# EFFECT OF FEEDING THREE DIFFERENT FORMULATED FEEDS HAVING DIFFERENT PROTEIN LEVELS ON THE GROWTH OF ANGEL FISH (*PTEROPHYLLUM SCALARE*) JUVENILES

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## ABSTRACT

**Experiment was conducted to study the effect of dietary protein level on growth and nutrient utilization by angel fish (*Pterophyllum scalare*) juveniles. Fifty-four juveniles (average wt. 2-2.5g) were equally divided in three treatments with each of three replicates. Three formulated diets with graded protein levels, T1 (35% CP), T2 (40% CP) and $T_3$ (45% CP) were fed to juveniles for 45 days. A trend of higher weight gain %, SGR, FER and PER was found with the increased CP level in the feed. Feed intake was similar in all the groups. $T_3$ group fed with 45% CP registered highest weight gain % (43.26 ± 2.07), SGR (0.78 ± 0.04), FER (0.29 ± 0.01), which were significantly higher ($P< 0.05$) than the $T_1$ and $T_2$ groups. Protein digestibility of $T_2$ and $T_3$ groups was significantly higher than the $T_1$ group. Survival was similar in all the experimental groups. Diet with 45% CP with protein energy ratio of 112.62 mg protein/K cal is ideal for juvenile angel fish for indoor rearing.**

**Keywords: Angel fish, Feed, Protein, Growth, digestibility, tissue composition**

## INTRODUCTION

There is a growing demand for ornamental fishes in several parts of the world. Major exporting countries of ornamental fishes in Asia are Singapore, Philippines, Indonesia, Maldives, Thailand and Hong Kong. In India, even though the potential for expanding this trade is very high, lack of availability of artificial feed is a major bottleneck for its expansion. Feeding natural feed is practically impossible for large scale ornamental fish production.

A variety of feeds have been developed and manufactured for ornamental fish. Most brands of commercially feeds used for freshwater ornamental fishes are of general type and are formulated to meet the maintenance needs of a large groups of

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fishes. This strategy makes sense from the feed manufacturer's point of view because they want to attract a large number of consumers for their products. Such feeds may not support the nutritional requirement of all the fishes. Unlike food fishes, ornamental fishes are not given due consideration for their growth as survival is the major criteria considered for this trade. Though there is demand of feed for ornamental fish, very little information is actually available about the nutritional requirements of the various cultured ornamental fishes.

Angelfish belongs to family Cichlidae and genus *Pterophylium*. Out of three species recorded under the genus *Pterophlium, P. scalare* (Liechtenstein 1823), is the most popular and available member of the family Cichlidae. Both the silver and a myriad of artificially selected color and finnage varieties are commercially produced. These Cichlids make a magnificent solo display, but there is no practical reason for excluding other fishes from their aquarium.

The main objective of the present study was to study the nutritional efficacy of three formulated feeds prepared with three protein levels on growth and survival and nutrient utilization of angelfish *P. scalare*.

## MATERIAL AND METHODS

The experimental set up was maintained in the wet laboratory of the Aquaculture Division for a period of 45 days.

*P. scalare* juveniles were treated with 3% common salt for 15 min in a quarantine tank and then transferred to a 250 L tank containing chlorine free water. The juveniles were acclimatized for 15 days with a practical diet. Round the clock aeration was provided to maintain the DO level.

Uniform size angel fish (average wt. 2-2.5 g) juvenile were equally divided in three treatments ($T_1$, 35% CP; $T_2$, 40% CP and $T_3$, 45% CP). Each tank was stocked with six juveniles containing 75 L water. There were three replicates for each treatment.

Three feeds were prepared with 35% ($T_1$), 40% ($T_2$) and 45% ($T_3$) crude protein level. The ingredient compositions used in these feeds are shown in Table 1. All the ingredients were collected from the local market in dry condition. The ingredients then powdered and evenly mixed. Pellet feeds were prepared with extruder by fixing a 2 mm die. The prepared feeds were first sun dried followed by oven drying at 60$^0$C. The feeds were kept in air tight polythene bags until further use.

Fishes were fed the diet at 5% of their body weight at the starting of the experiment and then reduced gradually based on daily observation. The daily ration was divided into two equal parts and was fed at 10.00 A.M and 6.00 P.M.

Water quality parameters *viz.*

**Table 1: Ingredients (%) of the formulated angel fish feeds.**

| Ingradients | Treatments | | |
|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ |
| *Acetes* meal | 16 | 26 | 34 |
| Fish meal | 22 | 27 | 40 |
| Soyabean meal | 26 | 21 | 5 |
| Wheat bran | 15 | 8 | 5 |
| Wheat flour | 15 | 12 | 10 |
| Oil | 3 | 3 | 3 |
| Vit-Mineral mix | 2.8 | 2.8 | 2.8 |
| Glycine | 0.2 | 0.2 | 0.2 |
| **Proximate Composition** | | | |
| Crude Protein | 34.60 | 39.20 | 44.70 |
| Ether Extract | 4.10 | 5.00 | 6.20 |
| Ash | 3.54 | 3.46 | 3.25 |
| Total Carbohydrate | 57.76 | 52.34 | 45.85 |
| Digestibility energy (K. cal) | 392.40 | 394.16 | 396.92 |
| Protein Energy Ratio (mg protein / K. cal) | 88.17 | 99.45 | 112.62 |

*Digestibility energy (K. cal) = (9 x lipid %) + (4 x proteinA) + (4 x carbohydrate %)*

*Composition of vitamin mineral mix (EMIX PLUS) (quantity/2.5kg)*

*Vitamin A 55,00,000 IU; Vitamin $D_3$ 11,00,000 IU; Vitamin $B_2$ 2,000 mg; Vitamin E 750 mg; Vitamin K 1,000 mg; Vitamin $B_6$ 1,000 mg; Vitamin $B_{12}$ 6 mcg; Calcium Pantothenate 2,500 mg; Nicotinamide 10 g; Choline Chloride 150 g; Mn 27,000 mg; I 1,000 mg; Fe 7,500 mg; Zn 5,000 mg; Cu 2,000 mg; Co 450 mg; Ca 500 g; P 300g; L- lysine 10 g; DL- Methionine 10 g; Selenium 50 ppm; Selenium 50 ppm; Satwari 250 ppm; (Lactobacillus 120 million units and Yeast Culture 3000 crore units).*

temperature, pH, dissolved oxygen, free carbon dioxide, ammonia-N, nitrite-N and nitrate-N were estimated every week. Optimal water quality in the experimental tanks were maintained by changing at least 50% fresh chlorine free bore well water each day. The water quality parameters were analysed once in 15 days as described by APHA (1985).

The proximate analysis of feed and tissue viz. moisture, crude protein, ether extract, total carbohydrate and ash were

done by prescribed method of AOAC (1990).

Fishes were weighed every 15 days to access the growth parameters. Fishes were starved overnight before taking the body weight. The growth indices were calculated as follows.

Feed Conversion Ratio (FCR) = quantity of dry feed given / wet weight of fish

Specific Growth Rate (SGR) = $[(\ln W_f - \ln W_i)/ t_2 - t_1] \times 100$

where $W_f$ = final maen weight, $W_i$ = initial mean weight and $t_2 - t_1$ = duration of the experiment (45 days).

Protein efficiency Ratio (PER) = weight gain/ protein fed

Feed Efficiency Ratio (FER) = wet weight of fish/quantity of dry feed given.

The digestibility of the test diets was carried out by indirect method using chromic oxide as marker. The diets were prepared by incorporating 1% chromic oxide ($Cr_2O3$) in the diet fed to fish during the last twenty days of the experimental period.

Faeces were collected after initial feeding of three days. Fishes were fed to satiation once daily. Faeces were collected in the morning by siphoning out the water by using a small diameter plastic pipe through a mesh strainer and dried in an oven at $105^0$ C to constant weight. For individual group, daily faeces collection were pooled, finely ground and stored freezer at $4\ ^0$C until further analysis.

The chromium content of the feed and faecal matters was estimated by using Atomic Absorption Spectrometer (AOAC, 1995). Wet digestion of the sample was carried out according to AOAC (1995). A sample of 2.5 gm was taken in a Kjeldhal flask to which nitric acid and perchloric acid was added at the ratio of 2.5:1 with gentle boiling by flame as necessary, until the solution is colorless. Then it was cooled and the volume was made up to 250 ml with distilled water, filtered and stored in a plastic bottle. This sample was used to estimate the chromium content by flame ionization Atomic Absorption Spectrophotometer (AAS 4129, Electronics Corporation of India Limited) using chromium cathode lamp (357.9 nm).

The digestibility of dry matter expressed as a percentage is calculated using the following formula: ADC = 100 – 100 (% Cr in feed / % Cr in faeces)

All the statistical analysis was performed by using the software SPSS (version 11). Significant differences among treatment groups were tested by one-way analysis of variance (ANOVA) and the comparison of any two mean values were done by Duncan's Multiple Range Test (DMRT).

## RESULTS AND DISCUSSION

Water temperature, pH, DO, $CO_2$, ammonia- N, nitrite- N and nitrate- N in the experimental tank are given in Table 2.

The body composition of fish is shown in Table 3. There was not significant (P>0.05) difference in fish fed different diet changing dietary protein level. Weight gain % significantly

**Table 2: Water quality parameters during feeding trials.**

| Water quality parameters | Treatments | | |
|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ |
| Temperature | 30.00 – 30.30 | 29.90 – 30.00 | 29.90 – 30.00 |
| $P^H$ | 8.04 – 8.25 | 8.22 – 8.30 | 8.22 – 30.00 |
| DO | 7.27 – 7.55 | 7.21 – 7.33 | 7.07 – 7.37 |
| $CO_2$ | Nil | Nil | Nil |
| Ammonia- N (mg/ml) | 0.17 – 0.24 | 0.17 – 0.19 | 0.14 – 0.32 |
| Nitrite- N (mg/ml) | 0.001 – 0.003 | 0.001 – 0.003 | 0.001 – 0.003 |
| Nitrate- N (mg/ml) | 0.02 – 0.05 | 0.02 – 0.04 | 0.02 – 0.05 |

**Table 3: Body composition and growth parameters of angel fish (% DM) fed different experimental diets for 45 days (Mean ± SE)**

| Body Composition | Treatments | | |
|---|---|---|---|
| | $T_1$ | $T_2$ | $T_3$ |
| Moisture | 72.92 ± 2.62 | 72.98 ± 2.12 | 74.28 ± 3.23 |
| Crude protein | 59.78 ± 0.20 | 59.75 ± 0.58 | 59.54 ± 0.91 |
| Ether extract | 10.47 ± 0.07 | 10.54 ± 0.20 | 10.42 ± 0.27 |
| Total carbohydrate | 10.47 ± 0.13 | 10.49 ± 0.15 | 10.42 ± 0.09 |
| Ash | 19.31 ± 0.23 | 19.22 ± 0.52 | 19.62 ± 0.75 |
| **Growth Parameters** | | | |
| Feed intake (g) | $17.56^a$ ± 0.38 | $18.24^{ab}$ ± 1.14 | $20.42^b$ ± 0.30 |
| Wt. gain (%) | $21.93^a$± 1.46 | $32.44^b$ ± 3.09 | $43.26^c$ ± 2.07 |
| SGR | $0.44^a$ ± 0.03 | $0.62^b$ ± 0.05 | $0.78^c$ ± 0.04 |
| FCR | $5.81^a$ ± 0.38 | $4.18^b$ ± 0.30 | $3.42^b$ ± 0.14 |
| FER | $0.17^a$ ± 0.1 | $0.24^b$ ± 0.09 | $0.29^c$ ± 0.01 |
| PER | $0.50^a$ ± 0.03 | $0.62^{ab}$ ± 0.04 | $0.69^b$ ± 0.04 |
| Digestibility (%) | $71.00^a$ ± 2.43 | $82.72^b$ ± 2.45 | $83.35^b$ ± 2.54 |
| Survival (%) | 100 | 100 | 100 |

($P<0.05$) varied among all the treatment groups (Table 3). Highest weight gain % was found in $T_3$ group (43.26 ± 2.07) and lowest in $T_1$ group (21.93 ± 1.46). Same trend was found for SGR. As the crude protein level in feed increased, weight gain % increased. This suggests angel fish juvenile require high protein in the diet. Protein requirement of growing fish are generally more (De Silva and Anderson, 1995) which is true for angel fish also. Tacon and Cowey (1985) found a positive correlation between SGR and dietary protein requirement. Growth rate of young fish is dependent on the daily intake of protein to maintain their requirement. De Silva *et al.* (1991) and Silver *et al.* (1991) correlated growth rate to the daily protein consumption irrespective of the dietary lipid content in red tilapia and Chinook salmon, respectively. Olvera-Novoa *et al.* (1996) also reported higher weight gain and SGR in other cichlids, *Cichlasoma synspilum* for diet containing more than 40% crude protein.

FCR trend was same as that of weight gain %. FCR value decreased gradually with the increased protein level of the feed indicating better utilization of feed by juveniles at higher protein level. This is confirmed from the higher digestibility of dry matter at 40 or 45% crude protein in feed. However, there was no significant difference ($P>0.05$) between $T_2$ (40% CP) and $T_3$ (45% CP) groups. Steffens (1981) and Jauncy (1982) found that best FCR recorded at certain protein level after which it increases. This is due to wider gap between protein and energy content of feed. In the present experiment dry matter digestibility was similar both at 40 and 45% CP.

PER of $T_2$ and $T_3$ groups were similar and higher than $T_1$ group. Higher protein in the diet increases the PER until protein requirement is fulfilled. Olvera-Novoa and Gasca-Leyva (1996) also reported similar results for other cichlids, *Cichlasoma synspilum*. From the present results it explains that protein requirement was satisfied at 45% CP with protein and energy value of 112.62 (mg protein/K.Cal DE). There was no mortality recorded in any of the experimental groups explaining no adverse effect of pelleted feed on juvenile of angel fish.

From the above experiment it conclude that a pelleted feed of 45% CP with protein energy ratio of 112.62 (mg protein/K.Cal DE) is optimum for indoor rearing of angel fish juveniles.

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## REFERENCE:


**AOAC., 1990.** *Official methods of association of official analytical chemist*, 15th ed. Assoc. OfficialAnalytical Chemists Inc., Arlington, 1298p.

**AOAC., 1995.** *Official Methods of Analysis of AOAC International*, Vol. 1, 16th edn. (ed. Cunniff, P. A.). AOAC International, Arlington, USA.

**APHA., 1985.** *Standard Methods for Examination of Waste water*, 16th ed. Am. Public Health Assoc., Inc., Washington, DC, 1268p.

**De Silva, S. S., and Anderson, T. A., 1995.** *Fish Nutrition in Aquaculture*. Chapman and Hall Aquacult. Ser. 1, London. 319 p.

**De Silva, S. S., Gunasekara R. M. and Shim, K. F., 1991.** Interaction of varying dietary protein and lipid levels in young red tilapia: evidence of protein sparing. *Aquaculture*, **95**:305-318.

**Jauncy, K., 1982.** The effect of varying dietary protein level on the growth, food conversion, protein utilization and body composition of juvenile tilapia (*Sarotherodon mossambicus*). *Aquaculture*, **27**: 43-54.

**Olvera-Novoa, M. A., Gasca-Leyva, E. and and Martinez-Palacios, C. A., 1996.** The dietary protein requirements of *Cichlasoma synspilum* Hubbs, 1935 (Pisces: Cichlidae) fry. *Aquaculture Research*, **27**:167-173.

**Silver, G. R., Higgs D. A., Dosanjh B. S., Mckeown, B. A., Deacon, G. and French, D., 1991.** Effect of dietary protein to lipid ratio on growth and chemical composition of Chinook salmon (*Oncorhynchus tschawytscha*) in sea water. In: S. J. Kausik and P. Luquet (eds.). *Fish Nutrition in Practice*. Institute National de la Recherche Agronomique, Paris, France., pp. 459-468.

**Steffens, W., 1981.** Protein utilization of rainbow trout (*Salmo gairdneri*) and carp (*Cyprinus carpio*): a brief review. *Aquaculture*, **23**: 337-345.

**Tacon, A. G. J. and Cowey, C. B., 1985.** *Protein and amino acid requirements. In:* P. Tytler and P. Calow (eds.). *Fish Energetics: New Perspectives*. Croom Helm, London, pp 155-183.