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Application of ipil-ipil leaf meal as feed Ingredient for monosex tilapia fry (*Oreochronis niloticus*) in terms of growth and economics

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Background

By production volume, tilapia (*Oreochronis niioticus*) culture is one of the largest freshwater aquaculture species worldwide and is mostly produced using semi-intensive systems in developing countries (FAO, 2000). Tilapia was introduced first in Bangladesh in 1954 from Thailand (Ahmed, 1956). Legumes such as Ipil-ipil (*Leucaena leucocephala*) are potentially a valuable feed resource for aquaculture in the tropics because of their widespread distribution in those areas. Most varieties have not been evaluated as feed for fish. Ipil-ipil and leaf material of *Leucaena* compares favourably with lucerne in terms of crude protein (CP), calcium (Ca) and phosphorus (P), and it is also a good source of b-carotene. Under optimum growing conditions, *Leucaena* can yield large amounts of high quality forage (NAP 1984). Legumes provide high-quality protein and energy, the nutritive value and digestibility of tropical legumes is higher than that of tropical grasses and the quality of herbage from grasses rapidly declines with increasing maturity.

Methodology

As in most fish culture systems, balanced feed is one the most significant inputs in tilapia culture, and accounts for 30 to 60% of production costs (El-Sayed, 1990; Goddard, 1996; Tudor et al., 1996). Tilapia, however, are also able to feed on vegetables, grains, algae, zooplankton, etc., which has been proven in a number of nutrition studies (Belal and Al-Jasser, 1997). Substitution of fish meal in balanced feed has been vital to reducing feed costs, and overall tilapia production costs. The ipil-ipil tree was cultivated in the dyke and roadside of the research conducted in the Allahwala

Hatchery and fisheries project of Cox's Bazar, Bangladesh. The recently collected fleshy leaves were selected for processing into ipil-ipil leaf meal. The process involves drying the fresh leaves, grinding and screening to produce the final meal product.

Four ingredients ie. fish meal, soybean meal, ipil-ipil leaf meal and rice bran were used to formulate four experimental diets as per table 1. The control diet (1) contained no ipil-ipil leaf meal.

The experiment was carried out for a period of 21 days from the 21 May to 11 June 2006, in four 3 x 1.5m hapa, installed in a nursery pond with a bamboo frame. Each hapa contained three identical chambers for replication to study the growth of monosex tilapia fry under different experimental diets. Each diet was trialed in a one hapa to allow comparison of their effect on growth. 600 fry graded for approximately uniform size were stocked into each hapa, with each chamber containing 200 fry.

The monosex tilapia fry were conditioned to feed at the surface. Experimental diets were fed as a powder spread on centre of each chamber by a small plate to avoid feeding competition with exterior fish. The amount of feed supplied to reared fry was 25 % of the total biomass per day for first 10 days and 20% of total biomass per day for the following 11 days. The growth and survival of the reared specimens in each hapa with three replicates were recorded on three occasions at seven day intervals. Samples were collected from a number of sites within each chamber. 10% of the fry (20 individuals) were sampled from each chamber with total length recorded. The economic feasibility of the experimental diets was studied by analyzing the unit cost and total costs of all ingredients were used in the experiments.

Table 1. Experimental feed formulations

Feed component	Diet 1 (control)	Diet 2	Diet 3	Diet 4
Fish meal	33	30	30	35
Soybean meal	35	33	30	25
Rice bran	32	17	15	25
Ipil-ipil leaf meal	0	20	25	15

Table 2. Mean body weight and length of tilapia on different diets after 21 days

	Diet 1 (control)	Diet 2	Diet 3	Diet 4
Mean body weight	2.167±0.35g	2.183±0.34g	2.267±0.35g	2.5±0.38 g
Mean body length	5.17±0.30 cm	5.187±0.31cm	5.19±0.31 cm	5.30±0.32 cm

Table 3. Tilapia performance on the four experimental diets

	Diet 1 (control)	Diet 2	Diet 3	Diet 4
Absolute growth	919.26g	929.26g	979.26g	119.26g
Average daily growth rate	11.50	11.62	12.25	14
Specific growth rate	5.86%	5.90%	6.05%	6.52%
Feed conversion ratio	2.74	2.73	2.78	2.42
Feed conversion efficiency	36.43%	36.67%	35.99%	41.23%
Protein efficiency ratio	1.04	1.047	1.028	1.178

Table 4. Crude composition and cost of the experimental diets

	Diet 1 (control)	Diet 2	Diet 3	Diet 4
Moisture	13.31%	13.47%	13.55%	13.6%
Fibre	16.79%	15%	14.8%	16%
Fat	7.63%	7.41%	7.4%	7.5%
Ash	9.31%	9.24%	9.25%	9.3%
NFE	18%	19.38%	19.7%	18.65%
Preparation cost/kg (Tk)	20.82	18.33	17.85	19.15
Unit cost/kg (Tk)	45.6	35.46	35.71	34.65

Results of the experiment

At the end of the third week the mean body weight and body length was recorded as per table 2. The length increment of this present study was lower than previous results. Generally the length increment depends on size at stocking with the larger specimens obtain greater length. So, the present experimental results were significant.

The performance of the different diets were assessed in terms of absolute growth, average daily growth rate, specific growth rate, feed conversion ratio, feed conversion efficiency and protein efficient ratio as per the table 3. Survival was100% in all experimental diets. Overall, a better growth of the reared tilapia was obtained using diet 4 which contained mixed protein of plant and animal origin. The present experiment demonstrated that tilapia show very poor growth when *Leauceana* constitutes 25% or more of the dietary protein. During the course of the experiment water temperature ranged from 30 to 32°C, water pH ranged from 7.2 to 7.4, and dissolved oxygen from 5.8 to 6.2 mg/L which are well within acceptable limits for tilapia culture.

A protein level of 35% was maintained for all diets, while the basic composition and cost of each diet was as follows:

The lowest production cost indicates economic viability of the feed. Ekramullah (1989) found preparation cost of pelleted feed ranged from Taka 11.87 to taka 26.14 per kg. In the experimental study the preparation cost of per kg feed 20.82, 18.33, 17.85 and 19.15 are in the agreement with the report of the researcher. In fish, partial replacement of fish meal or marine animal protein and soybean meal by ipil ipil leaf meal resulted in better growth performance, indicating an economical profit.

Discussion

The achievement of the present study was that 24% feed cost were reduced by using experimental diet 4 which contained 15% ipil-ipil leaf meal (a non-conventional feed ingredient) in the diet. Thus from over all discussion of the experimental results, it has been established that ipil-ipil leaf meal at 15%level used in the diets has good nutritive values and has a significant effect on the growth, FCR, FCE, and all of the performance measure of *O. niloticus*.

From the overall discussion of the present experimental results it has established that better growth and minimum feed cost of reared species may also be obtained using the feed with mixed protein of plant and animal origin. To achieve a balance nutritional composition in fish feed, a more diverse choice should be made in selecting feed ingredients. Products derived from ipil ipil have been shown to be important ingredients for practical feed of tilapia fish. The findings in the present study shown that ipil ipil leaf meal could be used as protein substitute up to 25% and optimum level 15% in the diet of growing tilapia. However, further studies are needed to justify the long term effect and benefit of ipil ipil leaf for fish health and fish production.

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Fermented feed ingredients as fish meal replacer in aquafeed production

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Feed is the most significant input for most aquaculture systems. Among feed ingredients, fish meal is a major component of feed costs. This has stimulated the evaluation of a variety of alternative dietary protein sources for partially or totally replacing fish meal protein in aquaculture feeds. Use of cheap animal protein ingredients like shrimp head meal waste as such is limited by the presence of exoskeletal chitin and ash content though it contains high levels of protein with an excellent amino acid profile. Similarly use of plant based ingredients in fish feed formulations have certain limitations viz., amino acid imbalance, low protein content and anti-nutritional factors. Utilization of seaweeds and other aquatic plants is also limited due to the presence of high crude fiber and low protein content.

Fermentation is a unique process which will improve the nutritional value of feed ingredients. Fermentation reduces the presence of exoskeletal chitin in shrimp head meal, anti-nutritional factors and fibre in plant based feed ingredients thus improves their nutritive value. Further bacterial fermentation hold promise for growth enhancement and immunostimulants in aquaculture. Fermentation also increases the availability of certain vitamins viz., riboflavin, cyanogobalamine, thiamine, niacin, B6, B12 and folic acid levels in some feed ingredients.

Fermented shrimp head meal

Fermentation is an important tool to reduce the chitin and ash content in shrimp head meal. Fermentation increases the total available protein, calcium and phosphorus. Lactic acid bacterial fermentation has been used successfully in fish insolation (Hall and Silva, 1994). *Lactobacillus plantarum* is used for fermentation of shrimp head meal. The amino acid profile of fermented shrimp head meal is relatively high except for histidine and tryptophan. Biologically ensiled shrimp head silage meal can effectively replace fish meal up to 30% in the diet of African catfish *Clarias gariepinus* fingerlings (Nwanna, 2003). Chitinoclastic and proteolytic bacterial strains could also be used to ferment prawn shell waste in order to improve the nutrient content; an increase in nutrient content was noted in terms of protein, lipid and total sugar in fermented product. Fermented shell waste has been used in both hatchery and grow out diets of *Penaeus indicus* (Amar, et al., 2006)