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Research Article

Growth Enhancement of Guppy (*Poecilia reticulata*) and Platy (*Xiphophorus maculatus*) with the Dietary Inclusion of Plant and Animal-Based Protein Sources

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ABSTRACT

Background/Introduction: Formulating a low-cost ornamental fish feed using locally available ingredients is a promising approach to enhancing the aquaculture sector in Bangladesh. **Objectives:** The present study was conducted to investigate the comparative effects of four types of feeds with different protein sources to observe the growth performance of Guppy (*Poecilia reticulata*) and Platy (*Xiphophorus maculatus*). **Materials and Methods:** The experiment was conducted in the wet laboratory of Zoology Section, Biological Research Division, BCSIR. Four different types of feed including three BCSIR formulated feed and one commercial feed was supplemented to the experimental fish. Physico-chemical parameters of the water and biochemical composition of feed as well as fish was performed periodically. Changes in colour was visually observed to assess feed effects. **Results:** The overall growth of two fish was significantly different in response to four types of feeds B1, B3, B4 and Market Feed (MF) for the period of twelve weeks. Finally, it showed that the overall effects of four feeds on growth performance were B1>>B3>>MF>>B4. The B4 feed has a higher protein content but still isn't delivering great overall results, aside from coloration. **Conclusion:** Using B1 and B3 feeds could definitely be a cost-effective alternative to the more expensive imported ornamental fish feeds, while still promoting good growth performance for the livebearers.

Keywords: Ornamental fish feeds, Growth performances, Guppy, Platy, Spirulina and Tubifex.

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INTRODUCTION

Ornamental or aquarium fish keeping is one of the most popular hobbies in the world today.[1] They are often referred as living jewels due to their color, shape and behavior. Ornamental fish are peaceful, generally tiny, attractively colored and could be accommodated in confined spaces. This century's old hobby is still growing interest in aquarium fishes which resulted in steady increase of their demand in international trade market.[2,3] The annual global export of ornamental fish is projected to be USD 176 million which compounded annually at a growth rate of 6.2%.[4] Indeed, since 1985, the value of international trade in exports of ornamental fish species has increased at an average rate of 14% per year.[5]

Presently aquarium or ornamental fish rearing is the most raising entrepreneurship to our national economy. It has become very popular in our country because of creating attractive decoration of houses, offices, hospitals etc. by their presence. The production of ornamental fish species for the aquarium hobbyist is a rapidly growing sector within the aquaculture industry which contributing significantly to the economic growth of the industry as a whole.[6] Moreover, in Bangladesh intensive ornamental fish farming techniques have not yet been freely adopted.[7] This is due to irregular supply of nutritional feed, lack of live feed, high price of imported fish feed etc. in our country. Therefore, a considerable research effort is needed to determine the quantity and quality of dietary protein necessary to achieve optimum growth performance of ornamental fish.

Among all categories of ornamental fishes, the live bearer category (viviparous and ovoviviparous) is very popular because of several reasons: brightly colored, good market demand; high diseases resistant, high market price in comparison to others and simple to manage and low risk in culture. The live bearing species such as Guppy (*P. reticulata*), Molly (*P. sphenops*), Swordtails (*X. helleri*) and Platy (*X. maculatus*) are a popular group being produced in Singapore, Malaysia, Indonesia, Thailand, India, China and Bangladesh.[8] To date, most of ornamental fish feeds in Bangladesh are being imported from Malaysia and Thailand, namely Osaka, Optimum, Sky fish, Nova etc. and their price

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ranged from 700-2400 Tk/kg.[9] Only one feed, named 'Quality Gold' is producing in Bangladesh and is selling with extremely high price (1000 Tk/kg). However, expensive imported fish feed and sudden death of fish discourage the aquarium hobbyist to them rear for longer time. Reducing the feeding costs could be a key factor for the successful development of aquaculture and rearing of ornamental fish feed.

Ornamental fish basically need the same nutritional requirements as other farmed fish enriched with protein, fats, carbohydrates, vitamins, minerals and trace elements which are necessary for the optimal growth, reproduction and health of the fish.[9] While feeding with artificial diets, growth responses and survival of ornamental fish in aquarium depends upon several factors such as water quality, feed quality, feeding levels etc.[10] The nature of ingredients of the formulated feed may also directly effect on the growth rate and survival rate of rearing fish.[11] Protein is the most expensive component in fish feeds and also the most important factor affecting growth performance of fish and feed cost. Hence, fish nutritionists should pay greater attention to reduce the cost of artificial diets by introducing alternative protein sources from variable sources. Formulation of a low-cost feed, locally available ingredients from plant and animal sources with high protein value is therefore, necessary to fulfill the protein requirement and easy rearing of ornamental fish in aquarium. Besides, the bright colour appearance of ornamental fishes should be intact or enhance for choice and demand in the trade market.

The advantages of Tubifex worm in the diet of ornamental fish as a live food have been demonstrated for bright coloration and growth but as a protein rich ingredient of formulated fish feed is yet to be known.[12,13] Mandal *et al.* (2010) observed the best result of growth in fantail guppy (*P. reticulata*) fed with live Tubifex than other commercial foods. Common blue-green algae Spirulina (e.g., *S. plantensis*) is also known as a good source of protein, vitamins and minerals for animal feed which promotes growth and development of fish as well as improves their color.[14] Trash from different sources like sea fish has been reported as a promising source protein which can be used as a useful by-product ingredient for fish feed formulation.[15] To date, no ornamental fish feed has been developed from these ingredients in Bangladesh. The present study was aimed to assess the growth performance of Guppy and Platy by feeding different experimental ornamental fish feed formulated with locally available ingredients but trash fish (B1), *Spirulina* (B3) and *Tubifex* (B4) as their major source of protein.

To establish a low cost, convenient and readily available ornamental fish feed to increase the production of ornamental fish culture and rearing in Bangladesh, BCSIR prepared three feeds (B1, B2 and B3) and compared with an imported market feed (MF). We assumed that the growth performance such as Food Conversion Ratio (FCR), Average Daily Gain (ADG), Specific Growth Rate (SGR), condition factor (K) etc. Would be different in four types of feed comparatively on two ornamental fishes (Guppy and Platy) because of their different ingredients. We expect that one or two of these locally made feed would reduce the depending on expensive imported ornamental fish feed in Bangladesh.

MATERIALS AND METHODS

The whole experiment was carried out in the laboratory at Zoology Section, Biological Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh from March 2015 to September 2015. To perform this study *Poecilia reticulata* (Guppy) and *Xiphophorus maculatus* (Platy) fish was selected because of its livebearer, faster growth, wide range of different water parameter tolerance and high survival rate in laboratory environments and their feeding behavior of different types of fish feeds. For these study fingerlings of these fishes were produced from laboratory reared brood fish. Average initial length of lab breed of Guppy and Platy fingerlings were 1.32 cm and 1.29 cm, respectively. 20 fingerlings were acclimated in each aquarium (29 inch in length and 14.8 inch in width) filled up with about 60 L of tap water. Aerator was used for 24 hr during the experimental period. No feed was given on first day. Feed was supplied regularly on the basis of 10% body weight. No license for ethical approval was required to feed or experiment on the ornamental fish in our country.

Four different types of fish feeds were used in this experiment for the duration of 12 weeks. One of them was commercial feed (imported from Malaysia). Three others were handmade feeds (B1, B3 and B4) formulated by BCSIR (Table 1). All ingredients were added by using Pearson square method of feed formulation to determine the proper dietary proportions of high and low-protein feeds. The proximate composition of four types of feeds and their ingredients have been conducted to determine their moisture, fat, carbohydrate and crude protein level by following the methods of AOAC (1995). A hand pelletizer having a perforated disc with 2 mm or smaller holes (requirements for ornamental fishes) was used to prepare the feed. The different size pellets dried under sun light for 3-4 days and finally in a hot air oven at 60°C for 1-2 days. After drying pellets were ready to feed for fishes. The feed were preserved in a dry air tied bag or container for at least 6 months at room temperature or 1 year in refrigerator at 4°C. Table 1 showed the name of different feeds with their composition used in the study:

Water quality parameters were recorded twice in a week by using a digital thermometer (WT-2, India) for temperature, dissolved oxygen meter (HI 9146, HANNA, Hungary) for dissolved oxygen, a digital pH meter (3505, JENWAY, Germany) for p^H value, a digital Lux meter (LX 1010B, UK) for light intensity and a conductivity meter (4510, JENWAY, Germany) for conductivity and Total Dissolve Solid (TDS). Growth (length, weight and width) of the sample fishes was measured once in a week at 10.00 am to 11.00 am. Five samples were measured randomly at a time

at an interval of 7th, 14th, 21st, 28th, 35th, 42th, 56th, 63th, 70th, 77th and 84th days of the experimental period. After 84 days of rearing at the termination of the experiment, the final length (cm), width (cm) and weight (g) of the individual fishes were carefully recorded. Changes in the coloration of experimental fishes were also observed visually to make a comparison of effects of fish feed.

Data analysis

Data were collated in Excel (Microsoft) and statistical analyses were conducted using R, version 3.6.3 (R Core Team 2020). Experiment data collected during the growth trial were used to determine the following growth parameters.

Body Length (BL)

Total Length (TL) of fish was calculated by the following formula:

$$TL=Tf-T0$$

Where, $T_{f=}$Final length, T_0=Initial length.

Body Weight (BW)

Body weight as weight gain was measured by the following formula as suggested by Tacon (1990)-Body Weight Increase:

$$(BWI)=Wt-W0$$

Where, W_t=Final weight, W_0=Initial weight

Condition factor (CF)

This is the factor through which condition of the fish is expressed in numerical terms i.e., degree of flatness is usually estimated as the condition factor. It was calculated by the following formula as suggested by Hile (1936).

$$K=(W/L3)*100$$

Where, K=condition factor, W=body weight in grams, L=body length in cm.

Average Daily Gain (ADG)

Average daily gain was determined by the following formula suggested by De Silva and Anderson (1994).

$$ADG = \frac{\text{Mean final fish weight} - \text{Mean initial weight}}{\text{Time (T2} - \text{T1)}}$$

Specific Growth Rate (SGR)

SGR is a measurement of the percentage body weight increase per day. Specific growth rate was calculated as the percentage increase in weight per animal per day as suggested by Hopkins (1992).

$$SGR = \frac{\ln Wt - \ln W1}{T - t}$$

Where, ln W_t=Natural Log of Weight at Time T, ln W_1=Natural Log of Initial Weight, T=Time T, t=Initial Time.

Feed Conversion Ratio (FCR)

FCR is calculated by following formula:

$$FCR = \frac{\text{Feed consumed by the fish (g)}}{\text{Live weight of the fish (g)}}$$

Survival Rate (SR)

Survival Rate (SR) was determined by the following formula suggested by Ai *et al.* (2006)-Survival=$N_t \times 100\ N_0^{-1}$ Where, N_t=Number of fishes harvested, N_0=Number of fishes stocked.

The Mann-Whitney U test was used to compare the total length and weight gain differences between Guppy and Platy culture. The Kruskal-Wallis test was performed to observe the differences in the pattern of each growth performance parameters among four types of feeds. Pearson's correlations were used to test for relationships between all growth parameters for Guppy and Platy fish. To quantify the associations between growth parameters and different types of feed, GLMs were fitted with a Gaussian distribution and identity link function. Total length and weight gain were fitted as response variables, feed (B1, B3, B4 and MF), Total Length (TL), Weight Increase (WI), Condition Factor (CF), Average Daily Gain (ADG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR) and fish (Guppy and Platy) as predictor variables. The best fitting model was obtained by stepwise regression with top-down selection of significant variables

Table 1: Different treatments with four types of fish feed used in rearing of Guppy and Platy fish.

Ingredients with crude protein (%)	Name of the feed	Composition of feed ingredients (100 g)
Trash fish (50%) Spirulina (52.92%) Tubifex (46%) Shrimp (37.5%) Mastered oil cake (36.54%) Soybean (38.26%) Rice brine (11.03 %) Corn grain (8.25%) Wheat (12%) Algae (11.33%)	BCSIR feed (B_1)	Rice brine (14.5 g), corn grain (14.5 g), wheat (14.5 g), shrimp (13.7 g), trash fish (13.7 g), mastered oil cake (13.7 g), soybean (13.7 g), fish oil (0.84 mL), vitamin and minerals (0.84 g).
	BCSIR feed (B_3)	Corn grain (27 g), wheat (27 g), Spirulina (14.81 g), shrimp (14.81 g), soybean (14.81 g), fish oil (0.76 mL), vitamin and minerals (0.76 g).
	BCSIR feed (B_4)	Corn grain (15.38 g), wheat (15.38 g), algae (15.38 g), shrimp (17.95 g), Tubifex (17.95 g), soybean (17.95 g), fish oil (0.57 mL), vitamin and minerals (0.57 g).
	Market Feed (MF) as control	Yellow corn, fish meal, white grain, soybean meal, shrimp meal, fish oil, vitamins and minerals.

Table 2: Proximate composition (mean±SE) of experimental feeds in four types of feeds.

Feed	Protein	Fat	Carbohydrate	Moisture	Ash	Energy (Kcal/g)
B1	26.36±0.0	12.57±0.0	42.98±0.0	7.32±0.0	10.77±0.0	399.53±0.0
B3	27.15±0.80	4.5±0.13	51.95±0.6	7.76±0.05	8.66 ±1.3	365.00±5.5
B4	31.26±1.9	2.61±0.08	53.65±2.06	5.6±0.06	6.87±0.14	371.0±1.0
MF	22.28 ±2.1	3.06±0.20	60.94±2.4	6.12±0.23	7.6±0.13	369.33±0.67

determined by Akakine Information Criteria (AIC) and the significance of the components was tested using F statistics.

RESULTS

Comparative nutritional composition of experimental feeds

The average proximate compositions of dry matter of the experimental feeds (B1, B3, B4 and MF presented in Table 2. It showed that the mean protein content (crude protein) was significantly higher in B4 (Tubifex) feed than MF ($F_{1, 3=}$6.302, p=0.016). The mean fat content was significantly different among all feeds except B4 and MF (($F_{1, 3=}$1290, p=0.00). Analysis of carbohydrate showed significantly different content among all feeds except between B1 and MF ($F_{1, 3=}$42.93, p=0.00).

Comparative analysis of growth performance regarding supplemented feed between Guppy and Platy

The growth performance of Guppy and Platy fish varied by feeding four types of fish feed (B1, B3, B4 and MF) during 84 days of the experiment.

The mean length, weight and ADG of both fish were highest in B1 feed and lowest in B4 feed (Figures 1A-C). In Guppy, the average condition factor of was highest in MF and lowest in B1 feed whereas in Platy, it was highest in B1 and lowest in B4 (Figure 1D). The mean SGR was highest in MF for Guppy and in B4 for Platy but lowest in B3 for both fish (Figure 1E). The FCR of both fish was highest in B3 whereas lowest in MF and B1 for Guppy and Platy, respectively (Figure 1F).

Association of growth performance parameters for Guppy and Platy fish rearing

The first two principal components of a PCA of growth performance factors for the four types of feeds of Guppy and Platy explained approximately 85.87% of the variance among individuals (Figure 2). PC1 was strongly correlated with most parameters (except SGR and FCR) of growth experiment on both fish. SGR and FCR were highly correlated with PC2 and had a stronger influence on the variation among feed trial of Guppy and Platy. Overall, the growth performance of both fish showed more or less similar response in B1 and B3 feeds than B4 and MF (Figure 2).

Survival Rate (SR)

Survival Rate (SR) of Guppy was 100%, feeding with B1, B4 and MF except B3 (95%). On the other hand, the highest SR was 95% feeding with B1 and B3 and was lowest at B4 (85%) in Platy culture. SR showed no significant difference in both fish (Paired t-test, t=1.46, d_f=3, p=0.24).

Pigmentation evaluation

The visual observation of pigmentation found different in both fishes treated with four types of feed. In Guppy, the brightest pigmentation recorded at B4 feed treatment and the lowest in MF (Plate 1). In Platy, the highest colouration was observed B4 feed treatment whereas lowest in B1 (Plate 2).

Physio-chemical properties of experimental water for Guppy and Platy culture

During the experimental period, the highest temperature (30ºC) was recorded in treatment with B4 and lowest (28.3) was recorded in treatment with B1 feed. The maximum dissolved oxygen was recorded in platy culture feeding with MF whereas; the minimum dissolved oxygen was recorded also in platy culture feeding with B4. The maximum light intensity was recorded in B3 treatment of Platy culture whereas; the minimum light intensity was recorded in B4 treatment of Guppy culture. The maximum pH was recorded in treatment with B4 feed whereas; the minimum pH was recorded in B1 feed treatment in Guppy culture. The maximum conductivity was recorded in B3 whereas; the minimum conductivity was recorded in treatment feeding with MF of Platy culture. The ranges of TDS (mg/L) content in four feed treatments were 4.26 to 4.38 in both Guppy and Play culture. The maximum TDS was recorded both in B4 and MF feeding treatment of Guppy culture whereas; the minimum TDS was recorded in B1 feed of Platy culture. There was no significant difference (p>0.05) in temperature, pH, DO, light intensity, conductivity and TDS among the treatments with four different types of feeds.

DISCUSSION

Ornamental fish, especially live breeders are the most popular pet fish because of their great variation and easy handling. Guppies and Platys are these fishes that are best known as a good choice for beginner aquarists, since they are hardy and reproduce rapidly.[16] In the present study, new-born fingerlings of both

Guppy and Platy were used to compare the effectiveness of three locally made (B1, B3, B4) and one imported Market Fish Feed (MF) on their growth response because of its availability, easy culture and omnivorous nature. We found significantly different and higher growth performances of BCSIR formulated feed in compare to expensive market feed. All growth parameters such as total length, weight increase, condition factor, average daily gain, specific growth rate and feed conversion ratio showed different pattern in Guppy and Platy fish.

In the experimental period, all fish showed good feeding response with all types of artificial feed and increased their total length significantly. The average highest length was recorded for B1 feed in both Guppy and Platy culture which indicates its best performance among four kinds of feed. The value of total length in Guppy (*P. reticilata*) was found ranging from 2.18 to 3.60 cm, which mirrored the result of present findings.[17] Body weight, as an indicator physical factor of fish growth usually shows which feed is best for fish culture.[18] During the experiment, body

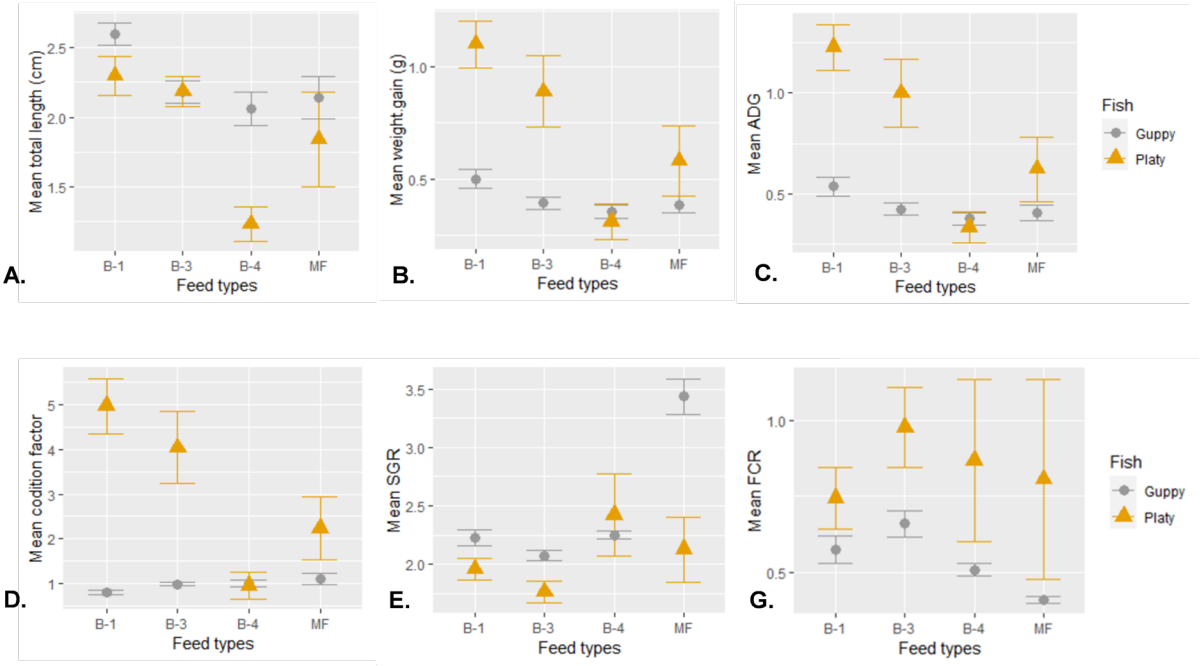

Figure 1: Mean (±S.E.) growth performance factors (A-F): Total Length (TL), Weight gain (WG), Condition Factor (CF), Average Daily Gain (ADG), Specific Growth Rate (SGR) and Food Conversion Ratio (FCR) of Guppy (circle) and Platy (triangle) fish feeding with four types of feeds (B1, B3, B4 and MF).

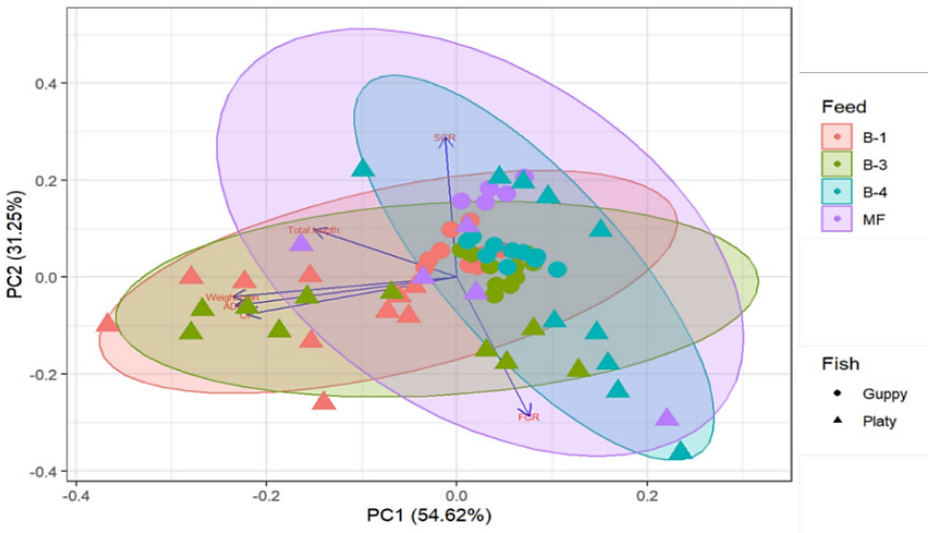

Figure 2: The first two Principal Components (PCs) of six growth performance parameters of Guppy (circle) and Platy (triangle) culture by feeding four types of feeds. PC1 (54.62%) describes overall variation in length, weight, ADG and condition factor of fish, while PC2 (31.25%) describes variation in SGR and FCR. Ellipses with 95% confidence intervals for each data set describing variation in four types of feed, separating the larger cluster for samples in MF than the other groups. Each dot represents single fish under four feed groups: B1 (red), B3 (Green), B4 (turquoise) and MF (purple).

weight showed significant difference with each other but response in both fishes were similar. The highest weight was recorded in B1 feed culture and the lowest was with B4 feed in both Guppy and Platy. Previous studies also recorded similar type of growth pattern for the weight of Guppy fish in different types of feeding trial.[17,19,20]

The observed Condition Factor (CF) showed significant differences among four types of feed as well as two fish which might be due to feed ingredients and different physiological response of Guppy and Platy. During the experimental period, the condition factor was highest in treatment with MF feed for Guppy culture and lowest value was observed in B4 for Platy culture. A study on the survival and growth of cat fish by feeding selected supplemental feeds found the values of condition factor between 0.51 and 0.87 that is quite similar with the findings of present study.[21]

After 12 weeks rearing period, ADG showed similar type response for feed in both Guppy and Platy culture. The highest ADG value was achieved at B1 treatment and the lowest value was observed at B4 treatment. Overall, B1 and B3 feeds had significantly different effects on the average daily gain than B4 feed. The significantly highest ADG in treatment B_1 might be due to the fact that the fish have utilized effectively the supplied feed. The overall pattern of SGR was significantly lower in B3 than B4 and MF but their mean value was different in Guppy and Platy. The values of Specific Growth Rate (SGR) of Guppy fish was the highest in treatment MF and lowest in treatment B3 whereas the highest in treatment B4 and lowest in treatment with B3 for Platy fish. It indicates that nutrients of B3 did not fulfill the dietary requirement of these fish to grow faster than other feed treatments.[17,22]

The feeding utilization was calculated in terms of feed conversion ratio where a low FCR value indicated the better food utilization or efficiency of supplemental feed.[23] In this study, the value of feed conversion ratio was varied between Guppy and Platy. In Guppy, the lowest i.e., the best FCR was observed in treatment with MF and the poorest FCR value was recorded in treatment with B3 feed. The lowest i.e., the best FCR was observed in treatment with B1 and the highest i.e., the worst FCR value was recorded in treatment with B3 for Platy fish. The observed FCR value showed significant difference with each other. The significantly high FCR recorded in the group fed with B3 feed might be the presence of strong odor of Spirulina or might be the non-availability of required amounts of nutrients for the growth of fish.[17] This result also indicated that all types of feed were palatable to both fish having good FCR value and can be used to feed these types of ornamental fish.

Survival rate, as an important factor of aquaculture showed no significant differences between Guppy and Platy and among treatment feeds. In this study, Guppy fingerlings shows almost 100% survival rate except B3 during the experimental period. But in Platy culture survival rate was lower among four types of feeds which ranged from 95% to 85%. It was recorded a 57 days of feeding trial on Guppy fish with different commercial feeds and found their survival rate between 94% to 91% which almost same with these findings.[20]

Colour is the most important indicator of quality for ornamental fish rearing and farming.[12] During the experiment, there was a visual difference among experimental fish colour feeding with different feeds. The highest color pigmentation was observed in treatment with feed B4 (mixed with Tubifex worm) among four kinds of feed at both Guppy and Platy culture. The second highest colouration was in B3 feed with Spirulina as major protein source. This might be the presence of natural pigment (carotenoids) in red blood worm, Tubifex (Astaxanthin) and high level of β-carotene as well as zeaxanthin in Spirulina enriched feeds-B4 and B3.[12,24-27] On the other hand, the lowest pigmentation recorded at MF and B1 treatment in Guppy and Platy culture, respectively which might be the absence of any natural pigment ingredients in these feeds.

Water quality of aquarium plays a vital role having direct influence on the general health status of the ornamental fish.[28] During the experimental period, the water temperature of aquarium was more or less similar in different treatments which ranged from 28.3 (14th day) to 30.6^{o}C (70th day). The Dissolved Oxygen (DO) content in four feed treatments (B1, B3, B4 and MF feed) were ranged from 6.05 to 7.07 (mg/L) respectively, for

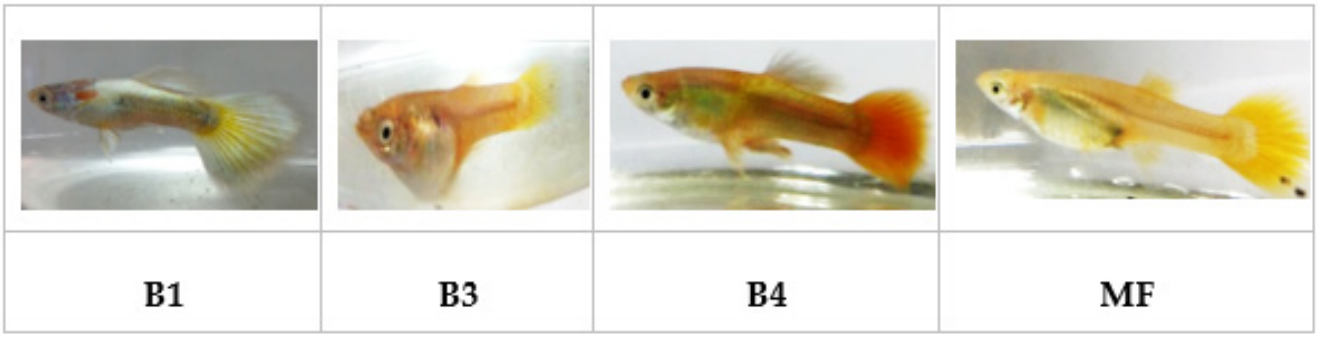

Plate 1: Effects of four types of feeds (B1, B3, B4 and MF) on color variation of Guppy for visual observation.

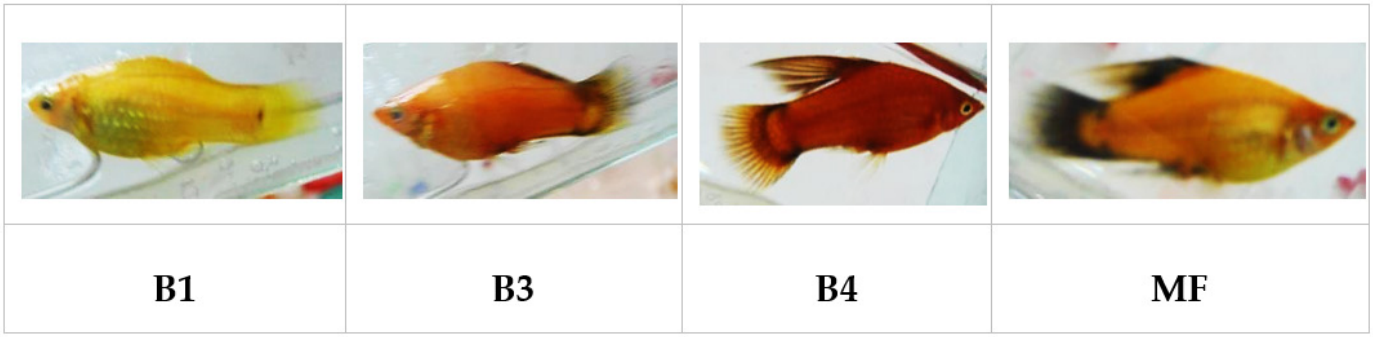

Plate 2: Effects of four types of feeds (B1, B3, B4 and MF) on color variation of Platy for visual observation.

guppy and platy culture. These findings were more or less similar to the findings of ornamental fish culture.[29] Similarly, the range of pH and the conductivity and TDS (mg/L) content in water of four feed treatments were within the acceptable range in both Guppy and Play culture.[29] During the experimental period, the light intensity was found approximately same which have very little impact on culture medium.

The level of dietary protein has significant importance on growth, survival and yield of fish.[30] Protein requirement for most live-bearing poecilid fish ranged between 25% to 40% on the basis of their growth pattern and reproductive performance.[16,20] In the present study, all handmade feeds contain almost same percentage of protein (26-31%) but their sources were different which greatly effects on the growth performances of experimental fish. These results indicated that the growth rate of fish was higher by laboratory made feed than Market Feed (MF) except B4. Local ingredients (Trash fish, Spirulina and Tubifex) for protein sources in combination with rice bran, corn grain, wheat (feed binder), mustard oil cakes etc. used in the present study were available and their effects on growth performance of platy and guppy fish were significantly noticeable.[31] found that local ingredients (Fishmeal, mustard oil cake, rice bran) are helpful for better growth of ornamental fishes which supports the findings of present study.

Present study observed that nutritional qualities of three selected available indigenous ingredients (Trash fish, Spirulina and Tubifex) were able to meet up the food demand for reproductive performance of Guppy and Platy fish. During the study period both Platy and Guppy fish reached maturation level at twelve weeks. The sexual dimorphism showed in both male and female fish. Guppy fish was breed multiple times in experimental period but Platy fish didn't breed during this period. In 70th day, Guppy fish breed 9 fry's at B3 treatment, 9 fry's at B1 and 1 fry at B3 in 75th day. At the end of the experiment Guppy fish breed only one fry on 77th day at B_1 treatment. The results of the present study showed that the both fish were accepting all type of feeds with different color appearance at higher quantity. Although the crude protein content was higher in B4 feed (Tubifex), the growth performance parameter indicated the best result in B1 feed made of trash fish. This is quite different from the findings of[32] who found that dark-colored feeds have a better performance than light-colored feed.

Feed cost is one of the important parts of any kind of fish culture. In this study, four kinds of feed used having different in their ingredients. Among them three were manufactured in the laboratory and another one bought from local market. The laboratory manufactured artificial ornamental feed cost was varied from the range of BDT (150 to 200) Tk/kg. But the artificial feed (bought from market) costs BDT 700 Tk/kg.[7] Therefore, the handmade feed was comparatively cheaper than the imported Marketed Feed (MF). If this market feed could be prepared locally then it will be cost effective. These findings are more similar to the findings[7] who reported that super Nova™ feed cost is BDT 1200 to 1500 Tk/kg.

CONCLUSION

The experimental results presented in this study have demonstrated that many of the artificial feeds used for ornamental fish could also be applied successfully in ornamental fish culture. It is evident from the results of the present study that the Feed used in T1, which contained the recommended amount of dietary protein and lipid levels, resulted better growth performance of Guppy and Platy compared to other diets. From the above discussion, it is clear that the effects of four different feeds on growth performance for Guppy and Platy culture was highest in B1 and then B3 and MF whereas lowest in B4. The poor growth performance observed in B4 feed suggests that it needs further improvement for optimal growth of poecilid fish. Therefore, trash fish and Spirulina mixed B1 and B3 feeds could be used as an alternative of expensive, imported ornamental fish feed. Current study is totally laboratory based, so field studies on mass culture are needed to clarify the actual effects of different artificial ornamental fish feeds on Guppy and Platy fish culture. To increase the production of Guppy and Platy fish and also other ornamental fish further research should be conducted on quality and performance of different artificial ornamental fish feed used in Bangladesh.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

AOAC: Association of Official Analytical; **FAO:** Food and Agricultural Organization; **MF:** Market Feed.

ETHICAL APPROVAL

No license was required to feed the ornamental fish in our country.

DATA AVAILABILITY STATEMENT

Data will be deposited in publicly accessible repository such as Dryad after acceptance of the manuscript.

SUMMARY

Formulating affordable ornamental fish feed using locally sourced ingredients is seen as a promising strategy to boost aquaculture in Bangladesh. The study aimed to compare the effects of four different feeds, each with distinct protein sources, on the growth performance of Guppy (*Poecilia reticulata*) and Platy (*Xiphophorus maculatus*). Over a twelve-week period, significant differences in growth were observed among the feeds: B1, B3, B4, and a commercial Market Feed (MF). The ranking of feeds based on growth performance was B1> B3> MF> B4, indicating that B1 and B3 supported the best growth, while B4, despite its higher protein content, was less effective except for enhancing coloration. The findings suggest that B1 and B3 can serve as cost-effective alternatives to expensive imported feeds, providing good growth outcomes for these ornamental fish.

REFERENCES

1. Kabir MA, Rahman MS, Hossain A, Mandal SC. Proximate composition and microbial quality of three imported aquarium fish feeds in Bangladesh. *Bangladesh J. Zool*. 2014; 42(2): 283-94.
2. Biondo MV and Burki RP. A systematic review of the ornamental fish trade with emphasis on coral reef fishes-an impossible task. *Animals*. 2020; 10(11): 2014.
3. De Silva SS and Anderson TA. Fish nutrition in aquaculture (Vol. 1). Springer Science and Business Media, 1994.
4. Tissera K The Global Ornamental Fish Industry-An Outline of the First Decade of the New Millennium. In International Conference Sustainable Ornamental Fisheries Way Forward, Souvenir, held on March; 2012. Pp.23-5
5. FAO. FishStat Plus: Aquaculture Production Statistics: 1997-2008. Food and Agricultural Organisation of the United Nations, 2010; Fisheries and Aqauculture Department, Rome.
6. Tlusty M. The benefits and risk of aquaculture production for the aquarium trade. *Aquaculture*. 2002; 205(3-4): 203-19.
7. Kabir MA, Rahman MS, Hossain A, Mandal SC. Proximate composition and microbial quality of three imported aquarium fish feeds in Bangladesh. *Bangladesh J. Zool*. 2014; 42(2): 283-94.
8. Chapman FA, Fitz-Coy SA, Thunberg EM and Adams CM. United States of America trades in ornamental fish. *Journal of the World Aquaculture Society*, 1997; 28: 1-10.
9. Craig S and Helfrich LA. Understanding fish nutrition, feeds and feeding. Virginia cooperative Extension. publication, 2009; 420-56.
10. CheikyulaJ and Ofojekwu P. Growth responses and survival of the goldfish, *Carassius auratus* (Cyprinidae) fry reared on Moina (Cladocera) and Cyclops (Copepoda). *Journal of Aquatic Scie*nces, 2003; 18(1): 1-9.
11. Begum M, Islam N and Islam Al. Effect of various feeds on the hatchings of *Cyprinus carpio* in aquarium with reference to temperature. *Bangladesh J. Aquaculture*. 1988; 10(2): 55-60.
12. Andriani Y, Priyadi A and Firdaus SN. Effect of tubifex and carrot meal combination on color quality of Botia *Chromobotia macracanthus*. In *E3S Web of Conferences*. 2020; (Vol. 147, p. 01007). EDP Sciences.
13. Alam MA, Khan MA, Sarower-E-Mahfuj MD, Ara Y, Parvez I and Amin MN. A model for tubificid worm (*Tubifex tubifex*) production and its effect on growth of three selected ornamental fish. *Bangladesh Journal of Fisheries*. 2021; 33(2): 205-14.
14. Duncan PL and Klesius PH. Effects of feeding Spirulina on specific and nonspecific immune responses of channel catfish. *Journal of Aquatic Animal Health*, 1996; 8(4): 308-313.
15. Adéyèmi AD, Kayodé APP, Chabi, IB, Odouaro OBO, Nout, MJ and Linnemann AR. Screening local feed ingredients of Benin, West Africa, for fish feed formulation. *Aquaculture Reports*. 2020; 17: 100386.
16. Chong AS, Ishak SD, Osman Z and Hashim R. Effect of dietary protein level on the reproductive performance of female swordtails *Xiphophorus helleri* (Poeciliidae). *Aquaculture*, 2004; 234(1-4): 381-92.
17. Kithsiri HP, Sharma P, Zaidi SS, Pal AK and Venkateshwarlu G.) Growth and reproductive performance of female guppy, *Poecilia reticulata* (Peters) fed diets with different nutrient levels. *Indian Journal of fisheries*. 2010;*57*(1) : 65-71.
18. Ai Q, Mai K, Tan B, Xu W, Zhang W, Ma H and Liufu Z. Effects of dietary vitamin C on survival, growth, and immunity of large yellow croaker, *Pseudosciaena crocea*. *Aquaculture*. 2006; 261(1): 327-36.
19. Sahin T, Turkmen G and Emiroglu DI. The Effects of Different Feeding Programmes on Growth and Survival Rates of New-born Guppy (*Poecilia reticulata* PETERS, 1859). In proceedings of the International Symposium on Sustainable Development, 2012. pp.25-30.
20. Sharon G, Fridman S, Reiss-Hevlin N, Sinai T, Boisot P and Zilberg D. Effects of different commercial diets on growth performance, health and resistance to *Tetrahymena* sp. infection in guppies, *Poecilia reticulata* (Peters). *Aquaculture Research*. 2016; 47(7): 2276-86.
21. Rahman MA, Bhadra A, Begum N and Hussain MG. Effects of some selective supplemental feeds on the survival and growth of catfish (*Clarias batrachus* Lin.) fry. *Bangladesh J. Fish. Res*. 1997;l(2): .
22. Mahfuj MSE, Hossain MB and Minar MH. Biochemical composition of an endangered fish, *Labeo bata* (Hamilton, 1822) from Bangladesh waters. American *Journal of Food Technology*. 2012; 7(10): 633-41.
23. Hassan HU, Ali QM, Ahmad N, Masood Z, Hossain MY, Gabol K, Khan W, Hussain M, Ali A, Attaullah M and Kamal M. Assessment of growth characteristics, the survival rate and body composition of Asian Sea bass Lates calcarifer (Bloch, 1790) under different feeding rates in closed aquaculture system. *Saudi Journal of Biological Sciences*, 2021; 28(2): 1324-30.
24. James R, Sampath K, Thangarathinam R and Vasudevan I Effect of dietary Spirulina level on growth, fertility, coloration and leucocyte count in red swordtail, Xiphophorus helleri. *Israeli Journal of Aquaculture*-Bamidgeh, 2006; pp.58.
25. Dernekbasi S, Unal H, Karayucel I and Aral O.) Effect of dietary supplementation of different rates of Spirulina (*Spirulina platensis*) on growth and feed conversion in Guppy (*Poecilia reticulata* Peters, 1860). *Journal of Animal and Veterinary Advances*, 2010; 9(9): 1395-9.
26. Güroy B, Şahin İ, Mantoğlu S and Kayal S. Spirulina as a natural carotenoid source on growth, pigmentation and reproductive performance of yellow tail cichlid *Pseudotropheus acei*. *Aquaculture International*, 2012; 20(5): 869-78.
27. Mathew RT, Debnath S, Kundu P, Alkhamis YA, Rahman MM, Rahman MM, Sarower MG and Rahman SM. Growth and survival of goldfish (*Carassius auratus*) juveniles fed Tubifex, custard meal and commercial feeds. The Scientific Journal of King Faisal University: *Basic and Applied Sciences*. 2022; 23(1): 30-5.
28. Al Z, Abdullah W, Asaad H, Mohamed, Augusto E. Serrano Jr and Rex Ferdinand M. Camouflage grouper (*Epinephelus polyphekadion*) fingerlings fed a commercial diet. *European Journal of Experimental Biology*. 2013; 3(1): 596-601.

29. Sharma M. Ornamental fish rearing and breeding-a new dimension to aquaculture entrepreneurship in Himachal Pradesh. *Int. J. Fish. Aquat. Stud*. 2020; 8(2): 157-62.

30. Pousão-Ferreira P, Castanho S, Ribeiro L, Coutinho J, Bandarra NM and Mendes AC (Larval rearing protocols for meagre *Argyrosomus regius*. Larvi, 2013; 378.

31. Begum M, Pal HK, Islam MA and Alam MJ. Formulation of quality fish feeds from indigenous raw materials and their effects on growth and maturity of *Mystus gulio*. *Journal of the Bangladesh Agricultural University*, 2008; 6(2): 355-60.

32. El-Sayed AFM. ed., *Tilapia culture*. 2006; CABI publishing.

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