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Article

Growth performance and survival of guppy (*Poecilia reticulata*): different formulated diets effect

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Abstract: Growth performance of guppy fries was assessed by providing four different types of formulated diets comprised of some available ingredients (fish meal (FM), prawn meal (PM), meat and bone meal (MBM), wheat flour (WF), corn flour (CF), starch (S) and soya bean oil) and the result was compared with supplied commercial diet as control. After 30 days experimental period, diet 1 (FM: PM=6:1) showed the best result in case of length gain (0.48 cm) in guppies whereas lowest (0.01 cm) was reported from diet 2 (PM: MBM= 4:3). The body weight gain in guppies was also found higher (0.004 g) in diet 1 than other diets. Specific growth rate (SGR) of all formulated diets was between 1.03% to 4.8% while 0.7% was found in commercial diet. Maximum survival rate (95%) was recorded in formulated diet 1 whereas 80% was investigated in control .Growth trend of guppies from all the supplied formulated diets resulted better rather than the imported commercial diets. So, Commercial diets might be replaced by experimental diets for the better production of guppy.

Keywords: guppy; formulated diet; growth; survival; SGR

1. Introduction

Guppies (*Poecilia reticulata*) are one of the popular ornamental fishes produced in many Asian countries as live bearing species (Chong *et al.*, 2004). As a freshwater fish of the family Poecilidae, guppies (*Poecilia reticulata*) are easy to keep and breed in aquaria (Adil *et al.*, 2014) and are becoming more popular having addaptive capability and affordable price. They generally accept all kind of foods including dried and live.The feed requirements vary in quantity and quality according to their feeding habits and digestive anatomy as well as their size and reproductive state and also affected by environmental variations such as temperature and the amount and type of natural food available (Gonzalez and Allan, 2007). Therefore, it is necessary to focus on the feed supply according to energy requirement. In ornamental fish, a correct formulation of the diet improves the nutrient digestibility; supply the metabolic needs and reducing the maintenance cost and at the same time the water pollution (Yohana and Wilson, 2011). It is also essential to provide the fish larvae appropriate size of feed for better growth and survival. Guppies can easily survive in confinement and culturists do not need to pay much attention for it's nutritional management but poor and unbalanced feed create problems related to lower growth and survival rates. Consequently, the production is related to quatily feed and total cost of feed formulation. This is a major economical concern for aquarium culturists. For this reason, formulated feeds are specifically designed for the productivity of ornamental fishes and are manufactured to result in optimal growth at minimal costs (Mohideen *et al.*, 2014).

Furthermore, ornamental fish culture has started to grow as an industry globaly.There are potentials of this sector for economy of the country like Bangladesh. About 6 billion of global trade is contributed by ornamental fishes (Venkataramani *et al.*, 2010). The start of the millennium projected an annual global exports of USD 176 million which compounded annually at a growth rate of 6.2% and reached around 342 million USD in 2010 (Tissera, 2012). Development of aquaculture technology, water management systems, better understanding of nutrition and aquatic disease management have helped this industry to reach every part of the world (Tissera, 2010). Thus a wide range of aquarium fishes are culturing with both commercial and decorative aspects. Besides, the industrial development of guppy is influenced by suitable feed and feeding at their developmental stages from fry to adult. Several studies already established on the impacts of different feeds on the growth of edible fishes but studies related to dietary formulation performance in ornamental fishes are scarce (Nancy *et al.*, 2015). According to this regard, research is essential for the better understanding of nutritional requirements and growth pattern of important ornamental fishes. Therefore, the present study was carried out to investigate the effect of different formulated diets on water quality and the growth and survival performance of guppy fries.

2. Materials and Methods

2.1. Experimental design and fry collection

Total 300 guppy (*P. reticulata*) fry were purchased from commercial suppliers of Chittagong aquarium fish shops, Bangladesh and acclimatized in a large glass aquarium in laboratory condition for one day. Then the fries were divided into five experimental groups including a control, each with three replicates. The divisions were designed on the basis of formulated feeding trial. The study was conducted with 20 guppy fries (almost uniform size) in each 12 L (13 inch X 8 inch X 9 inch) rectangular glass aquarium of 10 L fresh tap water for 30 days in the laboratory of Aquaculture in Chittagong Veterinary and Animal Sciences University, Bangladesh. Length and weight of individual guppies were recorded before starting of the experiment using measuring scale and electric balance. Separate aquariums were marked regarding five different diets. Among those experimental diets, four types were formulated using different commonly available ingredients. Continuous aeration was provided by 2 aquarium air pump and diffusers. Excreta and leftover feed were removed weekly from the bottom of each aquarium through siphoning. In every 4 days, one third volume of water was changed from each experimental unit.

2.2. Diet preparation and feeding

Five types of diets were provided to guppy fries in the present study. Diet 1, diet 2, diet 3 and diet 4 were prepared using ingredients according to Table 1 whereas control was a commercially available pelleted feed (Fish meal, corn gluten meal, corn meal, soyabean meal, shrimp meal, vitamin, mineral and astaxanthin were used as ingredients, according to the level). Fish and prawn meal (FM:PM=6:1), prawn meal and meat and bone meal (PM:MBM= 4:3), meat and bone meal, prawn meal and fish meal (MBM:PM:FM=4:2:1) and wheat flour, prawn meal and fish meal (WF:PM:FM= 4:1:2) were used as key ingredients in diet-1, diet-2, diet-3 and diet-4 respectively. The quantity of corn flour, starch powder and soya bean oil were kept constant to prepare 1 kg diet. No preservatives, synthetic vitamins and minerals were added. Feeds were made pellet through standard process and kept in fully air tight container after air drying in room temperature. Feeding was carried out thrice a day at 9:30am, 1:00pm and 5:00pm throughout the experimental period. Fry were initially fed at a rate of 100% of their body weight however the rate minimized gradually to 80%, 60% and 40% in every consecutive week interval. Fish health was monitored regularly though eye observation and dead fish were taken away immediately without any replacement.

Table 1. Ingredients quantity of prepared diets.

Ingredients	Diet 1 (g/kg)	Diet 2 (g/kg)	Diet 3 (g/kg)	Diet 4 (g/kg)	Control
Fish meal (FM)	600	0	100	200	Commercial
Prawn meal (PM)	100	400	200	100	pelleted feed
Meat and bone meal (MBM)	0	300	400	0	
Wheat flour (WF)	0	0	0	400	
Starch (S)	50	50	50	50	
Corn flour (CF)	200	200	200	200	
Soyabean oil	50	50	50	50	

2.3. Water parameters

The water quality parameters (temperature, dissolved oxygen, pH and turbidity) were recorded daily throughout the experiment. The dissolved oxygen and temperature was measured using portable meter (EcoScense DO 200A, USA). pH was observed by pen pH meter (LT-Lutron pH-207, Taiwan) and turbidity assessed through turb meter (Turb 430IR,USA).

2.4. Growth parameters

During the investigation, length and weight of individual guppy fry from all the respective aquariums were measured and recorded on the first day, followed by once again at the end of the experiment. Survival was also evaluated. Survival and Growth rate of *Poecilia reticulata* fry was calculated respectively for a period of 30 days using following equations:

(i) Body weight increase (BWI) (g) = $W_t - W_0$ (Tacon, 1990)

(ii) Percent body weight increase (PBWI) (%) = $[(W_t - W_0)/ W_t] \times 100$ (Bekcan *et al.*, 2006)

(iii)Length gain (cm) = Mean final length (L_t) – Mean initial length (L_0)

(iv) Percent length gain (%) = [(Mean final length (L_t) – Mean initial length (L_0))/Mean final length (L_t)] ×100%

(v) Specific growth rate (SGR) (%/day) = $(\ln W_t - \ln W_0) \times 100\ t^{-1}$ (Hevroy *et al.*, 2005)

(vi) Body weight gain (BWG) (g) = $(W_t - W_0) \times N_t$ (De Silva and Anderson, 1995)

(vii) Daily growth rate (DGR) (%) = $[(W_t - W_0)/ t] \times 100$ (De Silva and Anderson, 1995)

(viii) Survival (%) = $N_t \times 100\ N_0^{-1}$ (Ai *et al.*, 2006)

Here, W_t and W_0 were mean final and initial fish weight (g) and L_t and L_0 were mean final and initial length (cm) respectively; N_t and N_0 were final and initial numbers of fry in each treatment aquarium respectively and t is the experimental duration in days.

2.5. Data processing and statistical analysis

The derived data from the feeding trials were incorporated in Microsoft office excel sheets. Processed data then were analyzed to compare the effect of different experimental diets on the growth and survival of guppy fry. Growth parameters and water quality parameters according to five different diets were compared by using one-way ANOVA. Statistical data analysis was accomplished with SPSS software version 16.0 to evaluate the significant differences among treatments.

3. Results and Discussion

3.1. Physicochemical properties of water

Water quality parameters were recorded to assess the overall growth pattern of guppies. Highest pH (8.33) and temperature (30.14°C) were observed in control whereas the lowest (7.95) was reported in diet 2 (Figure1). Highest DO (4.84 mg/L) and lowest turbidity (3.3 FNU) were investigated in diet 2 whereas lowest DO (4.44 mg/L) and highest turbidity (11.38 FNU) were found in diet 4 (Figure 2). pH in all diets was positively correlated with DO ($p<0.05$) and turbidity ($p<0.01$) while negatively correlated with water temperature ($p<0.01$) (Table 2). The parameters were in between optimum range and similar trend was found in case of pH and temperature rather than DO in Bishnoi (2014) (pH7.9, DO7.4 mg/L and temperature 27°C). The water quality parameters were kept within the tolerable range. Therefore, there was no effect of water quality parameters on the growth and survival of guppy fries.

Table 2. Correlation among water parameters (pH, DO=Dissolve oxygen, Tem=Water temperature, Turb=Turbidity).

Parameter	pH	DO	Tem	Turb
pH	1			
DO	0.182*	1		
Tem	-0.313**	-0.055	1	
Turb	0.288**	0.038	0.022	1

** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed)

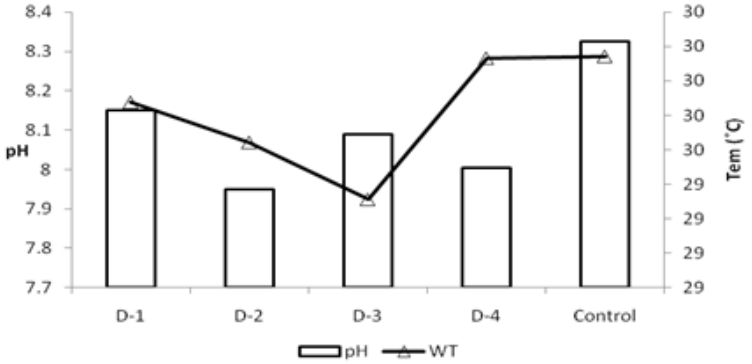

Figure 1. pH and temperature from different diets

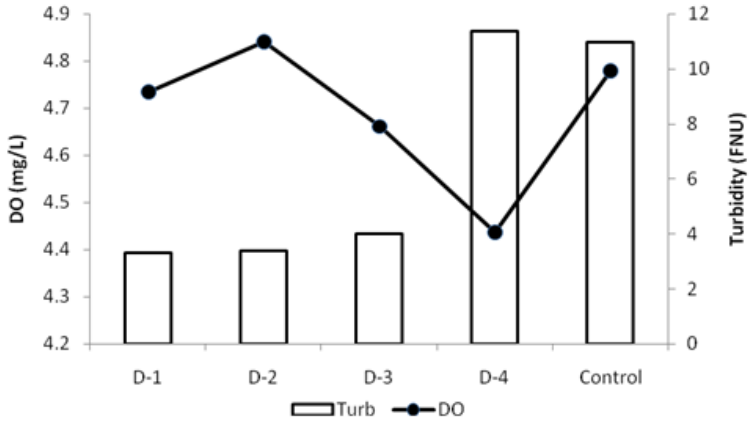

Figure 2. Do and turbidity from formulated diets.
**D-1= Diet 1, D-2= Diet 2, D-3= Diet 3 and D-4= Diet 4 in the figures

3.2. Growth performance

The growth performances were analyzed and compared with control diet. Growth pattern, survival and weight gain (%) had significantly varied among all experimental diets. The highest body weight increase (0.068 g) was found in diet 1 whereas the lowest (0.021 g) was found in diet 4. As the stocking density remained same, the variations resulted for the ingredient composition of the diets. In diet 1, FM was the major component and indicated the highest final weight (0.089 g). It might be due to high crude protein content ingredient. This was agreed by Mohideen *et al.* (2014) who stated that high crude protein content, feed acceptability and other factors are responsible for higher growth rate in case of sailfin moly (another popular ornamental fish). Besides, second highest (0.078 g) final weight was observed in diet 2 though the major ingredient was WF as a major source of carbohydrate. On the other hand, lowest final weight (0.13 g) was investigated from the control and the percentsge of boby weight gain was also lowest (Table 3). Diet 1 resulted the highest (76.4%) percent body weight increase while lowest (19.23%) was reported from commercial diets (Figure 3). The maximum percent length gain (25.53 cm) was measured from fries fed with diet 1 followed by diet 3, diet 4 and diet 2. Besides, 12.37 cm percent length gain was observed from commercial diet (Figure 4). The poor growth from commercial feeds might be reuslted because commercial feeds are not always prepared following recommended requirement of major nutrient components. Among those, protein is considered as one of the crucial nutrients for the early stages of fish. Altaff *et al.*, 2015 also observed the same thing that *g*enerally, the commercial feeds contain a minimum of fishmeal and additional animal by-products. According to Goldblatt *et al*. (1979), pelleted feeds lose essential nutrients like water soluble vitamins and amino acids during exposure to water within a short period. Bergot (1986) demonstrated that artificial feed changes the relationship between the animal and its environment.

Specific growth rate (SGR) was recorded highest (4.8%/day) in diet 1 followed by 2.01 %/day in diet 3, 1.29 %/day in diet 2 and 0.7 %/day in control (Figure 5).

Table 3. Growth performance of *P. reticulate* fry fed with formulated and commercial diets.

Growth parameter	Diet 1	Diet 2	Diet 3	Diet 4	Control
Initial length (cm)	1.395±0.177	2.345±0.57	1.52±0.368	1.75±0.608	2.49±0.609
Final length (cm)	1.88±0.487	2.36±0.837	1.57±0.808	1.77±0.94	2.86±0.35
Initial weight (g)	0.021±0.011	0.094±0.05	0.04±0.037	0.057±0.06	0.105±0.066
Final weight (g)	0.089±0.041	0.139±0.068	0.073±0.044	0.078±0.052	0.13±0.121
BWI (g)	0.068	0.045	0.033	0.021	0.025
Length gain (cm)	0.48	0.01	0.05	0.02	0.37
BWG (g)	0.004	0.003	0.002	0.001	0.002
DGR (%)	0.23	0.02	0.11	0.07	0.08

In the present experiment, guppies fed with commercial feed had the survival rate of 80% which is similar with survival of both diet 3 and diet 4. By contrast, the highest survival rate (95%) was reported from diet 1 and 90 % guppies were recorded remaining live from diet 2 at the end of the 30 days experiment (Figure 6). The results indicated that mortality rates were higher in fishes feed with commercial feed rather than formulated diets. Altaff *et al.* (2015) investigated the similar results in mollies when those were fed with commercial pellet feed and different types of formulated feeds.

Growth parameters data from different diets were positively and significantly correlated with each other throughout the experiment ($p<0.01$) (Table 4). It is resulted from the study that diet 1 evidenced the better growth rate in guppy fries compared with the other prepared diets and control. Moreover, formulated diets reported the better growth pattern than that in commercial feed. No toxicity, abnormal behavior and disease prevalence was recorded and mortality rate was also lower during the study.

Table 4. Correlation among different experimental diets.

Diets	Diet-1	Diet-2	Diet-3	Diet-4	Control
Diet-1	1				
Diet-2	.914**	1			
Diet-3	.968**	.983**	1		
Diet-4	.909**	1.000**	.979**	1	
Control	.843**	.988**	.948**	.989**	1

**. Correlation is significant at the 0.01 level (2-tailed).

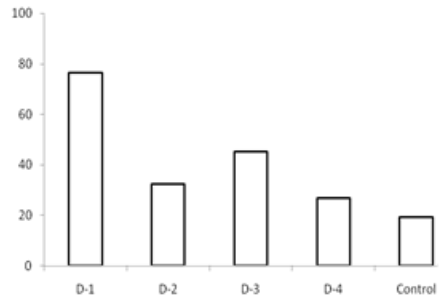

Figure 3. **Percentage of body weight increase (BWI)**.

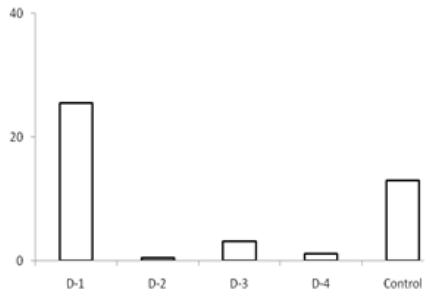

Figure 4. **Percent length gain.**

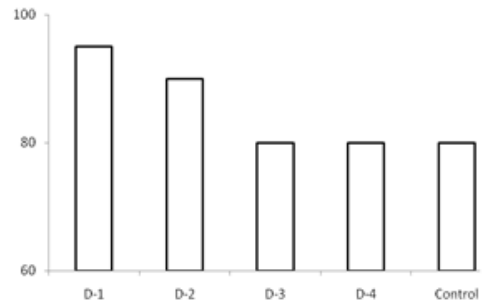

Figure 5. **SGR value from different diets.**

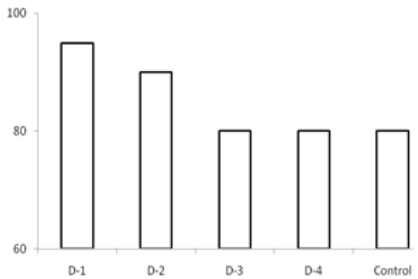

Figure 6**. Survival of fries fed with diets.**

**D-1= Diet 1, D-2= Diet 2, D-3= Diet 3 and D-4= Diet 4 in the figures

4. Conclusions

The study showed that, among the formulated diets those which are prepared mainly by fish meal, prawn meal and meat and bone meal resulted better growth than the commercial pelleted feed. The higher cost involvement, poor growth, less survival and higher mortality rate of imported commercial feeds brought less success in guppy farming as well as in ornamental aquaculture industry. On the other side, the less cost involvement and quality assured formulated feeds can bring a lot of change in this sector. Thus, the experimental diets could be used in commercial guppy farming by improving survival rate and growth performance. The further studies could be done by optimizing of stocking density and nutritional analysis of dry feed with different feeding level and scaling up of the rearing protocols to get better production of guppy.

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Conflict of interest

None to declear.

References

Adil S, T Sisman and Ü Incekara, 2014. An investigation on the growth and reproductive performance of *Poecilia reticulata* Peters (Cyprinodontiformes: Cyprinidae) fed diets with dried insects. Munis Entomology & Zoology, 9: 638-644.

Ai Q, K Mai, B Tan, W Xu, Q Duan, H Ma and L Zhang, 2006. Replacement of fish meal by meat and bone meal in diets for large Yellow croaker (*Pseudosciaena crocea*). Aquaculture, 260:255 -263.

Altaff K, V Sumithra, A Janakiraman and AH Ali, 2015. Growth and survival of fingerlings of black molly (*Poecilia sphenops*) with different animal protein based formulated diets. International Journal of Pure and Applied Zoology, 3: 375-381.

Bekcan S, L Dogankaya and GC Cakirogullari, 2006. Growth and body composition of European catfish (*Silurus glanis L*.) fed diets containing different percentages of protein. The Israeli Journal of Aquaculture-Bamidgeh, 58:137-142.

Bergot P, 1986. Elevage larvaire de la carpe commune (*C. carpio*): alimentation arti¢cielle. In: Aquaculture of Cyprinids (ed. by R. Billard & J. Marcel) INRA, Paris, France., pp. 227-234.

Bishnoi RK, 2014. Study of culture of ornamental live bearer fishes in small cement tanks as an additional source of income. World Journal of Environmental Biosciences, 3:77-80.

Chong ASC, SD Ishak, Z Osman and R Hashim, 2004. Effect of dietary protein levels on the reproductive performance of female swordtails *Xiphophorus helleri* (Poecilidae). Aquaculture, 234: 381-392.

De Silva SS and TA Anderson, 1995. Fish nutrition in Aquaculture, Chapman & Hall. Press London. pp. 319.

Goldblatt MI, WD Brown and DE Conklin, 1979. Nutrient leaching from pelleted rations. In Finfish Nutrition and Fishfeed Technology. Halver, J.E. and Tiews K., 2:118–125.

Gonzalez C and G Allan, 2007. Preparing farm-made fish feed. Nelson Bay: NSW Department of Primary Industries. Port Stephens Fisheries Centre Private Bag 1, Nelson Bay NSW 2315.

Hevroy EM, M Espe, R Waagbo, K Sandness, M Rund and G Hemre, 2005. Nutrition utilization in Atlantic salmon (*Salmo salar*) fed increased level of fish protein hydrolyses during a period of fast growth. Aquaculture Nutrition, 11:301-313.

Mohideen AKS, MA Sheriff and K Altaff, 2014. Effect of three different feeds on the growth and survival of sailfin molly *Poecilia latipinna* (Lesueur, 1821). Revelation and Science, 4: 45-48.

Nancy AA, S Rajareegam, J Ganesh and MCJ Milton, 2015. Partial replacement of fishmeal with seagrass *Syringodium isoetifolium* in formulated diets to evaluate the growth performance of freshwater ornamental fish *Poicilia reticulate*. Biolife., 3:132-139 .

Tacon AGJ, 1990. Standard method for nutritional and feeding of farmed fish and shrimp. Argent librations press. Vol 1. pp. 117.

Tissera K, 2010. An analysis of global trade data on Ornamental Fish, export, import trade provided by the FAO Fishery Statistics Division. Presented in International Aqua Show February 12, 2010, Kochi.

Tissera K, 2012. The Global Ornamental Fish Industry – An Outline of the First Decade of the New Millennium. International Conference Sustainable Ornamental Fisheries Way Forward, Souvenir, held on March 23–25, 2012, Kochi.

Venakataramani VK, N Jayakumar and T Vaitheeswaran, 2010. A study on the biodiversity of marine ornamental fishes of gulf of Manner, Southeast coast of India. Proceeding of the national seminer on Pollution Hazards and Marine Fishery Recources Management held at Fisheries college and Research Institute, Thoothukudi from 25 to 26 October 2007.pp.122-129.

Yohana V and C Wilson, 2011. Nutritional requirements of freshwater Ornamental Fish. Rev. MVZ Cordoba., 16: 2458- 2469.