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Effect of different artificial feeds on the growth and survival of tilapia (gift strain, *Oreochromis niloticus*) fry

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Abstract: *An experiment was carried out with 12 days old tilapia (GIFT strain, Oreochromis niloticus) fry for a period of 42 days to determine the effect of different feeds on growth and survival of tilapia fry in synthetic hapa in pond. Five different diets with protein level of 17.94% in Treatment 1 (T_1-control), 18.17% in Treatment 2 (T_2), 16.20% in Treatment 3 (T_3) and 16.19% in Treatment 4 (T_4) and 19.77% in T_5 were supplied. The highest and the lowest total length and weight 2.955 cm, 0.1735 g and 2.48 cm, 0.144 g were recorded for the fry fed with treatments T_5 and T_4 respectively. The maximum and minimum length and weight gains 2.05 cm, 0.16 g and 1.58 cm, 0.13 g were observed in fry fed with treatments T_5 and T_4 respectively. Growths of tilapia fry in terms of both length and weight under treatment T_5 were significantly ($p < 0.01$) higher than those of the other treatments. Treatment T_4 showed significant ($p < 0.01$) lowest growth performance among the five treatments. The highest survival (91.3%) rate and better growth were observed in fry fed with treatment T_5. The study suggests that T_5 feed where carbohydrate was partially replaced by protein percentage could be considered as a recommended feed for the growth and production of tilapia fry.*

Keywords: *Artificial feed, Tilapia Fry, Growth, Survival*

1. INTRODUCTION

Tilapia farming worldwide is now in dynamic state of expansion to satisfy both the domestic and international markets. The Nile tilapia (*O. niloticus*) contributes about 55% to the global production of about 450,000 Mt [1]. In Bangladesh, present national goal is to increase fisheries production from all sorts of water resources. Bangladesh has large number of ponds and seasonal water bodies like roadside canals and ditches where tilapia could be a suitable culture species. Tilapia is an important species farmed in small-scale aquaculture by resource-poor farmers. It is preferred by farmers because of its suitable features for aquaculture such as faster growth rate compared to other short cycled fish species. Thus tilapia farming became more acceptable technically and economically. Tilapia culture is a profitable enterprise and even small farmers of Bangladesh can afford to culture tilapia to augment their income.

Apart from Bangladesh, tilapias have become one of the most commercially important groups of cultured freshwater fish and have been dubbed as the "Aquatic chicken" [2]. The economically most important genera are Oreochromis and Sarotherodon, which are characterized by their breeding habits (Trewavas, 1982). Tilapia has also been described as the important aquaculture species of the 21st century, [3]. Tilapia is an excellent fish for growing in the shallow and seasonal ponds in a country like Bangladesh ([4], [5], [6], [7]) because it enjoys very suitable climatic and ecological conditions for culture of warm water species. Tilapia is widely recognized as one of the most important species for farming in a wide range of aquaculture systems [8] .

The introduction of tilapia in Bangladesh from Thailand was first initiated in 1954 with Mossambique species (*Oreochromis mossambicus,* Peters) from Thailand [9]. The early introduced tilapia species 'Mozambique Tilapia' (*Oreochromis mossambicus*) did not attain popularity to the farmers due to early maturation and frequent breeding, which resulted in over population in the ponds. Interest in tilapia culture

was revived in Bangladesh only after the introduction of Nile tilapia (*Oreochromis niloticus*) by UNICEF also from Thailand in 1974 [10]. At that time farming of this Nile species also did not flourish due to lack of research, unavailability of seed and inadequate extension services.

There is an increasing demand for the fry of tilapia among the farmers. There are very little readily available information on farming practices of tilapia is available in Bangladesh. Some works has been done on different aspects of larvae rearing in the laboratory in recent past in Bangladesh, but no reliable technique for large scale larvae and fry rearing of this fish has been established. The larval / fry stage is the most sensitive phase in the life history of most of the species because mortality rate is high at this stage. Unfavorable temperature and feed are the main cause for high mortality and low growth. To gain a better growth and survival of fish fry suitable artificial feed is highly essential.

There are various artificial feed available in markets. It is necessary to look for better artificial feed for rearing of tilapia fry. Protein level 30% is suitable in formulated feed for feeding tilapia fry in rearing hapas and nursery ponds [11]. Tilapia can easily acclimatize with the artificial feeds. This fish is known for its omnivorous feeding habits. Large scale rearing of fry with live food is not possible. Recommendation of an appropriate artificial feed is very essential for large scale rearing of fry successfully. However, a suitable artificial diet to ensure better growth and higher survival of the fry is yet to be developed considering the farmer context. At this initial stage of tilapia farming, the farmers must have adequate information about a proper feeding of fry rearing to best serve their purpose. With this point of view, the present research has been designed to understand practical information of the effects of different feeds through feeding GIFT fry. Efforts were concentrated on the evaluation of the effect of different feeds on the growth performances and survival of tilapia fry.

2. MATERIALS AND METHODS

The study was conducted in a fish farm and hatchery complex situated at Trishal upazila of Mymensingh district, Bangladesh for a period of 42 days to determine the effects of different feeds on growth and survival of tilapia (GIFT strain, *O. niloticus*) fry in synthetic hapa.

Water in the experimental pond was drained out and dried for 7-10 days under sunlight until the bottom become hard. Pond dike were repaired. All aquatic vegetation in the littoral zone of the experimental pond was removed by sharp scythe. Lime was applied at the rate of 1kg/decimal. Before applying lime, it was mixed with water carefully and kept exposed for a while to avoid heat generation and finally spread over surface of the mud. After 3 days of liming underground water was entered in the pond. The water depth of ponds was maintained at 75 cm throughout the study period.

2.1 The experiment: The study was conducted in 10 (ten) $1m^3$ nylon net hapas with a mesh size of 1.0 mm. The hapas were arranged in two columns (5 hapas per column) and were tightly fixed to bamboo poles that were set longitudinally as well as vertically. Each synthetic hapa kept 35 cm below water.

In this experiment, self produced 8 (eight) days old larvae were used. After 4 days of first feeding the fry were stocked in the experimental hapa having average weight of 0.012 g .

The experiment was designed into five treatment groups (group T_1, T_2, T_3, T_4 and T5) fed five different diets each having three replications. Twelve (12) days old fry of initial average length of 0.9 cm and weight of 0.012 gm were released at same stocking densities. The water depth of experimental synthetic hapa were 35 cm. Fry were acclimatized with the experimental pond water in plastic bowl and then stocked in the hapa. The fry under treatments were fed five times a day. Feeds were supplied to fry at the satiation level**.** The water quality parameters of ponds such as temperature, pH and dissolved oxygen were measured and recorded fortnightly throughout the experimental period.

2.2 Feed preparation and analysis: All the dietary ingredients were dried and ground to powder form. The required amount of dietary ingredients were then measured and mixed to form five experimental feeds. Proximate compositions of the dietary ingredients (Moisture, Crude protein, Crude lipid, Crude fibre and Ash content) and test diets were estimated by Association of Official Analytical Chemists [12] methods.

2.3 Sampling and evaluation of feeding effect: Samplings were carried out at an interval of 7 days where fry were caught by a scoop net and kept in a bowl with water. Total length and weight were recorded by using a scale and digital balance. After recording the length and weight the fry were released in the respective hapa. Growth of fry in length (cm) and weight (g) was measured every 7 days interval. The survival rate of fish for catch

treatment was examined on basis of number fish harvested at the end of the experiment.

2.4 Statistical analysis: One way analysis of variance (ANOVA) was performed to test the significance of variation among the treatment means. Statistical tests were performed by computer based statistical software SPSS (Statistical Package for Social Science).

3. RESULTS AND DISCUSSION

3.1 Feed composition: Percentage compositions of the different artificial diets for tilapia fry are shown in Table 2. Five different diets with protein level of 19.77% in T_5, 17.94% in T_1, 18.17% in T_2, 16.20% in T_3 and 16.19% in T_4 were supplemented to the fry. The crude protein of 19.77% in the T_5 feed was higher than other feeds. The amount of carbohydrate was lower in T_5 feed compared to other feeds.

3.2 Growth in length: The initial average length of fry was 0.9 cm in all different treatments. There were no significant ($p>0.01$) differences in initial length of fry under different treatments. The mean final length of tilapia fry obtained were 2.955±0.015 cm in T5, 2.785±0.005 cm in T_1, 2.87±0.015 cm in T_2, 2.545±0.02 cm in T_3 and 2.48±0.01 cm in T_4 (Table 4). The maximum and minimum final lengths were 2.955±0.015 cm and 2.48±0.01 cm in the treatments T_C and T_4 respectively. The final lengths of tilapia fry under treatments T5, T_1 and T_2 were significantly ($p<0.01$) higher than those of treatments T_3 and T_4.

The mean length gain of tilapia fry were 2.05±0.015 cm in T5, 1.88±0.005 cm in T_1, 1.97±0.02 cm in T_2, 1.65±0.005 cm in T_3 and 1.58±0.01 cm in T_4 respectively (Table 6). The maximum and minimum length gains were 2.05±0.015 cm and 1.58±0.01 cm in the treatments T5 and T_4 respectively. The length gain of tilapia (GIFT strain, *O. niloticus*) fry under treatments T5, T_1 and T_2 were significantly ($p<0.01$) higher than in treatment T_3 and T_4.

3.3 Growth in weight: The initial average weight of fry was 0.012 g in all different treatments. There were no significant ($p>0.01$) differences in initial weight of fry under different treatments. The mean final weight of tilapia fry were 0.1735±0.0025 g in T5, 0.162±0.002 g in T_1, 0.1665±0.0005 g in T_2, 0.1515±0.0025 g in T_3 and 0.144±0.005 g in T_4 (Table 5). The maximum and minimum final weights were 0.1735±0.0025 g and 0.144±0.005 g in the treatments T5 and T_4 respectively. The final weight of tilapia fries under treatments T_5, T_1 and T_2 were significantly ($p<0.01$) higher than those of treatments T_3 and T_4. The better results gain have been shown by the tilapia fry under treatments T_5, T_1 and T_2 where higher percentage of protein content was in feeds.

The mean weight gain of tilapia fry were 0.16±0.0025 g in T_5, 0.15±0.002 g in T_1, 0.15±0.0005 g in T_2, 0.139±0.0025 g in T_3 and 0.13±0.005 g in T_4 (Table 6). The maximum and minimum weight gains were 0.16±0.0025 g and 0.13±0.005 g in the treatments T_5 and T_4 respectively. The weight gains of tilapia fry under treatments T_5, T_1 and T_2 were significantly ($p<0.01$) higher than in treatment T_3 and T_4.

Overall the major growth parameters including final weight, weight gain, final length, length gain, specific growth rate, survival rate of tilapia fry were varied significantly ($p<0.01$) between the treatments (Table 6).

The results presented in table 4 and 5 indicate higher growth in length (cm) and weight (g) at higher percentage of protein content in feed and the growth rate gradually decreased with decreasing percentage of protein content in feeds.

In terms of size group of fry at the harvest, very small number (5) of fry was found in large group (3.6-6.5 cm). However, majority of the fry irrespective of all treatments were found in of medium group (2.6-3.5). In present study, medium group of fry was higher in T_5.

3.4 Specific growth rate (%/day): Specific growth rate (%/day) in different treatments ranged from 5.92 to 6.36 (Table 6). The significantly ($p<0.01$) highest specific growth rate (6.36) was found in T_5 while the lowest (5.92) was obtained in T_4.

3.5 Survival rate (%): After rearing period of 42 days , the average survival rate of tilapia fry in the treatments T_5, T_1, T_2, T_3 and T_4 were 91.3, 86.8, 89.8, 83.4 and 87.8 respectively (Table 6). The survival of tilapia fry under treatment T_5 was significantly ($p<0.01$) higher when compared to others.

Effects of different artificial feeding conditions on the growth of tilapia (GIFT Strain, *O. niloticus*) fry in synthetic hapa in pond were investigated in this experiment. Growth and survival of tilapia fry were significantly higher in the treatment provided with higher percentage of

protein content in feeds (T_5, T_2 and T_1) when compared with the treatment provided with comparatively lower percentage of protein content in feeds (T_3 and T_4). The maximum final length and weight gain were 2.955 cm and 0.1735 g which was obtained in the T_5 where high protein content feed was supplied. Whereas, the minimum final length and weight gain 2.48 cm and 0.144 g which was obtained in the T_4 where comparatively low protein content feed.

The result of the present experiment indicated that the growth of tilapia fry varied in different feeds. Five different diets with protein level of T_1, T_2, T_3, T_4 and T_5, were 17.94%, 18.17%, 16.20%, 16.19% and 19.77%, respectively. [11] reported that a protein level of 30% in formulated feed for feeding tilapia fry in rearing hapas and nursery ponds. [13] studied the protein requirements of Nile tilapia (*Oreochromis niloticus)* fingerlings and concluded that 20%–30% crude protein required in the ration for optimum growth in ponds. [14] carried out experiment with 7 diets containing 20, 25, 30, 35, 40, 45 and 50% protein each of which was used to feed 200 walking catfish (*Clarias gariepinus*) fry kept in circular concrete tanks for 60 days. They found that 30, 35 and 40% protein gave excellent growth but the diet containing 30% protein produced optimum growth. [15], [16] reared catfish fingerling in an outdoor rearing system with feeds of different protein levels. They found that 40% crude protein gave better result than lower and higher. [17] reported that 39.5% protein appeared suitable for rearing of C. *batrachus.* The protein percentage in the present study was lower than available literature that was due to formulate low-cost feed for tilapia fry rearing.

The specific growth rate (SGR % per day) under T_1, T_2, T_3, T_4 and T_5 were 6.20, 6.26, 6.04, 5.92 and 6.36, respectively. In the present study specific growth rate (SGR) varied from 5.92 to 6.36. SGR of fish fed on high protein and energy diet show higher value, but fish fed on supplemental feeds made on-farm could show SGR value between 3-4% per day [18]. [19] obtained SGR value of 3.10 with *O. niloticus* in Thailand using feed and fertilizer. On the other hand, [20] obtained a slightly lower SGR value 2.03 with tilapia in Honduras using feed and fertilizer. [21] also observed SGR value of GIFT strain ranged from 2.04 to 2.30 fed on formulated diet but are lower than the present value. The difference of SGR values of the present study and previous study is possibly due to in earlier studies the initial size of experimental tilapia was larger.

The survival rate in the treatments T_1, T_2, T_3, T_4 and T_5 were 86.8%, 89.8%, 83.4%, 87.8% and 91.3%, respectively. More or less similar type of survival rates were observed by [22], who recorded the survival rates of 86 to 95% in polyculture system in BAU ponds. [23] obtained survival rate of 86 to 94% in monoculture of Thai sharpunti. The survival rate recorded in present study is higher than that the survival rate recorded by [24], which might be attributed to the relatively smaller size of fingerlings used in the present study.

In present study, size variation occurs among the different treatments. In terms of size group of fry at the harvest, very small number of fry was found to be large group (3.6-6.5 cm). However, majority of the fry irrespective of all treatments were found to be of medium group (2.6-3.5 cm). In these types of fry rearing technique farmers should isolate the medium size group and sell first for early profit.

3.6 Water quality of experiment pond: The water quality parameters such as temperature, dissolved oxygen and pH of all the treatments were monitored fortnightly during the experimental period and values of these parameters shown in Table 7. Water temperature of the experimental hapa in pond was found in the range from 26.9°C to32.5°C. The pH of water of the experimental hapa was found in alkaline during the experimental period which is shown in Table 4.7. The highest pH value of experimental hapa in pond water was 8.3 and the lowest was 7.54. The range of dissolved oxygen (DO) value of water in the experimental hapa in pond was from 5.50 mg/l to 6.50 mg/l.

The water temperature was recorded in the experimental ponds ranged from 26.9°C to 32.5°C. The range of water temperature was suitable for fish culture. [25] reported that the suitable water temperature range was 25 to 35°C for fish culture. [21] measured the water temperature in the same 12 experimental ponds for GIFT strain culture at Bangladesh Agricultural University Campus Mymensingh, which varied between 29.4 and 33.0°C. From the above statement, water temperature in the present study was almost within the suitable range.

[26] Considered 5.0 to 7.0 ppm of dissolved oxygen content of water to be fair or good in respect of productivity and water having dissolved oxygen below 5 mg/l to be unproductive. [27] Stated that the concentration of dissolved oxygen below 5 mg/l were undesirable in fish

ponds. [28] Reported that the range of suitable dissolved oxygen for fish culture would be 5-8 mg/l. The overall mean dissolved oxygen contents in the present study ranged from 5.50 to 6.50 mg/l. From the above statement, the content of dissolved oxygen in the present study was almost within the productive range and suitable for fish culture.

[28] Reported that the suitable pH range for fish production were 7.3 to 8.4 and 6.5 to 8.5 respectively. [26] Stated that the pond water with almost neutral reaction having pH values of 6.7 to 7.5 was the best suited for fish production. [24] Found pH 7.2 to 7.3 on the research ponds of Bangladesh Agricultural University campus. In the present study, the pH value ranged from 7.54 and 8.30, which indicated good productivity of the pond. $_{P}$H range was found within the alkaline range in this treatment considering the above findings which was suitable for fish culture.

Growth, feed efficiency and feed consumption of fish normally governed by few environmental factors ([29], [30]). Environmental parameter exerts an immense influence on the maintenance of a healthy aquatic environment and production of food organisms. The water quality parameters measured in different treatments in the present study were found to be more or less similar and all of them were within the acceptable range for fish culture.

Overall, T_5 feed where carbohydrate was partially replaced by protein percentage had higher effect on growth and survival of tilapia fry higher. Thus, this feed could be considered as a recommended feed for the large scale production of tilapia fry. However, to reduce dependency of farmers on such commercial feed is critical as it quality and supply sometime fluctuate. Therefore, inclusion of such more protein based ingredients in the experimental diet could be tested in further research to develop low-cost feed for tilapia fry rearing considering the field context of Bangladesh.

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