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Research Article

EVALUATION OF GROWTH PERFORMANCE OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*) USING FEED PREPARED FROM ANIMAL BYE PRODUCT

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Abstract: A comprehensive trial of 90 days duration was undertaken to assess the effect of two types of low cost non-conventional fish feed prepared from animal bye product on biomass conversion rate as well as on gonad (ovarian) weight in Nile tilapia, *Oreochromis niloticus*. Two groups of juvenile fish (average weight 5.2 g; average length 4.5 cm) were fed with two different types of feeds with slaughter house offal meal (SOM) and hydrated poultry feather meal (PFM). These fish feeds were isonitrogenus (30 g 100 g^{-1}) and isocaloric (4 Kcal g^{-1}) in nature. The SOM made with dry slaughter house offal dust, rice bran, mustard oil cake and eggshell powder proved to be the better than the PFM. Significant difference (P<0.05) in body weight gain, feed intake (FI), feed conversion ratio (FCR), protein efficiency ratio (PER) and gonadosomatic index (GSI) were observed between the fish fed with SOM and PFM diets. No significant differences (P<0.05) in hepatosomatic index was observed. Between the dietary treatment groups, significantly lower (P<0.05) moisture content of body and higher whole-body protein were also found in SOM diet. The slaughter house offal possibly contained superior quality protein which in turn influenced somatic as well as reproductive growth of those fish. The study suggests that the SOM diets, which led to significantly higher (P<0.05) growth and nutrient utilization than the other diet in tilapia, *O. niloticus*, may be used for pond culture of this species.

Key words: *Oreochromis niloticus*, non-conventional, biomass, gonad, isonitrogenous and isocaloric.

Introduction

Feed is the most expensive item in fish farming which generally constitutes 60–70% of the operational cost in intensive and semi-intensive aquaculture system[1]. The need to minimize feed cost through the use of newer, cheaper and nonconventional sources of feed ingredients, has already been considered. Incorporating of such feed ingredients in fish feed will play a major role in matching its ultimate nutritional quality in addition to economic success. Generally, in third world countries the feed used in aquaculture is quite expensive, irregular and short in supply [2]. These feeds are sometimes adulterated, contaminated with pathogen as well as harmful chemicals for human health.

It is, therefore, very crucial to find an alternative to reduce feeding cost, and to make aquaculture a viable and attractive venture.[3] There is high competition for the same foodstuffs between man and his domestic animals. For both economic and practical reasons, fish feed should be prepared using locally available protein sources, preferably from those unsuitable for human consumption [4]. Next to fishery by-products, terrestrial vertebrate by-products usually constitute the second major source of animal protein within aquafeed for warm water fish species [5]. Animal by-products have been found to be a good source of protein [6] and its use as fish feed is well known in fish farming. Another advantage of using these animal by-products is their easy availability in the locality and low cost. Several workers have attempted to replace fish meal and other animal protein sources in diet with slaughter house waste [7, 8,9], poultry offal [10] for Indian major carps and other such fish. But use of such potential ingredient as feed for tilapia is still scanty.

Keeping the view above the main objective of the present study is to determine the role of formulated feed preparing from animal bye product as the key ingredient on growth as well as growth performances of tilapia (*O. niloticus*).

Material and methods

Experimental set up

Six groups of tilapia fingerlings comprising twenty five individuals in a batch (total 150) (average weight 5.2 g and average length 4.5 cm were obtained from Balarampur fish farm, West Bengal, India .The fingerlings were treated with potassium permanganate solution (1 mg L^{-1}) to remove any external parasites and were acclimatized in a big tank for two days. Each group of fingerlings also were initially weighed to record the initial biomass. They were stocked (25 fingerlings in each tank) in 6 rectangular cement tanks (1000 L) and three different feed were administered. Triplicate tanks were allocated for each dietary treatment. The water system was static in nature and the bottom of the tank was filled with inert agricultural soil (pH 6.4 ± 0.05) for restoring aquatic environment suitable for tilapia. Dechlorinated well water (temperature 30 ± 4 °C, pH 7.2 ± 0.05, free CO_2 0.5±0.01 mg L^{-1}, available nitrogen 0.6±0.05 mg L^{-1} and dissolved oxygen (DO) 6 mg L^{-1}) was used in the experiment.

Feed formulation and preparation

The principal feed ingredients were collected from slaughter house and poultry farm at minimum cost. These ingredients were economically cheap but contained significant amount of crude protein (above 30%). Biochemical composition of slaughter house offal and hydrated poultry feather used for feed for tilapia are shown in table 1.

Table 1: Biochemical composition of Slaughter house offal and Hydrated poultry feather used for feed for Tilapia (*O. niloticus*)

Ingredient (%)	slaughter house offal	Hydrated poultry feather
Dry matter	91.09	91.76
Organic matter	80.39	82.06
Crude protein	36.56	32.29
Crude lipid	9.57	8.65
Ash	10.70	9.70
Nitrogen free extract	25.27	31.23
Crude fibre	8.99	9.89
Gross energy (Kcal g^{-1})	3.54	3.61

Diets used for growth trial were so prepared that feed formulations remain almost isonitrogenous (30 g 100 g^{-1}) and isoenergetic (4Kcal g^{-1}) in nature by Pearson squre method. The choice of these nutrient levels, particularly protein, was intended to reflect the practical diets used in India. Diet formulations are presented in Table 2. The mustard oil cake, wheat flour, rice bran, egg shell dust and vitamin premix were common ingredient in every feed tested compensating lipid, protein and ash deficiency respectively in formulated feeds. The different ingredients were mixed properly using a food mixer (A200 Hobart Ltd). The proportion of different feed ingredients was determined by using Pearson's square method (table 2). The mixture was pelleted using a Pellet Mill (Model CL2) with a 12 mm die. The resulting pellets were dried under sun and then packed in polythene bags (5 kg/bag) and kept in dry and cool place.

Feeding

The feed was given in a submerged feeding tray at 09.30 am and 4.30 pm everyday for 1 h in each tank. Unconsumed feed was removed from the feeding tray and dried in a hot air oven at 100 °C. Feed consumption was estimated by subtracting the weight of the unconsumed feed from the weight of the feed offered. Fish, feed samples, and unconsumed feeds were weighed on an electric balance to an accuracy of 0.1 mg.

Growth calculation

Growth and nutrient utilization were determined in terms of feed intake (FI), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), energy retention (ER) and hepatosomatic index (HSI) and gonadosomatic index (GSI) [2].

FI (g fish-1 day-1) = Total feed intake per fish/number of days

SGR (% day-1) = 100 × (ln[final body weight]-ln[initial body weight])/no. of Days

FCR = feed intake/live weight gain

PER = live weight gain/crude protein intake

ER (%) = 100 × (final fish body energy - initial fish body energy)/gross energy Intake

HSI (%) = 100 × (liver weight/total body weight)

GSI (%) =100 × (weight of gonad /total body weight)

Analysis

Feeds and carcass samples were analyzed following standard procedures[11] (AOAC): dry matter (DM) after drying at 105 °C for 24 h; crude protein (CP) by Kjeldahl method. Samples were digested in concentrated sulphuric acid using a Digestor 2040 (FOSS, Denmark) followed by distillation using a Kjeltec 2300 autoanalyzer (FOSS, Denmark) to determine nitrogen content which was converted to crude protein multiplying a conversion factor of 6.25, crude lipid (CL) after extraction with petroleum ether by Soxhlet method (40-60 °C boiling range).; total ash by igniting at 550 °C for 3 h in muffle furnace (Size 2 Gallenkamp, UK). Organic matter (OM) was calculated by subtracting total ash from DM. Crude fibre was determined using a moisture free defatted sample which was digested by a weak acid HCL followed by a weak base NaOH using the Fibertec System 2021 (FOSS, Denmark). Nitrogen-free extract was determined by subtracting the sum of crude protein, crude lipid, crude fibre and ash from DM [12].

Gross energy was determined using a Bomb Calorimeter Model-DFU 24. The sample was combusted in a chamber pressurized with pure oxygen and resulting heat measured by increase in the temperature of the water surrounding the bomb.

The water quality parameters like temperature, pH, dissolved oxygen, sechi disc transparency, available nitrogen and phosphate were analysed twice in a week, following standard procedures (APHA).[13]

Statistical analysis

Data were analysed using one-way ANOVA and differences between the means of treatments were examined using Duncan's multiple range tests .

Results

The growth was significantly high (79.00 g) in the SOM fed fish in comparison to the PFM (57.33 g) fed fish (table 3). The length of fish was maximum (13.5 cm) in SOM fed treatment.

Table 2: Formulation and composition of the experimental diets (%)

Sl. No	Name of feed	Ingredients	% of ingredient in formulated feed	% of crude protein	% of lipid	% of carbohydrate *	Calorific value of feed (kcal/g)
1	SOM	Dry slaughter house offal dust Rice bran MOC Wheat flour Egg shell dust and vitamin premix (3:1)	47 10 32 10 01	30.11	9.0	12.3	4.0
2	PFM	Hydrated poultry feather dust Rice bran MOC Wheat flour Egg shell dust and vitamin premix (3:1)	49 10 30 10 01	30.05	9.1	12.7	4.1

The amount of feed intake (g $fish^{-1}$ day^{-1}) was high (1.85) in SOM provided treatment. This was 40.15% higher than PFM and as expected the feed conversion ratio (FCR) was low (2.18) in SOM. The specific growth rate was high (0.68) in SOM fed treatment. The protein efficiency ratio (PER) was significantly differed between the ($P<0.05$) treatments. The recorded value of PER in SOM fed treatment was 1.50 which was significantly higher than PFM fed fish. Though high hepatosomatic index (HSI) and gonadosomatic index (GSI) were obtained from SOM fed treatment but these values were not differed significantly (table 3).

Moisture content of fish was improved than the initial fish (table 4). The low moisture content is desirable. Moisture content was significantly ($P<0.05$) low in SOM (74.96) fed fish in comparison to the PFM (76.28). The amount of crude protein (CP) was high (11.65) in SOM fed fish. The lipid (5.98) and ash content (5.25) were high in SOM fed treatment. The gross energy was also high (4.01) in SOM fed fish.

Discussion

Throughout the experiment, water quality in all treatments remained within the favourable range required by tilapias indicating that these feed could be utilized in tilapia farming pond. [14]

The highest weight gain was observed in the treatment series administered with SOM feed. This indicates that fish can consume the feed well. The results show high acceptability for the SOM among cultured tilapia. This was possibly due to their higher palatability and preference of the fish to take it as their potential food. The low FCR of

SOM indicates that fish can easily digest the feed and convert these feed to their body mass. The tested value of FCR showed lower (2.19) enormity indicating a favorable effect of market the quality of product. FCR expressed as the amount of feed consumed per unit of body weight gained, is an important indicator of feed utilization efficiency, balance of bioavailable nutrients, and partitioning dietary nutrients towards growth [15]. FCR is an important economy indicator in feed production industry. FCR is a marker of how efficiently an animal utilizes feed, therefore minimizing feed wastage. Low FCR is usually desired in feed production. Apart from favorable economic attributes, minimizing FCR has significant environmental benefits, as a greater proportion of feed nutrients are converted to animal biomass and less nutrients are emitted into the environment where it may have adverse ecological consequences. Moreover, energy costs and environmental emissions associated with the manufacture and transport of feed decreases as FCR decreases for animal production. The protein efficiency ratio was significantly (P<0.05) high in SOM fed treatments than PFM fed treatments which vividly indicates the quality of protein is better in case of SOM. PER is an indicator of quality of protein content of feed. It shows how well the amino acids profile of feed protein content matches the requirements of the fish. High PER is usually desired. A high PER value is indicative of good protein digestibility and bioavailability, and the constituent amino acid profile satisfies the requirement for optimum body protein accretion and growth. The higher value of GSI indicates that the SOM has better impact on the reproductive function. The SOM contains iron in its hemoglobin part where as PFM was poorer in iron content. This has the negative impact on PFM as fish feed. The mortality of fish was significantly lower in SOM than other two meals indicating a better choice of the feed among the fish from beginning of feed administration. After the administration of the various test feeds, the moisture content was lower in SOM indicating improvement in flesh content of the fish. The protein content was high in SOM fed fish as the feed was converted into body protein in a higher ratio than PFM.

Table 3: Growth performance and nutrient utilization of *O. niloticus* fed SOM and PFM diets

	SOM	**PFM**
Initial weight (g)	5.10±0.07 [a]	5.06±0.07 [a]
Final weight (g)	79.00±1.28 [a]	57.33±1.26 [b]
Initial length (cm)	4.6±0.11 [a]	4.5±0.12 [a]
Final length (cm)	13.5±0.11 [a]	12.0±0.12 [b]
Feed intake (g $fish^{-1}$ day^{-1})	1.85±0.08 [a]	1.32±0.09 [b]
Specific growth rate (%day^{-1})	0.68±0.07 [a]	0.58±0.05 [b]
Feed conversion ratio	2.10±0.09 [a]	2.28±0.08 [b]
Protein efficiency ratio	1.50±0.04 [a]	1.30±0.05 [b]
Hepatosomatic index	1.72±0.07 [a]	1.70±0.06 [a]
Gonadosomatic index	1.44±0.08 [a]	1.01±0.09 [b]

Values are in mean±SD

Conclusion

The feed prepared with slaughter house offal as principal source of protein enhanced growth significantly and thereby yield of Nile tilapia, *Oreochromis niloticus*. Applying this feed, fish farming becomes more profitable to the poor resourced fish farmers by lowering the feed costs to a certain degree. Use of locally available feed ingredient like slaughter house offal would reduce the cost of formulated feed and preparation of feed may be done at small scale level leading to employment generation in rural areas.

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