



Evaluation of *Spirulina* Supplemented Diet and Its Influence on Bioenergetics and Biochemical Parameters in the Fish *Cirrhinus mrigala*

K. Kamalaveni, B. Santhosh and K. Sithara

Department of Zoology, Kongunadu Arts and Science College, Coimbatore-641 029, T.N., India

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ABSTRACT

Food intake is an important factor governing growth and reproduction and it is depend upon the quality and chemical composition of the feed. A comparative study was conducted to test the effect of *Spirulina* incorporated diet over the commercially available feed on bioenergetics and biochemical parameters of fish *Cirrhinus mrigala*. *Spirulina* incorporated diets were formulated to contain *Spirulina* at the level of 0.25, 0.50 and 1.0%. The results showed a better growth rate, feeding rate and absorption rate in the fish fed with *Spirulina* incorporated diet compared to commercial feed. The study also revealed that protein, carbohydrate and lipid contents were increased in fish with *Spirulina* incorporated diet.

INTRODUCTION

Fish is a vital source of food for people. It is most important single source of high quality protein, providing 16% of the animal protein consumed by the world's population according to the Food and Agriculture Organization (FAO) of the United Nations (1999). It is highly important to develop cost effective diets for more profitable expansion of the production of fisheries. Reducing the amount of fish food in diet formulations, without reducing fish performance have a positive impact on the profitability of commercial fish production.

A number of animal and plant source proteins have been evaluated for fish meal replacement in diet for a number of different species. In *Tilapia oreochromus* and channel catfish *Ictanura spunctus*, fish meal can be completely replaced by plant protein sources such as soyabean meal (Lovell 1998). *Spirulina* products are commercially sold as food supplement in health food stores around the world. Up to very recently, the interest in *Spirulina* was mainly in its nutritive value. Currently, however, numerous people are looking into the possible therapeutic effects of *Spirulina* (Amha Belay et al. 1993).

Ingredients used in commercial fish diets can be classed as sources of protein (amino acids), energy vitamins and minerals, special ingredients may be used to enhance growth, pigmentation or sexual development and to prepare diets having the required physical, palatability and preservation properties. Fish meal made from fish parts, such as waste from the fish processing and canning plants, has a lower percentage of high-quality protein than that of meal from whole fish. Quality protein in this may be low compared to *Spirulina* diet. The increase in cost and demand of feed-protein from conventional resources like fish meal and oilcakes necessitate fish culturists of developing countries to incorporate cheap and locally available ingredients in fish feeds. Some investigations have already been carried out on the incorporation of cheap ingredients in fish feed (Jackson et al. 1982). With few exceptions, feeding a single type of food is neither complete nor balanced and does not supply all the

nutrients a fish might need in its diet. A complete diet must be nutritionally balanced, palatable, water stable and have the proper size and texture. Hence, the present work has been designed to study the bioenergetics and biochemical parameters of the fish fed with *Spirulina* compared to a commercial feed available in the market and to evaluate the feed quality of *Spirulina* over the commercial feed.

MATERIALS AND METHODS

Cirrhinus mrigala, a commonly occurring freshwater major carp available in the local ponds and rivers, was selected for experimental studies. Fingerlings of *Cirrhinus mrigala* ranging in weight from 2-8 g and measuring 6-10 cm in length were procured from Aliyar reservoir in Coimbatore city. The collected fingerlings were maintained in rectangular glass aquaria and acclimatized to laboratory conditions ($27\pm 3^\circ\text{C}$). In the experiments three feeds T_1 , T_2 , T_3 were used (feed prepared with *Spirulina*) in different concentration of 0.25%, 0.5%, 1.0% respectively (Table 1). T_0 is the control which is a commercial feed available in the market.

During the period of experiment, the fish were fed with experimental feed two times a day. Each time a known quantity was issued. The experiment was continued for 60 days. Weight of the fish was noted on 15, 30, 45 and 60 days for each observation.

The sacrifice method (Maynard & Loosli 1962) was employed to determine the growth of the fish. Protein content of muscle and liver was estimated by the method of Lowry et al. (1951) using borine serum albumin as standard. The carbohydrate contents of muscle and liver were estimated by the method of Roe (1955) using glucose as standard. The lipid content of muscle and liver were estimated by the sulphophospho-vanilline method of Barner & Black (1973) using cholesterol standard. The data were subjected to Student 't' test and significance of difference between control and treatment groups were compared.

RESULTS AND DISCUSSION

The results of the study are shown in Fig. 1. Fish culture offers the greatest potential and substantial contribution to human nutrition. Growth pattern of fish is influenced by type and quantity of food. Analysis of feeding rate for 15th, 30th, 45th and 60th day showed an increased rate of 3.09% to 9.95%. This feeding rate is higher than that of commercial feed. Analysis of absorption rate showed an increase over the control from 2.12% to 8.00% due to adequate levels of indispensable amino acids.

Table 1: Feed formulations.

Sl. No.	Ingredients/ materials to be used	Quality of the material	% to be used		
			Feed A (T_1)	Feed B (T_2)	Feed C (T_3)
1.	Fish meal	50% CP	20	20	20
2.	Wheat flour	Soft flour	6	6	6
3.	Tapioca flour	Starch	10	10	10
4.	Soyabean meal	Veg. Protein	20	20	20
5.	De-oiled rice bran	Fibre source	22.25	22	21.5
6.	Wheat bran (Offal)	Fibre source	10	10	10
7.	Groundnut oil cake	Oil & Protein	10	10	10
8.	Mineral and vitamin	Complimentary	1.0	1.0	1.0
9.	<i>Spirulina</i>	Supplement	0.25	0.5	1.0
10.	Salt (NaCl)	Mineral source	0.25	0.25	0.25
11.	Vitamin E	Antioxidant	0.25	0.25	0.25

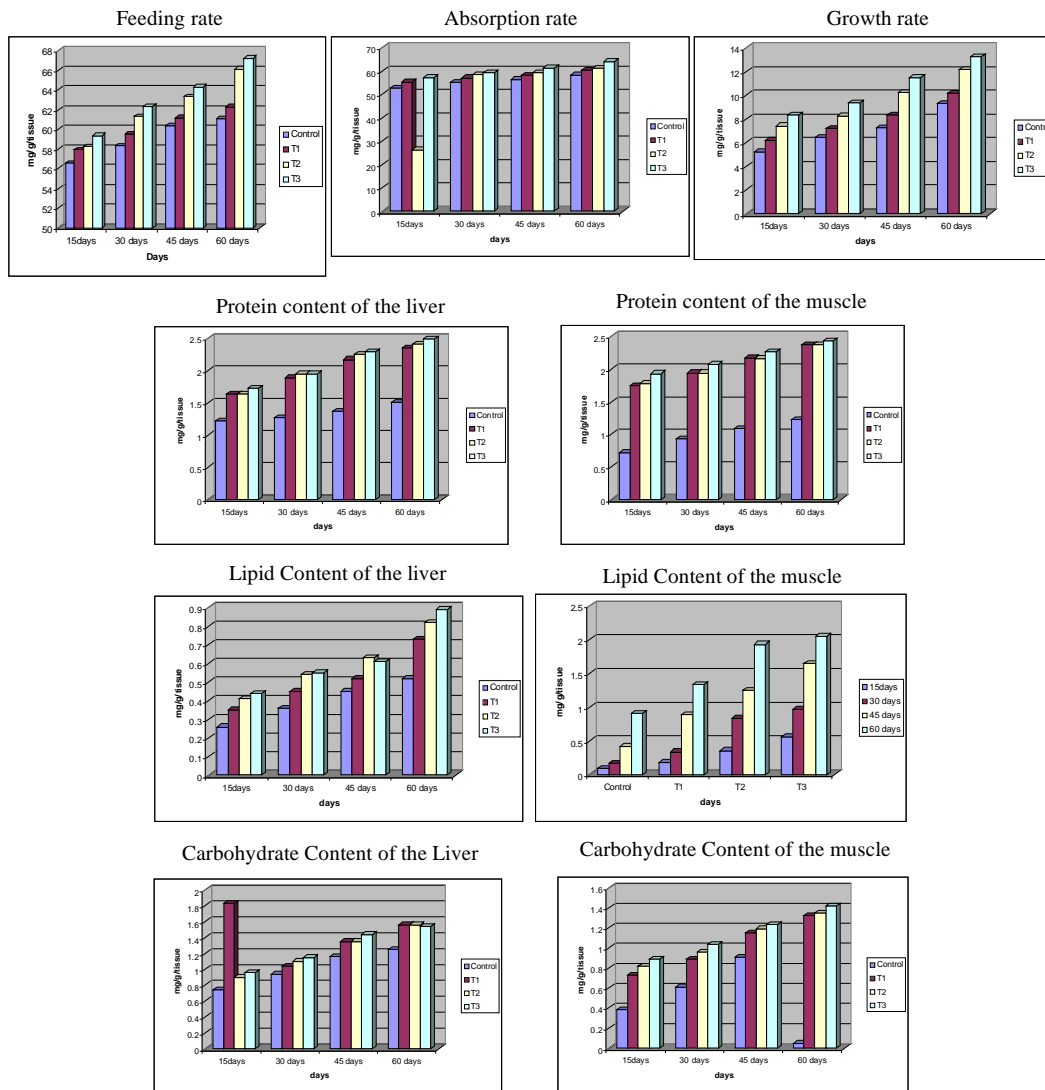


Fig. 1: Bioenergetic and biochemical parameters of the fish fed with *Spirulina* incorporated diet.

Spirulina incorporation in diet can reduce digestibility, increase absorption rate, and thereby increasing the growth rate from 15.83% to 56.69%. It was reported that *Spirulina* contains growth promoters in the form of unique polysaccharides (Parada et al. 1998). Results of the study indicate that growth rate and tissue composition of *Cirrhinus mrigala* is closely related to the quantity of diet at constant ratio (Mustafa & Jafri (1977)). In the present study all the diet levels with incorporated *Spirulina* meal exhibited weight gain compared to commercial diet. *Spirulina* is relatively high in protein with values ranging from 55-65% and induces all of the essential amino acids (Matsuno et al. 1974). Highly quality of the diet incorporated with *Spirulina* can increase the absorption rate thus increasing growth rate.

The percentage change in protein, carbohydrate and lipid content in muscle of fish fed with *Spirulina* diet vary from 85.11 to 73.57, 2.81 to 27.23 and 50 to 118.09 respectively. These values are very high when compared to commercial feed. The concentration of protein was found to be high in the muscle and liver of the experimental animals when compared to protein content in commercial feed. This increase may be due to the presence of high content of amino acids, which could have been inhibited by the fish (Sornaraj & Ranjit Singh 2005). Percentage changes in the carbohydrate content in muscle vary from 2.81% to 27.23%, and in liver from 6.41% to 10.79%. The increase in the carbohydrate content in the muscle is of significance, because the muscle of the fish needs carbohydrate for energy transformation, and it may be mobilized from the gills and liver (Kannan 1996, Periyasamy 1999).

Fat is not as readily utilizable substance as carbohydrate. The percentage change in lipid content varied from 9.38% to 54.72%, and in muscle from 50% to 118.09%. It suggests the lesser uptake of lipid components by tissues for utilization. The lipid content in liver and muscle of the fish fed with *Spirulina* also showed a significant increase over the lipid content in fish fed with commercial diet. It may be due to the low uptake of lipid component by tissue for utilization. In the absence of any appreciable difference in the carbohydrate quantity, the fat assumes more importance by increasing the overall calorific value of the diet and favouring growth (Majib-or-Rahman & Saleem 1989).

In the present study, efficacy of the diet incorporated with *Spirulina* and commercial feed was evaluated through food utilization and biochemical parameters. The increased food utilization and biochemical parameters in *Spirulina* incorporated feed over the commercial feed suggest that the former can be recommended for fish culture due to the feed quality and highly nutritive content.

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