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Effect of different feeds on the growth and survival of silver barb *Barbonymus gonionotus* (Bleeker, 1849)

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Abstract

An experiment was carried out to examine the effect of different feeds on the growth and survival of silver barb. Three groups of fish fingerlings average weight (0.54g to 1.29g) were raised in aquaria at a density of ten fish per tank with three replicates. Three prepared diets each contains 30% crude protein was supplied 5% of wet body weight of fish daily. Diet A (rice bran + fishmeal) was better for the fish growth (SGR 2.2%) but was the lower survival rate, followed by diet B (rice bran + soybean meal) (SGR 2.08%) with the highest survival rate. Diet C (rice bran + groundnut cake) was poorest growth rate (SGR 1.86%) and the lowest survival rate. Thus, diets A and B resulted in better growth and survival of silver barb.

Keywords: Diet, feed ingredients, growth performance, silver barb

Introduction

Freshwater aquaculture is a rapidly expanding fish producing source and in order to develop aquaculture on a commercial basis, mass production of healthy and high quality seeds is warranted. Fingerling production is one of the many challenges faced in the commercial production of freshwater species (Paray *et al.*, 2015) ^[1].

Studies on the nutrient requirement of fish feed and systematic feeding are very important role to fish growth and survival of fish culture.

Nutrition is the science of feeding to get optimal and sufficient development of fish body weight, energy and health maintenance. Formulation of balance diet and appropriate feeding are the two most important requirements of aquaculture. Feed contains different ingredients such as protein, carbohydrates, lipids, minerals and vitamins which are necessary for fish (Alyshbaev, 2013) ^[2]

One of the most feed ingredients is protein and protein is the main constituent of the tissues and organs of the fish. Protein requirements are higher for smaller fish and when fish grow larger the protein requirements usually decrease (Crig and Helfric, 2017) ^[3]. Therefore, considerable research effort is needed to determine the quantity and quality of dietary protein necessary to achieve optimum growth performance of fish (Manivannan, 2012) ^[4].

The most commonly method used for balancing crude protein level is the Pearson's square method (Bocek *et al.*, 2006) ^[5]. The square method is an easy way to determine the proper dietary proportions of high and low protein feedstuffs to add to feed to meet the dietary requirement of the animal.

Myanmar is mainly an agricultural country. There are many by-products from agriculture activities which represent potential substitute materials for fishmeal. Raw materials such as soybean, groundnut cake, sesame cake, sunflower seed cake, cotton seed cake, broken rice, rice bran are used in aquaculture traditionally (Win Oo, 2004) ^[6].

The choice of Silver barb is necessary in this study because it is an important tropical fish species on account of its fast growth rate, palatability easy, year-round reproduction and adaptability to a wide range of culture conditions. It has been one of the most popularly cultured freshwater fish species in many parts of the world, especially in Southeast Asia (Chaudhary *et al.*, 2008) ^[7]. It is valued in commercial fisheries and it is also used for aquaculture and in the aquarium trade.

Having consideration the above facts this study was carried out therefor, to investigate the effects of different feeds on the growth and survival of silver barb fingerlings and to access the efficacy of formulated feed from different protein sources.

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Materials and Methods

Experimental Fish

The experimental fish, silver barb fingerlings were obtained from Fishery Department. The fingerlings were brought to the laboratory and were acclimatized to the laboratory conditions for one week.

Experimental Design

The experiment was conducted in nine glass aquaria each having 50 L of water with ten fish (4.0-5.8 cm total length and 0.54-1.29 g body weight) per aquarium. The fingerlings were randomly distributed at the rate of ten fish per aquarium with three replications for each diet treatment. Aeration was

continuously provided from air pump. Siphoning a portion of water from each aquarium was done daily, before feeding for the removal of uneaten food and feces. Then, an equal volume of tap water was added as replacement to keep water quality. Different feed ingredients such as rice bran, fish meal powder, soybean meal powder and groundnut cake powder were used. Feed ingredients were analysed for proximate composition and the result are presented in Table 1. Each experimental diet was prepared to contain 30% crude protein using Pearson's square Method.

Diet-A (Rice bran 57% + Fish meal powder 43%)

Diet-B (Rice bran 47% + Soybean meal powder 53%)

Diet-C (Rice bran 40% + Groundnut cake powder 60%)

Table 1: Proximate composition of the experimental feed ingredients (% dry matter basis)

| Experimental diets | Dry matter | Crude protein | Crude fiber | Total fat | Total ash | NFE |
|-----------------------------|------------|---------------|-------------|-----------|-----------|-------|
| Rice bran | 89.43 | 12.03 | 4.14 | 19.15 | 4.77 | 49.34 |
| Groundnut cake powder | 90.55 | 41.7 | 5.4 | 7.70 | 5.75 | 30 |
| Soybean meal powder | 91.55 | 46.2 | 5.1 | 3.00 | 4.95 | 32.3 |
| Fish meal powder | 91.57 | 53.08 | 2.1 | 16.88 | 21.86 | — |
| NFE = nitrogen free extract | | | | | | |

The experimental fish was fed twice daily at morning and evening at a feeding rate of 5% of their body weight for a period of 90 days and during this period water quality parameters such as dissolved oxygen, pH and temperature were recorded. Feed requirements were readjusted once for two weeks by measuring the growth of fish during experimental time.

Analysis of Data

Using the data collected during the study, growth parameters and survival rate were determined based on the following formulae according to Mohanta *et al.*, (2008)^[8]; Mollah *et al.*, (2011)^[9]; Hossain *et al.*, (2014)^[10].

Weight gain (WG) = Mean final fish weight (g) - Mean initial fish weight (g)

Per cent weight gain (WG) (%) = $[(FW-IW)/IW \times 10]$

Specific growth rate (SGR) (%) = $100 [(LnW2-LnW1)/t]$;

Where FW: mean final fish weight (g), IW: mean initial fish weight (g), W1: initial live body weight (g), W2: final live body weight (g), Ln: Natural logarithm, t: culture period (days)

Feed conversion ratio (FCR) = $[Total\ feed\ intake\ (dry\ weight)/Total\ live\ weight\ gain]$

Survival rate (%) = $100 \times (Final\ number\ of\ fish/ Initial\ number\ of\ fish)$

For the statistical analysis, data from the replicates of each group were pooled for one-way ANOVA analysis and differences at the 5% level were considered significant.

Results

The growth and survival of silver barb, *Barbonymus gonionotus* fingerlings fed with different experimental diets designated as diet a, diet B and diet C were conducted in this work. Three different diets were prepared containing 30% crude protein. The rate of feeding was 5% of entire body weight. There was general increase in the mean growth weight of fish in three treatments during the experimental period.

Monthly changes in mean growth weight of silver barb treated with different feeds were shown in Table 2, Fig 1. The initial mean weight values 0.82 ± 0.19 , 0.88 ± 0.23 and 0.82 ± 0.18 g of fish attained to final mean weight values of 6.68 ± 1.95 , 5.74 ± 2.07 and 4.89 ± 1.85 g respectively. There were no significantly ($P > 0.05$) different initial mean body weight between three treatments. However, at the end of experiment, there was significant ($p < 0.05$) difference in mean growth weight between diet A and diet C.

The growth performance of silver barb in terms of initial weight, final weight, weight gain, specific growth rate, food conversion ratio and survival rate gathered during the experimental period were summarized in Table 3.

The body weight gain (WG) was attained 5.86g by feeding diet a, 4.86g by feeding diet B and 4.07g by feeding diet C. The maximum body weight gain (WG) 5.86g was observed in fish fed with diet A (rice bran plus fish meal powder). The SGR of fish in different treatments varied between 1.86% and 2.2%. The best growth was obtained in fish group fed with diet A. At the end of experiment, WG and SGR of fish fed by different feeds were significantly ($p < 0.05$) different between fish groups fed with diets A and C.

The feed conversion ratio (FCR) of three different diets were 2.2 in diet A, 2.08 in diet B and 2.75 in diet C. Diet A produces significantly the best FCR (2.20), which indicating the lowest FCR value gave the highest SGR in experimental fish (Fig 2). Diets B and C produced poor FCR and there was no significant ($P > 0.05$) difference between the FCR values of diets B and C.

The fish survival rate in three treatments tanks were ranged from 90% to 100%. The highest survival rate (100%) was observed in diet B followed by diet a (92.3%) and diet C (90%). A Significant ($p > 0.05$) difference was not found in survival rate of fish between groups.

There was no extreme temperature difference during the experimental period water temperature ranged from 19 °C- 24 °C. Dissolved Oxygen ranged from 3.68 ppm to 4.82 ppm and the pH value recorded in the range of 8.0- 8.4.

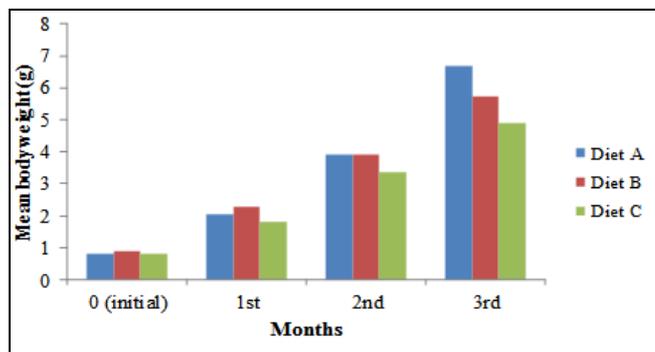


Fig 1: Monthly changes in mean growth weight of Barbonyus gonionotus fingerlings during experimental period

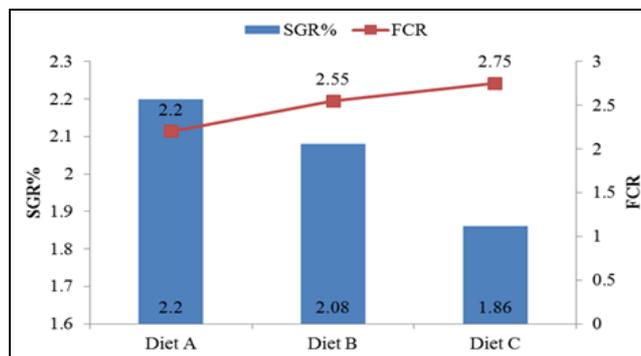


Fig 2: Relation of specific growth rate (SGR) to feed conversion ratio (FCR) of Barbonymus gonionotus fingerlings during experimental period

Table 2: Monthly changes in mean growth weight of silver barb fingerlings in three treatments during experimental period

| Experimental time (90 days) | | | | |
|-----------------------------|-------------|-----------------|-----------------|-----------------|
| Mean growth weight (g) | | | | |
| Months Diets | 0 (initial) | 1 st | 2 nd | 3 rd |
| Diet A | 0.82±0.19 | 2.04±0.52 | 3.89±1.29 | 6.68±1.95 |
| Diet B | 0.88±0.23 | 2.29±0.76 | 3.91±1.58 | 5.74±2.07 |
| Diet C | 0.82±0.18 | 1.79±0.41 | 3.37±1.34 | 4.89±1.85 |

Table 3: Growth parameters and survival rate of silver barb fingerlings in three treatments during the experiment period

| Treatments Parameters | Diet-A | | | Diet-B | | | Diet-C | | |
|-----------------------|--------|-------|------------|--------|------|-----------|--------|------|-----------|
| | Min | Max | Mean (±SD) | Min | Max | Mean(±SD) | Min | Max | Mean(±SD) |
| Mean Initial Weight | 0.48 | 1.29 | 0.82±0.19 | 0.47 | 1.24 | 0.88±0.23 | 0.54 | 1.25 | 0.82±0.18 |
| Mean Final Weight | 3.45 | 11.02 | 6.68±1.95 | 1.91 | 9.37 | 5.74±2.07 | 2.14 | 8.78 | 4.89±1.85 |
| Weight Gain(WG) | | | 5.86 | | | 4.86 | | | 4.07 |
| Weight Gain (WG) (%) | | | 714.63 | | | 550.47 | | | 496.34 |
| SGR (%) | | | 2.2 | | | 2.08 | | | 1.86 |
| FCR | | | 2.2 | | | 2.55 | | | 2.75 |
| Survival Rate (%) | | | 92.3 | | | 100 | | | 90 |

Discussion

In order to investigate the growth and survival rate of silver barb, the fish fingerlings were fed with different prepared diets.

The dietary protein requirement of various cultured fish species have been investigated by a number of authors (Sun Arno, 2002 [11]; Ali *et al.*, 2003 [12]; Choudhury *et al.*, 2002) [13] and these studies showed that the dietary protein requirement for fish varied from species due to feeding habit, size and water temperature. Protein level in aquaculture feeds range from 25-40 percent. Viputhanumas, (2000) [14] studied the silver barb fingerlings fed on the different protein levels and finally he recorded the 30% protein level was suitable for silver barb fingerlings. Therefore, the experimental diets were prepared to include about 30% crude protein for experimental fish.

During the experiment, fish in all tanks were fed with 5% of fish body weight per day. Chaudhury *et al.*, (2008) [7] reported that growth performance of silver barb in mono and poly culture system was fed with 4% body weight daily in their experiment. In addition Azad Shah *et al.*, (1998) [15] conducted that silver barb fingerlings were fed at the rate of 5% of fish body weight daily.

In this experiment, maximum body weight gain (5.86) was found in fish fed on diet-A (rice bran plus fishmeal powder) while diet-B (rice bran plus soybean meal powder) was (4.86) and diet-C (rice bran plus groundnut cake powder) was (4.07). This result agrees with Choudhury *et al.*, (2002) [13] who described that the maximum mean per cent weight gain

during the feeding trial was observed in major carp fingerling fed on diet containing fishmeal at different feeding frequencies. Lai Lai Tun (2009) [16] and Nwe Yin Htay (2009) [17] reported that the maximum weight gain was observed in Cyprinus carpio and Labeo rohita fingerlings fed on diet containing rice bran and fishmeal powder.

In the present work, the specific growth rate (SGR) of silver barb fed with different feeds were 2.2% (diet-A), 2.08% (diet-B), and 1.86% (diet-C). The highest specific growth rate was recorded in fish fed with diet A (rice bran plus fish meal powder). Sunarno (2002) [11] recorded the SGR of silver barb Barbodes gonionotus fingerlings on different protein levels of 20%, 25% and 30% were 3.30, 3.91 and 4.18 respectively. Hossain *et al.*, (2014) [10] reported the SGR of prawn, catla, rohu and silver carp ranged from 3.99 to 4.26, 3.71 to 3.83, 2.49 to 2.55 and 2.44 to 2.59% respectively. They noted the SGR of mirror carp was 2.45±0.03 and 4.00±1.03 between temperature 14 °C and 35 °C in their study. High water temperature increases the metabolic rate resulting in increased food demand (Begum *et al.*, 2007) [18]. Therefore, better growth rate may attain in high water temperature, which increased feed intake and metabolic rate of the fish. Freshwater fish have an optimum growing temperature in the range of 25-30 °C at which they grow quickly (Kausar and Salim, 2006) [19]. During the study period recorded water temperature ranged from 19 °C to 24 °C which slightly differ from the range of optimum growing temperature.

At end of experiment, the value of feed conversion ratio (FCR) of fish fed on three different diets were 2.20 (diet-B),

2.55 (diet-A) and 2.75 (diet-C). Feed conversion was highly efficient in the group of fish fed on diet-A with FCR of 2.2 which indicating a high quality feed. FCR is a measurement of how efficient the fish can convert the feed into body mass. Most authors mentioned the best FCR values as 1 and 2. An FCR of 1.5-2.0 is considered good growth for most species (Craig, 2017) [3]. However, according to Reddy and Rao (2004) [20] the FCR vary among species, sizes and activity, level of fish, environmental parameters and culture system used. As the lower the FCR, the higher the weight gain obtained from the feed. Actual consumption of the feed from the initial amount of distributed feed is one of the practical limitations of the FCR.

Sunarno (2002) [11] mentioned that survival rate of silver barb *Barbodes gonionotus* was 99.1%, 97.2% and 96.3% in fish fed with isocaloric feeds. Survival rate of silver barb fingerlings ranged between (90% - 100%) in this experiment and there was no significantly ($p>0.05$) different between three treatments. So, experimental prepared feeds gave the strong survival rate of fish in all tanks.

Bhatnagar and Singh (2010) [21] stated dissolved oxygen (DO) level >5 ppm is essential to support good fish production. Bhatnagar *et al.*, (2004) [22] also suggested that 1-3ppm has sub lethal effect on growth and feed utilization: 0.3 to 0.8 ppm is lethal to fish and >14 ppm is lethal to fish fry. In this study, recorded DO value was in the range of 3.68 to 4.82ppm and this DO range may determine the desirable limit.

According to Ekubo and Abowei (2011) [23], pH between 7 and 8.5 is ideal for biological productivity, fishes can become stressed in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0 and death is almost certain at a pH of less than 4.0 or greater than 11.0. Santhosh and Singh (2007) [24] also stated the suitable pH range for fish culture is between 6.7 and 9.5. Ideal pH level is between 7.5 and 8.5 and above and below this is stressful to the fishes. In this study, the pH value in the range of 8.0 to 8.4 is within the normal range for fish culture.

In conclusion, nutrient requirements of silver barb fingerlings, based upon locally available feed ingredients such as rice bran, fishmeal powder, soybean meal powder and groundnut cake powder feed-stuffs, were prepared and used. According to the result of present finding, the growth performance was highest in the fish fed on diet a (rice bran plus fishmeal powder). It showed the fishmeal protein source gave the best growth rate of the silver barb fingerlings. The survival rate is the highest in fish fed on Diet-B (rice bran plus soybean meal powder). Therefore, vegetable source of protein may give the best survival rate in fish fingerlings. Although fish meal is a source of high quality protein, soybean meal should be used as a supplementary feed for culture species. Because soybean meal are widely used as the most cost effective alternative for high quality fish meal in feeds for many aquaculture fish species due to its high protein content and excellent amino acid profile low cost, availability and steady supply as compared to the other plant protein sources (Bhosale *et al.*, 2010) [25]. The results of the experiment showed that the best growth performance was found in the fish fed on diet A and the second best growth performance was found in the fish fed on diet B. There was no significantly ($p>0.05$) different in WG ratio, SGR and survival rate between diet A and diet B. So, vegetable source of proteins can compare with animal source of protein on growth of silver barb in this study.

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