

## Research Note

# Nutritional Status of Commercial Fish Feed Available in Tripura, India

S. Munilkumar<sup>\*1</sup>, A. Dey and S. C. Mandal

College of Fisheries, CAU, Lembucherra, Agartala, Tripura - 799 210, India

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Fish farming in Tripura, a small north eastern state of India, is an important source of protein and income for small-scale land owners. The importance of aquaculture can be gauged from the fact that aquaculture contributed about 95.55% of the annual average fish production of 15 440 t in the state during 1999-2004 (Nandeesh & Munilkumar, 2006). The important fish species being cultured in the state are rohu (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus mrigala*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*) and *Pangasius pangasius*. Most of the farmers practice extensive type of culture system where a very intensive stocking and multiple harvesting are practised throughout the year.

Absence of formulated feed affordable to the fish farmer is one of the factors which accounts for the poor fish productivity in the state. Most of the farmers in the state have small land holdings and mainly depend on the natural productivity of the pond and use fertilizers to boost the productivity but with no tradition of additional feeding. However, the excessive use of these inputs deteriorates the water quality (Boyd, 1992). To obtain high growth rates under field conditions, farmers have to feed the Indian major carps (IMC) with supplementary diets containing about 40% protein preferably of plant origin (Kalla *et al.*, 2004).

Edwards *et al.* (2000) emphasized that supplementary feeds should complement the

limiting nutrients in natural foods. In some ponds having turbid water, fertilizers alone may not be effective in stimulating natural food and supplementary or complete diets may be required. In ponds, in which only fertilizers have been used, the size of the fish is often smaller than in ponds where supplementary feeds or complete diets have been used. Presumably, larger fishes have difficulty in obtaining sufficient nutrition from plankton and other natural food items (Edwards *et al.*, 2000). As feed cost constitutes between 30 and 70% of the total operating expenditure, feeds and feeding practices are crucial elements in the successful operation of aquaculture.

Except for a few well established fish farmers, most of the farmers in Tripura are poor who cannot afford even minimum inputs. In view of these, the State Fisheries Department promote establishment of feed mills in the state through Self Help Groups (SHGs) with the financial support towards attaining self sufficiency in fish production. Fourteen such feed mills, equipped with pelletizer having a capacity of 10-20 kg h<sup>-1</sup>, have come up in each of the four districts in the state. The selling price of these feed range between Rs 12 and 15 kg<sup>-1</sup>. The Department also procures some of these feeds from the SHGs to distribute amongst the farmers to promote the use of feed. However, there is no reliable quality check for these feeds. Therefore, the present study was taken up to evaluate the nutritional status of the feed available in the state so that steps could be suggested for overall

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\* Corresponding author; e-mail: munilkumar@gmail.com

<sup>1</sup> Present address : Central Institute of Fisheries Education, Kolkata Centre, Salt Lake City, Kolkata - 700 091, India

improvement in the feed quality in cases where the quality is found to be below the acceptable standards.

Nine randomly selected feed samples were collected with the help of the State Fisheries Department from each of the nine different feed mills which are being operated by SHGs in the state out of the fourteen feed mills available. Each feed sample was representative of a single batch of feed manufactured by a single feed mill. The feed samples thus received were analyzed for proximate composition following AOAC (2000) with three replicates for each sample. Crude protein content was estimated using a semi automatic nitrogen analyzer (Kel Plus protein estimation system, Pelican), crude fat by Socs Plus solvent extraction system (Pelican) and crude fibre using Fibertech (Foss). The nitrogen free extract (NFE) which is equivalent to carbohydrate content in the feed samples was subsequently calculated as the difference between dry matter content (100%) and the sum of protein, fat, ash content and crude fibre in the dry matter (Henken *et al.*, 1986). The gross energy contents of the feed samples were estimated using the average caloric conversion factors of 39.54 kJ g<sup>-1</sup>, 20.08 kJ g<sup>-1</sup> and 17.15 kJ g<sup>-1</sup> for lipid, protein and carbohydrate respectively (Brett & Groves, 1979). Data were subjected to one-way analysis of variance (ANOVA) using SPSS version 16.0. Significant difference between the treatment means was determined using Duncan's multiple-range tests. Significance level was set at  $p < 0.05$ .

The feeds available were mostly in powder form which when delivered, act as manure only. It was found that the feed ingredients were not properly ground to get homogenous mixture (< 500 µm). Feed mixtures were often cooked before being fed to fish. Cooking destroys harmful bacteria and also helps to increase the digestibility of carbohydrate rich ingredients like broken rice and rice bran by gelatinizing the starch.

The percentage composition of the feeds was: rice bran (35%), wheat bran (10%), mustard oil cake (30%), soyabean powder (15%), dry fish (9%) and vitamin mix (1%). The composition was uniform throughout

the feed mills in the state as the feeds were prepared as per the feed formulation recommended by the Department of Fisheries, Tripura. Though these feed mills have pelletizers, most of the feed is distributed as powdered mixture which can be delivered in gunny bags in the ponds. The proximate composition of the feed samples and their calculated gross energy contents along with Protein to Energy ratio (PE) are presented in Table 1. The mean values of different parameters like crude protein, crude fat, crude fibre, moisture, ash, NFE, gross energy and PE ratio were significantly different among the nine different samples ( $p < 0.05$ ). The crude protein content ranged from 12.10 to 24.63% with an average of  $18.63 \pm 3.73\%$ . The range of crude fat content was 3.60 to 8.13% with an average of  $6.92 \pm 1.47\%$ . The crude fibre content ranged from 9.03 to 26.06% with an average value of  $13.04 \pm 5.88\%$ , whereas, the nitrogen free extract ranged from 29.17 to 39.37% with an average of  $35.57 \pm 3.57\%$ . There was significant difference among the crude protein, crude fat and crude fibre levels of the different feeds ( $p < 0.05$ ).

In pond conditions, the optimum dietary protein requirement levels for IMC ranges from 30-45% *viz.*, adults of IMC require 30% dietary protein while fingerlings and fry require 35 and 40% respectively for good growth and survival (Sen *et al.*, 1978; Renukaradhya & Varghese, 1986). Supplementary diets containing about 40% protein may have to be given to obtain higher growth rates (Kalla *et al.*, 2004). However, the feed available in the Tripura state with average crude protein content of  $18.6 \pm 1.01\%$  falls short of the optimum requirement in terms of crude protein to obtain good growth of IMC (Table 1). This may lead to poorer growth as observed by Chiu (1989) in carp fry feed containing 25% protein.

The range of crude fat content in the feed samples was 3.60 to 8.13% with an average of  $6.92 \pm 1.47\%$  which is on the lower side (Table. 1). The gross lipid requirement of IMC is 7 - 8% of the diet (Murthy, 2002). Lipids or fats act as a source of energy and essential fatty acids and also serve as a carrier for fat soluble vitamins.

Table 1. Nutritional quality of the fish feed manufactured in Tripura state, India

| Sample No. | Moisture (%)              | Crude Protein (%)         | Crude Fat (%)            | Ash (%)                    | Crude Fibre (%)            | Nitrogen Free Extract (%)  | Gross energy (kJ g <sup>-1</sup> ) | PE Ratio (mg protein kJ <sup>-1</sup> ) |
|------------|---------------------------|---------------------------|--------------------------|----------------------------|----------------------------|----------------------------|------------------------------------|-----------------------------------------|
| 1          | 8.77 <sup>c</sup> ± 0.15  | 19.60 <sup>d</sup> ± 0.30 | 6.83 <sup>c</sup> ± 0.25 | 18.10 <sup>e</sup> ± 0.10  | 10.70 <sup>bc</sup> ± 0.10 | 36.00 <sup>c</sup> ± 0.90  | 12.81 <sup>d</sup> ± 0.01          | 15.30 <sup>d</sup> ± 0.23               |
| 2          | 8.03 <sup>b</sup> ± 0.15  | 20.67 <sup>f</sup> ± 0.15 | 7.87 <sup>d</sup> ± 0.15 | 15.17 <sup>a</sup> ± 0.06  | 10.47 <sup>b</sup> ± 0.15  | 37.80 <sup>de</sup> ± 0.66 | 13.74 <sup>h</sup> ± 0.02          | 15.04 <sup>d</sup> ± 0.14               |
| 3          | 7.23 <sup>a</sup> ± 0.15  | 21.77 <sup>g</sup> ± 0.40 | 6.70 <sup>c</sup> ± 0.10 | 16.60 <sup>b</sup> ± 0.10  | 9.37 <sup>a</sup> ± 0.06   | 38.33 <sup>de</sup> ± 0.80 | 13.59 <sup>g</sup> ± 0.02          | 16.01 <sup>e</sup> ± 0.32               |
| 4          | 9.10 <sup>c</sup> ± 0.20  | 20.13 <sup>e</sup> ± 0.25 | 7.87 <sup>d</sup> ± 0.21 | 16.87 <sup>c</sup> ± 0.21  | 9.03 <sup>a</sup> ± 0.45   | 37.00 <sup>cd</sup> ± 1.31 | 13.50 <sup>f</sup> ± 0.10          | 14.92 <sup>d</sup> ± 0.29               |
| 5          | 8.37 <sup>b</sup> ± 0.15  | 17.53 <sup>c</sup> ± 0.15 | 5.47 <sup>b</sup> ± 0.35 | 20.00 <sup>f</sup> ± 0.20  | 9.27 <sup>a</sup> ± 0.06   | 39.37 <sup>e</sup> ± 0.90  | 12.43 <sup>c</sup> ± 0.02          | 14.10 <sup>c</sup> ± 0.11               |
| 6          | 10.47 <sup>e</sup> ± 0.25 | 17.17 <sup>c</sup> ± 0.06 | 8.00 <sup>d</sup> ± 0.10 | 15.37 <sup>a</sup> ± 0.06  | 10.47 <sup>b</sup> ± 0.15  | 38.53 <sup>de</sup> ± 0.61 | 13.22 <sup>e</sup> ± 0.06          | 12.99 <sup>b</sup> ± 0.10               |
| 7          | 9.77 <sup>d</sup> ± 0.15  | 24.63 <sup>h</sup> ± 0.21 | 8.13 <sup>d</sup> ± 0.12 | 17.30 <sup>d</sup> ± 0.10  | 11.00 <sup>c</sup> ± 0.20  | 29.17 <sup>a</sup> ± 0.76  | 13.17 <sup>e</sup> ± 0.05          | 18.71 <sup>f</sup> ± 0.23               |
| 8          | 9.67 <sup>d</sup> ± 0.25  | 12.10 <sup>a</sup> ± 0.20 | 3.60 <sup>a</sup> ± 0.10 | 16.80 <sup>bc</sup> ± 0.10 | 26.07 <sup>e</sup> ± 0.06  | 31.77 <sup>b</sup> ± 0.70  | 9.30 <sup>a</sup> ± 0.04           | 13.01 <sup>b</sup> ± 0.27               |
| 9          | 8.37 <sup>b</sup> ± 0.25  | 14.07 <sup>b</sup> ± 0.15 | 7.80 <sup>d</sup> ± 0.20 | 16.60 <sup>b</sup> ± 0.20  | 21.00 <sup>d</sup> ± 0.10  | 32.17 <sup>b</sup> ± 0.90  | 11.42 <sup>b</sup> ± 0.05          | 12.32 <sup>a</sup> ± 0.18               |

Data represent the Mean ± Standard deviation of three replicates. Mean values with different superscript letters in a column are significantly different ( $p < 0.05$ )

The nitrogen free extract of the feed samples was in the range of 29.17 to 39.37% with an average of  $35.57 \pm 3.57\%$  (Table 1). This was found to be more than the optimum level as a dietary level of 22 - 30% of carbohydrate has been found to be optimum for growth of IMC (Murthy, 2002). The carbohydrates present in feed or feed stuff contain two fractions, the crude fibre and the nitrogen free extract. Growth retardation and reduced feed efficiency was observed when the carbohydrate level exceeds 35% in the diet (Murthy, 2002).

The crude fibre content in the present study ranged from 9.03 to 26.06% with an average value of  $13.04 \pm 5.88\%$  (Table 1). Though optimum level of crude fibre is beneficial in improving the utilization of certain nutrients (New, 1996), level as high as 24% has deleterious effect on fish health. Intake of some feeds having more than 26% crude fibre content, may result in poor growth as commonly observed in fish fed with feeds containing high proportions of plant proteins which led to a decrease in feed intake resulting from reduced feed palatability (Gomes *et al.*, 1995).

The gross energy content of the feeds ranged from 9.30 to 13.74% kJ g<sup>-1</sup> with an average value of  $12.58 \pm 1.36$  kJ g<sup>-1</sup> (Table 1). A minimum dietary gross energy level of 15 kJ g<sup>-1</sup> is considered essential for efficient

nutrient utilization in mrigal while for juveniles of rohu, 16 kJ g<sup>-1</sup> gross energy or a PE ratio of 22 mg kJ<sup>-1</sup> is reported to be optimal for growth and feed efficiency (Mukhopadhyay, 2001). When sufficient energy sources such as lipids and carbohydrates are available in the diet, most of the ingested protein is utilized for protein synthesis thereby resulting in better growth (Murthy, 2002). However, energy content less than the optimum in the feeds may result in non availability of protein for optimum growth.

The PE ratio ranged from 12.32 to 18.71 mg protein kg<sup>-1</sup> (Table 1). Optimum PE ratios for carp fry and fingerling are 27.0 and 22.7 mg protein kJ<sup>-1</sup> respectively (Mohanty, 2001). The optimum PE ratio in the diet is very important for growth and to reduce the feed cost. The lower PE ratio in the present study indicates the shortage of protein as a source of energy in the feeds indicating the poor quality of the feed.

The feeds that are being prepared by different SHGs in Tripura contain less than optimum crude protein required by the IMC. The main reasons being the non availability of quality fish meal and high cost (Rs 50-180 kg<sup>-1</sup>) which needs to be procured from far off places. As most of the farmers are poor, they could not afford the costs of feed.

Adoption of simple measures can improve the overall quality of the feeds. It

is preferable to process the feed in the form of compressed pellets through mincers. The process of grinding, mixing and mincing can increase the feed efficiency by ensuring that the individual food particles are of a suitable size for effective intake and digestion. As the nutritional quality of the feeds available in Tripura was not as per the nutritional requirements of the Indian major carps, the regular application of manure and fertilizers is a must in the present scenario.

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