

Impact of Formulated Diets on the Growth and Survival of Ornamental Fish *Pterophyllum Scalare* (Angel Fish)

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Abstract

A feeding trail was conducted on juvenile of angel fish *Pterophyllum scalare* to investigate the effect of three different diets such as animal based protein, plant based protein and mixed protein on growth and survival rate of the fish. Juvenile *Pterophyllum scalare* were divided into three groups, fed with three different protein based diets along with control group. Before the feeding trail, the initial length and weight were measured. During the 4 weeks of experiment, fish were fed 3% body weight at a daily rate. The findings of the present study indicated that the growth and survival rate of angel fish *Pterophyllum scalare* varied significantly ($P < 0.05$) with different protein based diets compared with control fish group. Fish fed with animal based protein diet showed better growth performance in terms of length and weight (19.3 ± 0.72 mm and 0.13 ± 0.01 mg) respectively and better survival rate (92%) than those fed with other protein diets ($P < 0.05$). The fish fed with mixed protein diet showed higher specific growth rate (0.43%) than other diets provided. This study clearly demonstrates that animal based protein diet can be used as formulated feed for angel fish without any adverse effect on fish growth.

Keywords: *Pterophyllum scalare*; Animal based protein; Plant based protein; Growth performance

Introduction

The fresh and marine water ornamental fish production and trade is a profitable alternative in the aquaculture sector [1]. Apart from the economic importance, the nutritional strategy for ornamental fish is scanty and often few or even no data of the nutritional requirements is available [1,2]. According to Lovell [3], fish can regulate and maintain their food intake in natural conditions and therefore their nutritional requirements, reducing the possibility of suffering nutritional deficiencies; however, this problem can be observed when the fish are subject to confinement conditions. Most of the information is not specific to ornamental fish because it has been based on results from farm fish kept under different farming conditions, nutritional requirements and feeding habits. Therefore, the limited information about nutrient digestibility in ornamental fish increases the maintenance costs and the water pollution (Sales and Janssens). Nutrition is one of most important factors influencing the ability of cultured fish to exhibit its genetic potential for growth and reproduction. They are also greatly influenced by factors such as behavior of fish, quality of feed, daily ratio size, feed intake or water temperature. In contrast to the culture of edible fish, information on the dietary requirements and feeding practices of ornamental fishes are limited [4-7]. Angel fish (*Pterophyllum scalare*) a cichlid is in great demand due to its elegance, reproductive capacity and adaptability to captivity with high economic value [8]. In the wild the angelfish is found in the central Amazon River of Brazil and tributaries into Peru, Colombia, Guyana, French Guiana and eastern Ecuador. They inhabit swamps or flooded grounds where the aquatic vegetations are dense and the water is either clear or silty. The aim of this study was to evaluate the impact of formulated feeds (animal based protein, plant based protein and mixed protein) on growth and survival of angel fish.

Materials and Methods

Experimental fishes

Juvenile of *Pterophyllum scalare* (Angel fish) used in this experiment were procured from a commercial ornamental fish farm, Kulathoor, Chennai. The animals were acclimatized for 1 week to the experimental conditions and diets. Before the experiment, the fishes were starved for 24h. Thirty juvenile (for each experimental group) angel fish were randomly selected with an average weight 0.05 ± 0.01 mg and length 0.99 ± 0.08 mm and stocked into each aquarium fibre tanks ($80 \times 30 \times 40$ cm) with three replicates and gentle aeration was provided by air stones. During the experiment, the water quality parameters were maintained and mean values for temperature, dissolved oxygen, pH and salinity were $27 \pm 2^\circ\text{C}$, pH 6.5–7.8, and 0.2 mg/l, respectively. The photoperiod used was 12h light/12h dark cycle. The length and weight of the each fish was taken after completion of the experiments.

Cleaning and siphoning

To maintain hygienic condition and prevent pollution caused by remaining food and faeces, the aquarium were cleaned every day prior to feeding time in morning by siphoning out the excreta and 80% of the water was exchanged to prevent sudden increase in water temperature as the experiment was conducted in summer months. The dead fish, if any, were removed and recorded for calculating the survival rate.

Experimental diet and feeding

Three types of formulated diets were prepared (animal based protein, plant based protein and mixed protein) in the feed mill and were evaluated against control diet (Kayal plus). The composition and

proximate analysis of the diets are given in Tables 1 and 2. Proximate compositions of feeds were analyzed following the standard methods as described in AOAC [9]. The diets were offered twice a day (morning and evening) for 30 days. All groups of fish were fed daily at 3% BW in two instalments at 08:00 and 16:30 hours (30 days for all the experiments). Fishes were exposed to the diet for 3h during each ration thereafter the uneaten feed was siphoned out, stored and weighed for calculating feed conversion ratio (FCR). Fish were bulk weighed at an interval of 15 days with feeding ration adjusted accordingly. Uneaten feed was siphoned out and stored separately for calculating FCR.

S.No.	Ingredients	Animal Protein Based Feed	Plant Protein Based Feed	Mixed (plant + animal) protein Based Feed
1	Fish Meal	400	-	200
2	Soya Meal	-	400	200
3	Wheat Floor	400	400	400
4	Corn Floor	100	100	100
5	Starch	150	150	150
6	Fish Oil	40	40	40
7	Vitamins	5	5	5
8	Minerals	5	5	5

Table 1: Composition of Animal protein and plant protein based formulated feed (gm/kg)

Parameters	Animal Protein Based Feed	Plant Protein Based Feed	High Protein Based Feed	Low Protein Based Feed
Moisture	7.6	8.2	10.3	9.9
Protein	38.9	24.5	37.1	24.6
Lipid	15.7	11.9	6.1	4.2
Carbohydrate	11.1	8.2	12.5	14.9

Table 2: Proximate Composition of different formulated feed (%)

Growth performance

The growth performance, specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER) for each group was determined by Olmedosanchez et al. [10]. Specific growth rate (SGR) = $(\ln \text{ Final weight} - \ln \text{ Initial weight}) \div \text{No of days in trial} \times 100$ Feed conversion ratio (FCR) = $\text{Feed given (dry wt)} \div \text{Weight gain (wet weight)}$ Protein efficiency ratio (PER) = $\text{wet weight gain by fish (g)} \div \text{Protein intake (g)}$ Statistical Analysis Data are presented as mean \pm SD. Statistical significance of data were analyzed following one-way ANOVA and Duncan's multiple range tests were used to compare differences among individual means [11]. All the results were treated significant at the 5% level. The statistical package used for the analysis of data was SPSS 16 ver.

Results and Discussion

Fish growth is a complex process governed by many parameters like fish species, nutrients present in the feed, feed additives and rearing environment, individually or in combination. The growth parameters like percentage of weight gain, food conversion ratio (FCR), feed efficiency ratio (FER) and specific growth rate (SGR) were recorded.

In the present study, selected protein based experimental diets were eagerly consumed by three fish groups. Overall growth performances of angel fish fed with different experimental diets are shown in Table 3. One way ANOVA showed significant differences in length and weight of the angel fishes when fed with different formulated diets at $P < 0.05$ level. Juvenile total length (19.3 ± 0.72 mm) and weight gain (0.13 ± 0.01 mg) were significantly high in animal based protein diet followed by mixed protein diet (19.2 ± 0.77 mm and 0.13 ± 0.01 mg), Plant based protein diet (12.4 ± 1.45 mm and 0.02 ± 0.01 mg) and control (19.2 ± 0.68 mm and 0.13 ± 0.01 mg). The fish fed with mixed protein diet showed higher specific growth rate (0.43%) than other diets. Lower specific growth rate (0.1%) was observed in plant based diet (Table 3).

S. No	Experimental diets	Total Length (mm)	Weight gain (mg)	SGR
1	Control	19.2 ± 0.68^{ab}	$0.13 \pm 0.01 \text{ mg}^{ab}$	0.43
2	Animal based protein diet	19.3 ± 0.72^{ab}	$0.13 \pm 0.01 \text{ mg}^{ab}$	0.36
3	Plant based protein diet	12.4 ± 0.77^a	0.02 ± 0.01^a	0.1
4	Mixed protein diet	19.2 ± 0.77^{ab}	0.13 ± 0.01^{ab}	0.43

Table 3: Growth performance of angel fish (*Pterophyllum scalare*) fed in experimental diets. Each value is the mean \pm SD of three observations.

Groups with different alphabetic superscripts differ significantly at $P < 0.05$.

Angel fish fed on different formulated diets viz., animal based protein diet, plant based protein diet and mixed protein diet showed significantly high survival rate 92%, 80% and 91%, respectively, and low survival rate (76%) was noticed in control diet during 30 days of experimental period. The survival rate of angelfish significant differs with different experimental diets (Figure 1).

In the present study, the inadequate micro and macro nutrients of the plant based protein diet fed fish group exhibit minimum length and weigh; therefore, plant protein based ingredients is not desirable to the juveniles of angel fish. The level of protein content, lipids as well as essential amino acids and fatty acids might not be at sufficient level in the plant protein based diet. Sajad Hassan [12], reported that, some of the anti-nutritional factors are present in the plant protein based diet and also not easily digestible by the monogastric animals like fishes.

The protein efficiency ratio was moderately higher in 34% CP (Crude Protein) containing diets fed fish groups whereas gradual decreases of PER was noted in 30 and 26% CP comprised diets fed fish groups meanwhile there are no significant differences observed for the productive performance parameters among protein and energy levels Zuanon et al. [6]. Similarly, Ribeiro et al. [4] reported that protein efficiency ratio was not showing significant difference on freshwater

angelfish fry fed diets with 26, 28, 30 and 32% CP, this may be associated with decreases in the amounts of nitrogen wasted by fish into the water [13], which are especially important for ornamental fish, which are frequently raised in small tanks.

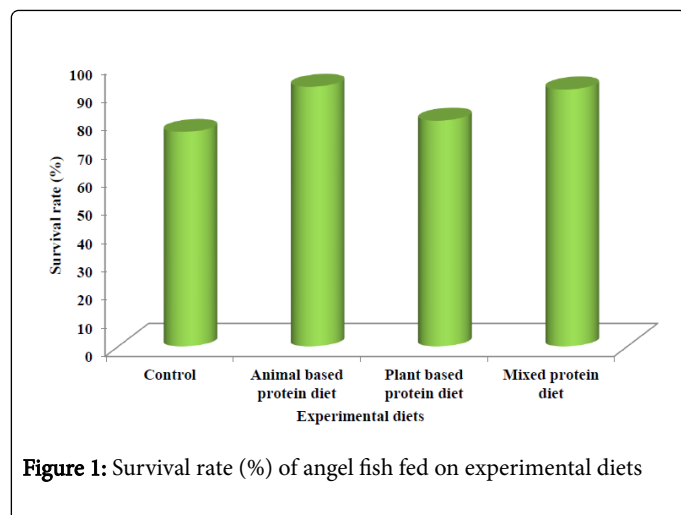


Figure 1: Survival rate (%) of angel fish fed on experimental diets

The weight gain values obtained in the present study showed variation compared to the observation of Rodrigues & Fernandes [5] and Luna-Figueroa [14] for the same species. This variation in weight gain for the same species may be related to factors including quality of the protein used (amino acid composition and digestibility), feeding frequency, amount of diet supplied and the animal development stage. The low values observed for the specific growth rate (SGR) of fish from the present study can be explained by the fish development phase, since the SGR decreases as fish increases in size [15]. Higher SGR values were reported by Luna-Figueroa [2], Rodrigues & Fernandes [5] and Zuanon et al. [6] (4.34, 2.04 and 2.47% per day, respectively), for fish of the same species, but smaller sizes than the fish from the present study.

Leger et al. [16] explained clearly in his review that, selection of fish diet ingredients and the ingestion of food by fish is probably affected by its size and palatability. Size is thereby considered as one of the most important aspects. As food preference is closely related to the match between food and mouth size, the selected food changes with the growth of fish [17]. Ulloa and Romero [8], while evaluating the different commercial diets on growth and survival of *P. scalare* juveniles under controlled conditions reported that the differences in size and presentation, all tested diets were consumed by fish at the different sampling times registered along the experiment, and consequently, at different growing stages (from 1.65 ± 0.21 to 3.12 ± 0.34 mm of mean initial and final standard lengths, respectively). In the case of the latest, the relationship between digestibility and biochemical composition of diet is considered as a crucial selecting criterion. Due to its high affinity to be metabolized and retained, protein is considered the most important energy component for fish growth by Halver [18]. In the case of cultured carnivorous fish, dietary protein requirement usually accounts for 40 to 50% of feed dry matter [19]. The findings of present feeding experiment of angelfish suggest that animal based protein can be used as formulated feed for effective rearing of angel fish. The present study also suggests that animal based protein along with plant based protein can be used without any adverse effect on fish growth and survival rate.

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