**ECONOMICALLY FEASIBLE FISH FEED FOR GIFT TILAPIA (*Oreochromis niloticus*) FOOD FISH CULTURE IN SRI LANKA**

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**Abstract**

Tilapia is an unique fish in the inland fish production of Sri Lanka with maximum contribution coming reservoir fisheries catches. There is a possibility to enhance tilapia aquaculture further through other systems of aquaculture practices. However, feed cost is the highest operating cost in the aquaculture practices and an economically and efficient feed would play major role in stimulating feed based aquaculture of tilapia. Keeping this in view, a trial was carried out in cages (1m3) that were installed in abandoned clay pits. Nine cages were used and the advance fingerlings of Tilapia (GIFT strain) (mean length= 9.7**±** 2.08 cm and mean weight = 18.7**±**12.0 g ) were stocked at a stocking density of 100 fingerlings m-3. Two aqua feeds, namely, Feed-A and Feed-B were prepared by using locally available ingredients. The protein percentage in Feed-A and Feed-B was adjusted to 20% while another poultry feed with the same level of protein was used as Feed-C. In feed A , protein was contributed mainly by fish meal , but in feed B , fishmeal and Soybean meal were used as the major protein sources. The cost for feed-A, Feed-B and Feed-C were US$ 0.59, 0.48 and 0.61 per kg respectively. Feed-A and Feed-B were tested by using Feed-C as the control diet and all treatments had triplicates. Feed was provided twice daily at 5% of body weight. The trial lasted for 125 days. The pH, Temperature, DO and Toxic Ammonia were measured in clay pit and they were in acceptable ranges. The final mean weight and specific Growth Rate (SGR-W) of the fish fed on Feed-A, Feed-B and Feed-C were 36.57±14.49, 48.67±17.80,35.58±16.11 g, and 1.0634±0.1017,1.2929±0.0905, 1.0410±0.1094, respectively. As such the Average Daily Growth (ADG) of the fish fed on Feed-A, Feed-B and Feed-C were 0.2155±0.0374, 0.3123±0.0450, 0.2077±0.0374 g day-1 respectively and significantly different(p<0.05) in Feed-B than Feed-A and Feed-C. The mean survival and condition factor(CF) of the fish fed with Feed-A, Feed-B and Feed-C were 98.67±1.15, 81.00±14.18, 97.00±4.58 and 1.8617± 0.0679, 1.9373±0.0599, 2.1077±0.3531 and not were significantly different respectively (p>0.05). Feed Conversion Ratio (FCR) of Feed-A, Feed-B and Feed-C were s2.03, 1.69 and 1.99. Accordingly, Feed-B could be recommended as suitable economically feasible feed for tilapia (GIFT strain) food fish culture.

Key words: GIFT tilapia, food fish culture, aquafeed, poultry feed

**INTRODUCTION**

Tilapia is a unique fish in the inland fish production of Sri Lanka with maximum contribution coming from reservoir fisheries catches. There is a possibility to enhance tilapia aquaculture further through other systems of aquaculture practices. According to (Pullin,1985),Tilapias are widely recognized as one of the most important fish species for freshwater aquaculture in a wide range of farming systems from simple small-scale water-fed fish ponds to intensive culture systems. As the growth rates of the Genetically Improved Farmed Tilapia (GIFT) strain were superior to those of local strains of the Nile Tilapia (Eknath *et al.* 1993; Bentsen *et al.* 1998; Guptha and Acosta 2004 and Ridha 2006) this variety should be popularised in Sri Lanka. As such, thousands of abandoned clay pits (in Gampaha and Hambantota Districts) and abandoned shrimp ponds (in Northwestern province) are the available resources to produce Tilapia for world market.However, as feed cost is the highest operating expense in the semi-intensive aquaculture practices, an economically as well as efficient feed would play a major role in stimulating feed based aquaculture of tilapia. Currently farmers used different food items and poultry feed is much more popular among farmers as the cost is lower than commercially available fish feed. The aim of this research is to evaluate the growth performance of GIFT Tilapia with two formulated feed and with poultry feed as control feed.

**MATERIAL AND METHODS**

The feeding trial was conducted in cages installed in abandoned clay pits in Gampaha District. The area of the abandoned clay pit was 200m2 with 10-20m water depth. Nine plastic net cages with the capacity of 1m3 (1x1x1m in each cage) were used in this trial. Two experimental feed (Feed-A and Feed-B) were formulated using locally available raw materials such as rice bran, coconut meal, extracted soybean meal and fishmeal (Malaysian). These feed ingredients were purchased from an urban market in Colombo. Feed-A was prepared with fishmeal as the major source of protein. Feed-B was prepared with fishmeal and soybean meal as protein sources. Feed-A and Feed-B were formulated with the percentage (%) protein as 20% according to the Pearson’s square method and estimated for crude protein % prior to the formulation of feeds. The % protein (N x 6.25) of both fishmeal and soybean meal were determined by semi-micro Kjeldahl digestion, distillation and titration described in APHA (1985). Commercially available poultry feed (control) was used as the control feed and treatments were tested in triplicate. Ingredient compositions of these three feeds are shown in Table 2. The ingredients for two feed types were measured according to the ingredient composition of the respective formulae and mixed together using a laboratory electrical mixer (Sherry). The required amount of feed was adjusted as 5% of the body weight throughout the culture period according to the total biomass in respective cages. The total biomass of fish in respective cages was determined through the mean weight of fish that was obtained through the sampling in each cage and assuming no mortality had occurred in cages. Sampling was carried out monthly from the beginning until the trial was ended. Fish in the sample were observed externally for the fish disease particularly external worms. The water temperature and the pH of the tanks were measured using glass mercury thermometer and the pH meter (Model: GENWAY-3051) in each sampling day around 0900 -1000 hrs. The feed was divided into two portions and kept in polythene bags to hand it over to the farmer.

**Table 1. Ingredient composition and cost of the feeds**

|  |  |  |
| --- | --- | --- |
| **Feed-A** | **Feed-B** | **Feed-C (Poultry feed)** |
| Coconut meal | Coconut meal | Coconut meal |
| Rice bran | Rice bran | Rice bran |
| Fish meal (Malaysian) | Fish meal (Malaysian) | Fish meal (Brasil-999) |
|  | soybean meal | soybean meal |
| Vitamin premix | Vitamin premix | Vitamin .premix |
| Wheat flour as Binder | Wheat flour as Binder | Raw rice |
|  |  | Maize |
|  |  | Shells |
| 20% protein | 20% protein | 18-20% protein |
| **US$ 0.59/kg** | **US$0.47/kg** | **US$0.61/kg** |
|  |  |  |

Advanced fingerlings of GIFT Tilapia (Mean length=9.7±2.08 cm and Mean weight= 18.7±12.0 g) were obtained from Aquaculture Development Centre in Dambulla and stocked in these cages according to the stocking density of 100 fingerlings m-3.

Two farmers involved in the preparation of feed dough in situ adding warm water to the premix ingredients and homogenized until a dough-like paste was formed and feeding fish twice per day once in the morning (0830 hrs) and once in the evening (1530 hrs). The feed dough was provided to the middle of the top cover of the cage which was 15 cm submerged in the water. This trial was lasted 125 days.

Specific growth rate (SGR), Average Daily Growth (ADG), Condition factor (CF) Weight gain (WG), % survival and Food Conversion Ratio (FCR) of the fish for each cage with different feed types were calculated using the following equations.

|  |  |
| --- | --- |
| WG **=** | Mean weight ×No.of survived fish |
|  |

|  |  |  |  |
| --- | --- | --- | --- |
| SGR-W **=** | Ln Final weight–Ln Initial weight | x 100 | Ricker, 1979 |
| Experimental duration |

|  |  |  |
| --- | --- | --- |
| ADG **=** | Final weight of fish- Initial weight of fish |  |
| Days of rearing |

|  |  |  |  |
| --- | --- | --- | --- |
| FCR **=** | Weight gained by fish (g) |  | Helper, 1988. |
| Weight of feed consumed |

|  |  |  |  |
| --- | --- | --- | --- |
| CF **=** | Weight of fish(W) | x 100 | Ricker, 1975 |
| Total length of fish(L)3 |

|  |  |  |  |
| --- | --- | --- | --- |
| % Survival **=** | No. of fish harvested | x 100 |  |
| No. of fish stocked |

In order to detect statistically significant differences, experimental values were compared using a One-way analysis of variance (ANOVA), and the significance of mean differences tested using a Tukey’s multiple range test. The significance level was set at p<0.05.

**RESULT AND DISCUSSIONS**

The crude protein level of fish meal (Malaysia) was 50.14±1.21 and soybean meal was 34.19±2.25. These two components were used in a 1:1 ratio in Feed-B. There were not significant differences (p>0.05) in the survival rate of fish fed on Feed-A, Feed-B and Feed-C (Table 2). As such, the condition factor (CF) of the fish that fed on these 3 feed types was not significantly different (p>0.05) too. However, further growth performance of fish should be considered to select one or more feed types for the culture of GIFT Tilapia.

**Table 2. Growth performance of Tilapia (GIFT strain) food fish with two different aquafeed (Feed-A & Feed-B) and with poultry feed (control feed) within 125 days culture period.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Growth Indices** | **Feed-A** | **Feed-B** | **Feed-C** |
| MW final | 36.57a  ±4.6758 | 48.67b  ±5.6255 | 35.74 a  ±4.8569 |
| Weight Gain (g) | 2.6547a  ±0.4373 | 3.9147b  ±0.5594 | 2.5177a  ±0.4698 |
| CFfinal | 1.8617a  ±0.679 | 1.9373 a  ±0.0597 | 2.1077 a  ±0.3531 |
| % Survival | 98.67a  ±1.15 | 81.00a  ±14.18 | 97.00a  ±4.58 |
| SGR-final | 1.06a  ±0.10 | 1.29b  ±0.09 | 1.04a  ±0.11 |
| ADGfinal | 0.2155a  ±0.0374 | 0.3123b  ±0.0450 | 0.2077a  ±0.0374 |
| FCR | 2.03 | 1.695 | 1.988 |

Figures in the same row having similar superscripts are not significantly different at p>0.05

Accordingly, these three feed types help to keep the health and well-being of the fish and provide more or less similar survival. Accordingly these three feed types could be considered in GIFT Tilapia food fish culture. The weight gain of the fish fed on Feed-B has shown the significantly highest value while Feed-C has shown the poorest value. As such, the ADG of the fish fed on Feed-B was significantly higher and different from the ADG of the fish fed on Feed-A and the control feed, Feed-C. As such the higher ADG of the fish fed on Feed-B could be seen through out the culture period (Figure 1).

Figure 1. Average Daily Growth (% ADG) of GIFT Tilapia in day 22, day 63 and 125 day in the culture period

Accordingly it was revealed that the growth of fish enhances with Feed-B than Feed-A and Feed-C.

As such the final mean body weight of the fish fed on Feed-B was significantly different (p<0.05) and higher than the fish fed on Feed-A and Feed-C (Table 3). It also revealed that the importance of Feed-B in GIFT tilapia food fish culture than Feed-A and Feed-C.

Furthermore the SGR of the fish fed on Feed-B has shown significantly higher value (1.29±0.09) than Feed-A (1.06±0.1) and Feed-C (1.04±0.11) Table 3). The higher value of SGR could be seen in the fish feed on Feed-B through out the culture period than the fish fed on Feed-A and Feed-C (Figure 2).

Figure 2. The Specific Growth Rate (SGR) of GIFT Tilapia in day 22, day 63 and 125 day in the culture period

Wannigama *et al*. (1985) have observed no significant difference in the growth of Tilapia when fed 29% protein diet or a 19% protein diet in the cages in perennial reservoirs in Sri Lanka. These three feed types were in 20% protein and have shown significantly difference ADG in Feed-B than Feed-A and Feed-C. It may be due to other reason such as (i) palatability, (ii)digestibility or (iii) more or less acceptability of the Feed-A. The remaining big grain particles in Feed-C could be observed in the top cover of the cage where feed provided but it was not observed in Feed-A and Feed-B provided cages as the ingredients were used in fine powder form. Accordingly the better ADG, SGR and Weight gain of the fish with Feed-B could be happen due to the presence of soybean meal with fish meal together as protein provider.

Then according to the growth performance (ADG, SGR, CF, Weight gain) of the fish, Feed-B could be recommended for GIFT Tilapia food fish culture in Sri Lanka. However the FCR and production cost of the three feed types should be considered.

The better FCR has observed in Feed-B=1.695, then in Feed-C=1.9886 and finally in Feed-A=2.03. Accordingly, it has shown the efficiency of Feed-B is higher than the other 2 feed types used. As such the cost of feed should be considered as we need the economically feasible feed. The production cost of Feed-B was lesser than the production cost of Feed-A (Table 1). It was due to the replacement of the part of the fishmeal (the expensive component of fish feed) through soybean meal.

Considering all the facts shown above, Feed-B could be considered as economically feasible feed for GIFT Tilapia food fish culture in Sri Lanka. Further research is needed to improve this feed as commercial feed. De Silva (1989) has shown, in developing countries where labour costs are comparatively low, a significant saving in feed costs can be made by feeding diets with a lower protein content than that which is thought to be the optimal dietary protein requirement, without significant loss in growth or yield. In this study it has clearly shown this less protein amount could be provided through the mixture of fishmeal and soybean meal.

**Recommendations**

* Promotion of oil extracted soybean meal instead of import it as already produce big quantities of soybean seeds in dry zone in Sri Lanka.
* Production of fishmeal component through the minor cyprinid fauna, the unexploited fishery resources in reservoirs to reduce the production cost of Feed-B further more (future research are needed).
* Feed-B should be developed up to commercial level to promote Tilapia Aquaculture in the country (future research are needed).

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