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Growth performance of Nile Tilapia (*Oreochromis niloticus* L.) fed with two leguminous plant leaf meals

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Abstract

The growth performance and approximate general composition of Nile tilapia fed with leguminous leaf meals were studied for 90 days. Two almost isonitrogenous (25% CP) diets were formulated using groundnut (*Arachis hypogea*) and arahar (*Cajanas cajan*) leaf as the key ingredient. Fish cultured with feed without any leguminous leaf treated as a control. Weight gain, Crude protein, lipid and ash content was highest ($P < 0.05$) in GLM fed treatment and differed significantly with ALM as well CON. Moisture content was significantly lower in fish fed with GLM feed. Fish growth and other growth performance parameters are affected positively when fed GLM which is good for the quantity and quality of the fish production. Groundnut leaf meal contains such ingredients which improve the growth, growth performance parameters as well as approximate general composition of fish.

Key-Words: Approximate general composition, leguminous, isonitrogenous, groundnut, arhar and crude protein

Introduction

Fish is one of the most essential protein sources for majority of the population in the universe. With the increase in global population, there is an urgent need to increase the fish production to meet the ever increasing requirement of protein. In India there remains a wide gap between production and demand of fish. Such an ever increasing demand can never be supplied through conventional culture system. Therefore fish farming by applying improved artificial feed is very essential to make up the wide gap between the demand and supply of fish. Feed is an essential component for rapid production of fish under cultured condition, and is the most expensive operating cost item accounting for over 50% of costs in semi-intensive aquaculture (De Silva, 1993) and up to 70% in intensive aquaculture (Thompson et al., 2005). Moreover, this is irregular and short in supply. The feeds are available in market sometimes adulterated, contaminated with pathogen and contain chemicals harmful to human health.

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On the other hand, if the fish farmers can produce an alternative feed for their own fish farm they may be able to provide healthy and hygienic feed on a regular basis. Such feed would be fresh, almost free from any pathogen and harmful chemicals and be available at comparatively low in cost. *Groundnut and arhar*, belong to the legume "bean" family (Fabaceae). These are cultivated throughout India as well as West Bengal. After harvesting huge amount of plant residue is left in the crop field which contains a significant amount (20-23%) of crude protein (Table 1). Many studies have been carried out to evaluate the effects of non-conventional ingredients used in diets as FM substitutes on fish (Bag et al., 2011).

As part of investigations examining the suitability of groundnut and arhar leaf in diets for Nile tilapia (*O. niloticus)* the main objective of this study was to evaluate growth, proximate composition of fish flesh in response to the alternative feeds.

Material and Methods

Experimental set up

Twenty five fingerlings of Nile tilapia (male and female ratio 1:1) in triplicate groups used in three different treatments. The fish fingerlings were treated with potassium permanganate solution (1 mg L^{-1}) to remove any external parasites and were acclimatized in a big tank for five days. The experiment was conducted for 90 days from June to August in the year 2011 at the tanks of aquacultural engineering section of IIT-

Kharagpur, West Bengal, India. One thousand litre of tap water plus dry inert soil of 40 kg and pond water plus dry pond bottom mud of same amount were used for fed treatments and control treatment respectively. The water was exchanged in all the tanks at 7 days interval. A constant depth of water was maintained adding water at 3 days interval.

Feed formulation and preparation

The principal feed ingredients were collected from local agricultural field which contained significant amount of crude protein (about 20%). These substances were procured at minimum cost. Biochemical compositions of groundnut and arhar leaf used for feed for tilapia are shown in Table 1. Diets used for growth trial were prepared that feed formulations remain almost isonitrogenous (25 g 100 g^{-1}) and isoenergetic (4.0 Kcal g^{-1}) in nature. The choice of these nutrient levels, particularly protein, was intended to reflect the practical diets used in India. Details of diet formulations are presented in Table 2. Mustard oil cake, wheat flour and egg shell dust were common ingredient in every feed tested. These ingredients were used to compensate lipid, protein and ash deficiency in formulated feed. Each feed was fortified with egg shell dust which is available almost free of cost for calcium supplementation. This was added keeping in mind that the developing fish needs huge quantity of calcium for its bone development. The different ingredients were thoroughly mixed using a food mixer (A200 Hobart Ltd). The proportion of different feed ingredients was determined by using Pearson's square method. The mixture was given the shape of pellets using a Pellet Mill (Model CL2) with a 12 mm die. The resulting pellets were dried in a hot air oven for 48 h at 50 ºC and then packed in polythene bags for frozen.

Feeding

The feed was given ad libitum in a feeding bag hung from an iron rod in four locations in each tank. Unconsumed feed was removed after 1hour from the beginning of feed administration

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), and hepatosomatic index (HSI) as follows: (Bag et al., 2011)

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

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

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

Analysis

Feeds and carcass samples were analyzed following standard procedures (AOAC, 2000): dry matter (DM) after drying in a hot air oven (Gallenkamp, UK) at 105 °C for 24 h; crude protein (CP) by Kjeldahl method (N × 6.25) after acid hydrolysis, crude lipid (CL) after extraction with petroleum ether for 7-8 h 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 (Giri et al., 2000). Crude fibre was determined using a moisture free defatted sample which was digested by a weak acid HCl (0.1N) followed by a weak base NaOH (0.1N) 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 (Maynard et al., 1979).

Results and Discussion

A steady and rapid growth of fish was noticed till 60 days of release of the fingerlings (irrespective of treatment variations) in the experiment while after 60 days it was slightly declined till hervest. However, the rate of growth was quite faster in case of fed fishes than that of control. In final observation i.e. on 90 days after release the weight of individual fish under GLM treatment was maximum than the other two treatments (Figure 1).

In the present investigation the amount feed intake (g $fish^{-1}$ day^{-1}) ranged 1.27–2.14 in case of *O. niloticus*. It was recorded minimum in control treatment (1.27 g) and maximum in ALM (2.14 g). These results show an encouraging response of the fish to the newly formulated feeds. GLM exhibited superior results to ALM as well as control. This may be due to the better acceptability of GLM than other feed offered. The SGR was obtained maximum in GLM (0.92) followed by ALM (0.83) and CON (0.50). FCR, an important indicator of feed utilization efficiency was recorded lowest in GLM (2.26) and highest in ALM (2.58).This indicates that fish can assimilate and utilize the GLM based feeds well than the other feeds. The highest PER value in the present study was recorded from GLM (1.47) fed fish indicating that quality of protein as well as its richness of amino acid profile in groundnut leaf is better than the other feed ingredients. Hepatosomatic index (HSI) was measured at the end of the experiment to evaluate condition and nutritional status of fish. A significant high value of HSI (1.82) was obtained from GLM for *O. niloticus*. Gonadosomatic index (GSI) is a tool for measuring the sexual maturity of animals in

correlation to ovary and testis development. The GSI value of the present investigation for *O. niloticus* was in the range of 1.25–1.53 (Table 3).

The moisture content ranged from 72.77–75.50%. The moisture content of GLM and ALM was always less than CON. Similar finding also reported from Ogunji et al. (2008). The maximum amount of crude protein and lipid was recorded from GLM fed fish. The crude protein and crude lipid of GLM and ALM feed easily accumulated in the fish flesh. The ash content of fish under all the treatments ranged between 5.10-5.70% and highest value was recorded from GLM fed fish. It is indicative to the fact that the feed prepared with groundnut leaf contains some such ingredients which increase the ash content of fish (Ebrahim and Abou-seif, 2008).

Growth of animal is a complex process influenced by its genotype, hormonal status, nutrition and the environment under which it grows (Ayoola et al., 2010). In the present study it is observed that the fish fed with the diets formulated with two alternative sources had different effects on various growth parameters like body weight, body length, SGR and FCR. This might have happened possibly because of differences in acceptability and palatability of feeds and the environmental condition of the tank. Although the genetic potential for growth may differ among fish, nutritional and hormonal factors are significant contributors to the expression of that genetic potential for growth and efficiency of nutrient utilization (Ayoola et al., 2010).

Conclusion

The feeds prepared from groundnut and arhar leaf enhance not only growth of fish but improve flesh quality of fish by increasing the crude protein and lipid content of fish which is beneficial for human health

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Table 1: Biochemical composition of groundnut and arhar leaf used for feed for tilapia

Ingredient (%)	Groundnut	Arhar leaf
Dry matter	93.77	93.32
Crude protein	22.25	19.78
Crude lipid	8.89	8.43
Carbohydrate	10.38	9.67
Ash	9.05	9.19
Nitrogen free extract	34.89	37.19
Crude fibre	8.31	9.06
Gross energy (Kcal g^{-1})	3.43	3.34

Table 2: Detailed information of each formulated diet

Name of feed	Ingredients	% of CP in ingredient	% of ingredient in formulated feed	% of crude protein in feed	% of lipid in feed	% of carbohydrate in feed
GLM	G N Leaves	22.25	40.0	25.46	8.1	10.4
	MOC	34.65	30.0			
	Wheat flour	9.08	28.0			
	Egg shell dust	1.8	2.0			
ALM	MOC	34.65	30.0	25.46	8.1	10.4
	Wheat flour	9.08	28.0			
	Egg shell dust	1.8	2.0			
ALM	MOC	34.65	33.0	24.85	8.3	10.0
	Wheat flour	9.08	26.0			
	Egg shell dust	1.8	1.5			
CON	MOC	34.65	37.5	24.40	9.5	11.5
	Wheat flour	9.08	60.5			
	Egg shell dust	1.8	2.0			

Table 3: Growth performance and nutrient utilization of *O. niloticus* under different feeds

Particulars	CON	GLM	ALM
Initial weight (g)	5.10 ± 0.02^{a}	5.10 ± 0.03^{a}	5.10 ± 0.02^{a}
Final weight (g)	50.24 ± 0.16^{a}	88.41 ± 0.15^{c}	80.04 ± 0.14^{b}
Initial length (cm)	4.50 ± 0.02^{a}	4.50 ± 0.01^{a}	4.50 ± 0.02^{a}
Final length (cm)	14.00 ± 0.11^{a}	15.30 ± 0.14^{c}	14.90 ± 0.11^{b}
Feed intake (g $fish^{-1}$ day^{-1})	1.27 ± 0.12^{a}	2.09 ± 0.18^{bc}	2.14 ± 0.21^{c}
Specific growth rate (% day^{-1})	0.50 ± 0.01^{a}	0.92 ± 0.01^{c}	0.83 ± 0.01^{b}
Feed conversion ratio	2.55 ± 0.05^{b}	2.26 ± 0.03^{a}	2.58 ± 0.04^{b}
Protein efficiency ratio	1.31 ± 0.06^{a}	1.47 ± 0.06^{b}	1.29 ± 0.06^{a}
Hepatosomatic index	1.60 ± 0.04^{a}	1.82 ± 0.02^{c}	1.71 ± 0.03^{b}
Gonadosomatic index	1.25 ± 0.05^{a}	1.53 ± 0.05^{c}	1.39 ± 0.08^{b}

Values are mean±SD, n=3

Values in the row superscripted by different alphabets are significantly different from each other ($P<0.05$, Duncan's new multiple range test (Duncan, 1955)

Separate analysis was done for each row.

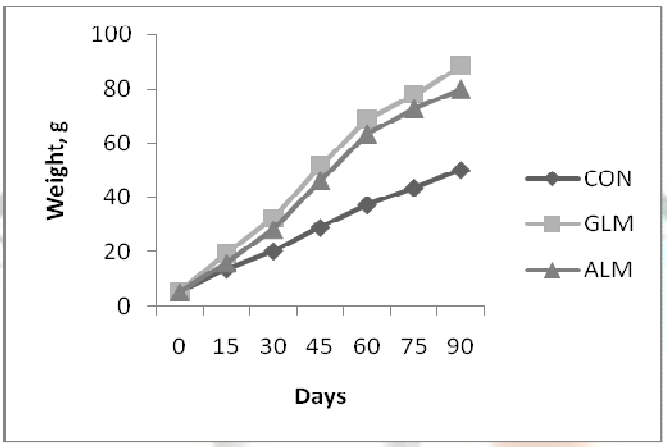

Fig. 1: Growth rate of *O. niloticus* fed with GLM and ALM feed

Table 4: Effect of feed formulae on proximate composition of whole body of *O. niloticus* at harvest time (%fresh weight basis, mean±SD)

Particulars	CON	GLM	ALM
Moisture	75.50±1.21[b]	72.77±1.23[a]	75.20±1.19[b]
Crude protein	13.36±0.20[a]	14.74±0.19[b]	13.39±0.17[a]
Crude lipid	4.60±0.05[a]	6.56±0.08[c]	5.53±0.06[b]
Ash	5.10±0.06[a]	5.70±0.06[a]	5.35±0.07[b]