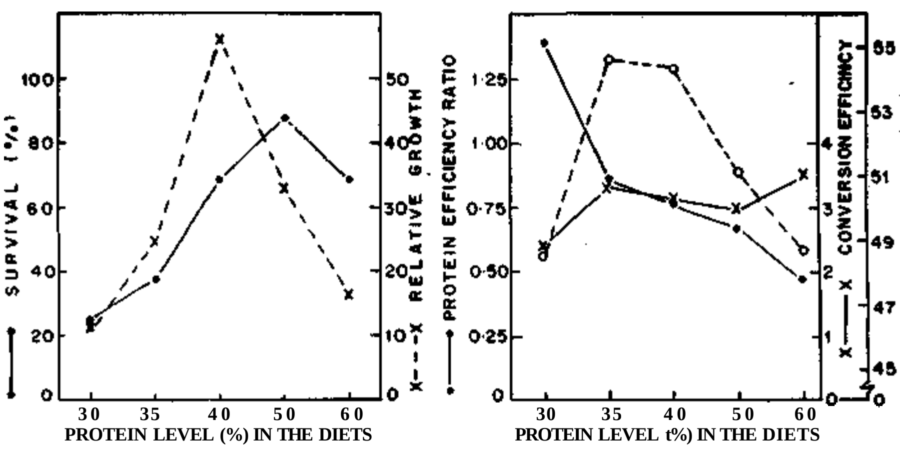


FIG. 1. Survival, relative growth, conversion efficiency and body protein of *L. macrolepis* fry at different levels of dietary protein.

Percentage gain in length recorded from different treatments is shown in Table 2. Gain in length increased with increasing level of protein up to 40%, and declined at higher protein diets.

TABLE 2. *Stocking details and results of the experiments on the effect of different dietary protein levels on* Liza mactolepis *fry.*

| | Protein levels in diets (%) | | | | |
|---|---|---|---|---|---|
| | 30 | 35 | 40 | 50 | 60 |
| Initial mean length (mm) | 42.0 | 42.4 | 40.8 | 43.6 | 43.7 |
| Final mean length (mm) | 48.5 | 51.0 | 51.0 | 45.4 | 47.4 |
| Gain in mean length (mm) | 6.5 | 8.6 | 10.2 | 1.8 | 3.7 |
| Percent gain in length | 15.48 | 20.28 | 25.00 | 4.13 | 8.47 |
| Initial mean weight (g) | 1.220 | 1.310 | 1.060 | 1.050 | 1.118 |
| Final mean weight (g) | 1.360 | 1.640 | 1.660 | 1.400 | **1.380** |
| Gain in mean weight (g) | 0.140 | 0.330 | 0.600 | 0.350 | 0.200 |
| Percentage gain | 10.29 | 20,12 | 36.14 | 25.00 | 14.49 |
| No. of animals stocked (initial) | 16 | 16 | 16 | **16** | 16 |
| No. of animals suvived | 4 | 6 | 11 | **14** | 11 |
| Body protein (%) (dry wt) | 48.75 | 54.58 | 54.41 | SI.00 | 48.75 |
| Growth per day (% body weight) | 0.24 | 0.50 | 0.98 | 0.63 | 0.36 |

Relative growth (wet weight basis) (Fig. 1) was mxaimum (56.6%) at 40% protein level and minimum (11.49%) at 30% protein level. The values of relative growth attained at 50% and 60% are much lower than that attained at 35% and 40% protein levels.

*Conversion efficiency and protein efficiency ratios:* The minimum (2.4) and maximum (3.53) conversion efficiency values were recorded at 30% and 60% protein diets, respectively. The conversion efficiency values recorded in other protein diets were not significantly different (Fig. 1). The highest (1.388) and lowest (0.47) PER values were recorded at 30% and 60% protein levels, respectively, showing that increasing protein levels lead to decreased PER values.

*Body protein:* The peak quantity of body protein coincided with diets of 35% and 40% protein levels (Fig. 1). And thereafter there was decrease with increasing protein level of the diet. In the status of the fish in regard to body protein, those reared at 30% protein was comparable *to* those reared at 60% protein, showing that with continued increase of protein uptake, more protein goes for purposes other than growth, most possibly for metabolism.

## DISCUSSION

Mullets in general are reported to be capable of utilizing feeds of **small** particle size. The feed particles fed to the fry was accepted well and most of the feed was consumed. No external deficiency symptoms were observed in any of the experimental fish. After sampling for recording weights, decrease in food intake was observed for two days, probably because of handling stress, especially wWle weighing.

The high survival rates at higher protein levels (40% 50% and 60%) coupled with poor survival rates at lower protein levels (30% and 35%) indicate increased requirement of protein in the diet of *Liza macrolepis* fry. This is in agreement with the observations made by various authors that fish fry require more protein in the diet compared to fingerling and yearling fish (National Research Council, 1977; Andrews, 1977). The minimum protein level in diet necesssary to produce maximum growth in *L. macrolepis* fry at the experimental conditions seems to be about 40%. This is much lower than the reported requirement of portien (70%) in the form of albumin for very young mullets, *Mugil auratus* and *M. Capito* (Vallet *et. al.,* 1970). This -marked difference in the protein requirement may be due to species-specific variations, rearing conditions or perhaps due to the differences in the protein sources used in the experiments. In another tropical fish *Chanos chanos* the optimum protein level in the diet for maximum growth and survival of fry was reported to be about 40% (Lim et al 1979). The relatively poor growth at protein levels of 50% and 60% in the present study confirms this observation, indicating that protean beyond this optimum level is poorly utilized for growth and is perhaps catabolized for energy. Cowey et al (1981) demonstrated that gluconeogenic enzymes increased in rainbiw trout when fed on high dietary protein concentrations, indicating that with high protein diets protein is increasingly catabolized for liberation of energy, which is stored as fat.

Protein efficiency ratio decreased with increased protein levels in the diet, indicating maximum utilization of protein for synthesis of body tissues in the low protein diets. It appears that the non-protein energy component has been maximally utilized as a source of energy, thus sparing the protein'for tissue synthesis in the low protein level diets. The present results agree with those of Andrews (1977) who reported that higher protein concentrations produce better growth in Channel catfish fingerlings, whereas the lower protein concentrations provide better protein conversion. It is also observed that maximum protein addition in the body of the experimented fish occurred with diets of 35% and 40% protein levels, suggesting that protein in the feed is maximally utilized for tissue build up at these protein levels. Above this limit, instead of more protein being utilised for growth, more and more of protein is diverted for metabolism. As there was no significant variation between these two treatments in the body-protein levels, it appears that the maximum protein conversion into tissue protein was possibly attained at 35% protein level and that further increase in the protein level did not promote increased protein deposition in tissues. Although the minimum conversion efficiency and the maximum protein efficiency ratio were observed at 30% protein level, the data on survival, growth and body protein content indicate that the fry of *L. macrolepis* require an optimum protein level of 40% in the diet.

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