Effects of some Artificial diets on the Growth Performance, Survival Rate and Biomass of the fry of climbing perch, *Anabas testudineus* (Bloch, 1792)

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Abstract: An experiment on culture of climbing perch (*Anabas testudineus*) in cemented tanks using different protein level diets was conducted to find the appropriate feeding diets and their effects on the growth, survival and biomass of 15-days old fry of *Anabas testudineus* in intensive culture . The experiment was carried out for duration of 60 days with 4 treatments in 8 cemented tanks each of size 12×6×1.5 feet. The initial length and weight were 14.5 ± 0.4 mm and 0.95 ± 0.05 g respectively. The feeds were applied twice a day at the rate of 10 %(initially) to 5% (later on) of the body weight of the fry/day. The results showed that the growth of fry varied significantly ($P<0.05$) with different diets. The highest growth, survival rate and biomass were found in the trial where fishes were fed on Sabinco feed containing 50.92% protein (on dry matter basis), followed by Feed-3 containing 30% protein. The poorest growth rate was shown by Feed- 1 (prepared by rice bran, wheat bran, fish meal and soybean meal) containing 20% protein. There was no significant difference in survival rates among the fry fed with Sabinco and prepared diets. The experiment suggests that Feed-2 (Sabinco Feed) can be recommended for the intensive culture of climbing perch. [Nature and Science. 2010;8(2):36-42]. (ISSN: 1545-0740).

Key words: Climbing perch, Artificial diets, Survival rate, Growth Performances and Biomass

1. Introduction

Fish is the major protein sources in the diet of the Bangladeshi people. Fish contributes about 60% of the available protein in the diet. It indicates the importance of fish in contributing to the level of nutrition of the people of Bangladesh (DOF, 1998; FAO, 1992). In spite of having large fisheries resources, Bangladesh is facing an acute malnutrition problem due to the shortage of animal protein supply in the diet.

Among various production inputs, the choice of fast growing species with desirable aquaculture traits is a pre-requisite for augmenting fish production in culture-based fisheries. Natural food based culture of major carp is still in practice in Bangladesh but carp culture could not be widely practiced in the shallow and seasonal ponds. In this regard koi fish (*A. testudineus)* is an excellent fish for growing in the shallow and seasonal ponds in a country like Bangladesh (Hussain *et al*. 1989, Gupta 1992, Kohinoor *et al*. 1993, Akhteruzzaman *et al*. 1993, Gupta *et al*. 1994) because Bangladesh enjoys very suitable climatic and ecological conditions for culture of warm-water species.

MAEP (1995) has shown that pond size affects the production of major carps. Small ponds below 0.1 acre size may not be profitable for conventional carp polyculture. Mustafa and Brown (1984) reported that growth rate in small ponds was rapid than in large impounded ponds. They commented that small ponds were more productive and easily manageable in our country. Edible fish production per unit area, *A. testudineus* is more productive than most farm fishes at the same level of intensification.

The labyrinth fishes, Anabantoidie, derived their name for having a labyrinth like accessory - breathing organ on either side of the head. Two widely known Asian members of the groups are climbing perch (*A. testudineus)* and gourami *(Ospharonemus).*Climbing perch, *A. testudineus* is a fresh water fish indigenous to South and Southeast Asia. It can thrive well in low dissolved oxygen (DO) waters and it can migrate between ponds. Wild climbing perch (*A. testudineus)* is a popular fish in Asia with larger fish (over 60 g) fetching a high market price.

Due to its air breathing ability and tolerance of adverse environmental conditions this fish turns out to be a very good candidate of fish culture. It is found in fresh and brackish waters mostly in ponds, swamps and lakes of Bangladesh, India and Southeast Asian countries. It is commonly called as koi fish in Bangladesh.

Larvae and young fry of *A. testudineus* fed on phytoplankton and zooplankton, larvae fry and adults feed on crustaceans, worms, moluscs and insect, algae, soft higher plants and organic debris (Potongkam,1972). For fish,

the optimum amount of protein in formulated feeds is important because either low or high levels of protein may lead to poor growth. As well, excess protein in fish diet may be wasteful and cause the diets to be unnecessarily expensive.

Therefore, attempts were taken to investigate the requirement of optimum protein level in formulated diets for *A. testudineus* fish. The objectives of the experiment were- a) to explore a suitable artificial feed for *A. testudineus* fry to obtain its maximum survival and growth b) to develop culture techniques through determination of effective feeding rate and locally available suitable feeds in on-station and on-farm condition and c) to estimate the proximate chemical composition of feed ingredients to be used for the formulation and development of quality fish feeds.

2. Materials and methods

The experiment was conducted in 8 cemented tanks of equal size (12×6×1.5 feet) for a period of 60 days at Tongi Fish Seed Multiplication Farm, Gazipur. Four different feeds were used in this experiment to observe their effects on growth, survival and biomass of *A. testudineus.*

2.1 Fry source

The fry of *A. testudineus* used in this experiment were obtained from a private hatchery named Reliance Aqua Farms situated at Bailor, Trishal, Mymensingh. Fry's were carried to the study area under well oxygenated condition.

2.2 Experimental design

Eight cemented tanks of 12×6×1.5 feet each were used in this experiment. The tanks were divided into four treatments namely treatment T_1, T_2, T_3 and T_4 each having two replications. Four different feeds namely Feed I, Feed II, Feed III and Feed IV were applied to the treatment T_1, T_2, T_3 and T_4 respectively. 15 days old 100 fry of *A. testudineus* of almost equal sizes were stocked in each tank.

2.3 Preparation of the tanks and release of fry

Cemented tanks with 2-4 m^3 water volume was used for nursing the fry. The tank was filled with well filtered water approximately one week before stocking. Water outlet of tanks was covered with proper mesh size net. The mesh size was changed (increased) during fish rearing to facilitate washing out the faeces and waste foods. The proper mesh size was 1.0-1.5 mm at the beginning of rearing. After the preparation of the tank the collected fingerlings were gently acclimatized with the tank water and released carefully.

2.4 Management of the tanks & fry

For maintenance of good health and growth of fry, frequently cleaning of tanks and feeding of fry are necessary. All the tanks were rubbed daily for removing bacteria accumulated on inner surface of rearing tanks. Faeces, waste particles of food and dead bodies of fish were siphoned at regular interval. From the 5^{th} or 6^{th} day of rearing antibiotic treatment was used. The most efficient antibiotic is terramycin. Four-six tablets of terramycin (2-3 g) produced for veterinary treatment can control the outbreak of bacterial diseases. Moreover, when there was deterioration in water quality, 10-20% water was replaced.

2.5 Collection of feed ingredients and Feed preparation

Sabinco (formulated feed; Feed II), Fish meal, Soybean meal, rice bran, wheat bran and vitamin pre-mix were collected from local fish and poultry feed traders of Gazipur town. Poultry viscera were collected from local grocery market. Rodovit GSS of Rhone Poolenc was used as vitamin pre-mix. Depending on the chemical composition and caloric values of the ingredients different diets were prepared. Physical properties like size, flavour and odor, texture, color; density (sinking rate), dehydration capacity and water stability were considered. Diets in the form of meal, paste and cakes were tried; however at the later stages soft pellets were prepared.

Table 1: Composition of the test feeds (%)

Ingredients	Feed - I	Feed II (Sabinco)	Feed - III	Feed - IV
Fish meal	18.0	40	30.0	22.0
Soybean meal	8.0	25	15.0	11.0
Wheat bran	30.0	15	21.0	20.0
Rice bran	43.0	19	31.0	44.0
Poultry viscera	-	-	2.0	2.0
Vitamin & Mineral mixture	1.0	1.0	1.0	1.0

The selected ingredients as mentioned above were used for the preparation of three different isocaloric fish feeds, denoted by Feed I, III and IV according to the treatment groups, by mixing the ingredients in such a manner so as to give crude protein values of 20, 30 and 24.7 % respectively. The amounts of ingredients needed to prepare 1 kg of feed were calculated from their proximate chemical composition and adjusted in such a manner that all the feeds contain nearly the same amount of energy per kg of feed. The feed were made into bite size pellets by adding starch solution or liquid from boiled rice and dried in an oven at 40° C for 2 days; or extracted as pellets from a pelleting machine and stored, sealed and frozen until used. These pellets were spread out on polythene paper and allowed to sundry for 4-6 hrs. Then the dried feed was stored in an air tight plastic bag.

2.6 Proximate analysis of the test feed

Proximate composition of the test of feeds were determined following the standard methods given by Association of official Analytical Chemists (AOAC, 1980) in the Nutrition Laboratory of Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. The proximate composition of different feeds is shown in Table-2.

Table 2: Proximate analysis (% dry matter basis) of test feed

Parameters	Feed - I	Feed – II	Feed - III	Feed - IV
Dry matter	86.70	88.90	87.78	89.62
Crude protein	20.60	50.92	30.10	24.7
Crude lipid	11.61	8.35	10.40	12.01
Ash	12.30	16.36	15.30	13.80
Moisture	13.30	11.10	12.22	10.38
NFE*	31.80	24.36	9.9	20.3
Energy (Kcal/100g)	419.25	580.6	472	470. 5

- Nitrogen Free Extract calculated as: 100 - %(Moisture Protein + Lipid + Ash + Crude fibre).

2.7 Methods of feeding

After acclimatization of the released fish in the tank the *A. testudineus* fry were fed with Sabinco feed and three other prepared supplemental feeds at the rate of 10% (initially) and 5% (later on) of total body weight of stocked fry twice daily up to satiation at 09:00 AM and 5.00 PM. In the early stage the feed was diluted with small amount of water and then it was applied in the tank and later on it was spread directly. The fry were considered to be satiated when they stopped feed up taking or searching for food. After half an hour of feed supply the uneaten food particles and faeces were removed by siphoning.

2.8 Sampling & health monitoring

Sampling was done at 7 days interval and random samples of 20 *A. testudineus* fry were caught by glass nylon hapa from all the treatments. The fry were checked once a week and inspected for signs of malnutrition or disease. Dead fishes were immediately removed from the tank. Inefficient feeding practices can place the fish under stress which can result in parasitic infections. However, during this stage, sibling cannibalism was probably the greatest cause of mortality.

Total length and weight were recorded using a graph paper attached Petri dish and a Metler AJ 100 digital balance respectively. After careful measurement the fry were released in the respective place.

2.9 Evaluation of the water quality parameter

Water quality parameters such as temperature, pH and dissolved oxygen were monitored every 2 days of interval during the experimental period. Temperature was recorded using a Celsius Thermometer; dissolved oxygen and pH were measured directly by a portable digital DO meter (WPA OX 20) and a portable digital pH meter (WPA CD 70).

3. Results

Detailed result of the study on the growth performance, survival rate, biomass, water quality parameter and all other aspects reared in the eight cemented tanks fed on four different diet as recorded in during the period of study are presented below-

3.1 Growth

The initial average length of fry of *A. testudineus* increased from 14 mm to 40 mm, 15 mm to 66 mm, 14.5 mm to 56 mm and 14.2 mm to 51 mm for T_1, T_2, T_3 and T_4 treatments respectively after the experimental period. The initial average weight of *A. testudineus* fry increased from 0.9 g to 3.5 g, 1.0 g to 7.3 g, 0.95 g to 5.82 g and 0.92 g to 5.4 g for the treatments T_1, T_2, T_3 and T_4 respectively. The highest and lowest average final length was found for T_2 and T_1 treatment respectively. Again the highest and lowest average final weight was also found in the same treatments respectively.

3.2 Survival rate

The highest survival rate was found in treatment T_2. . The survival rates were recorded 74, 85, 81 & 79% in the treatments T_1, T_2, T_3 and T_4 respectively**.** However, these differences were not significant (P>0.05) among treatments of each experiment.

3.3 Biomass

After 60 days of study period, the highest biomass (total weight of fish) was found in treatment T_2 (620.5 g) and lowest biomass was found in treatment T_1 (259.74 g).

3.4 Water quality parameter

The physico-chemical parameters of water in different cemented tanks under different treatments during the trial are shown in Table-7. Temperature pH and DO of water in different cemented tanks under different treatments ranged from 28.8 to 29.8 ^{0}C, 7.6 to 8.1 and 5. 5 to 6.2 mg/l.

The differences in results among replications of a treatment were invariably small. Consequently, all values for a treatment were determined by combining the results of replications and averaging them.

Table 3: Growth of the fry of *A. testudineus* in cemented tanks during the trail period of 60 days (replications averaged).

Feed (Treatments)	Sampling day									
	1		15		30		45		60	
	Length (mm)	Weight (gm)	Length (mm)	Weight (gm)	Length (mm)	Weight (gm)	Length (mm)	Weight (gm)	Length (mm)	Weight (gm)
T_1	14	0.9	18	1.35	24	1.92	34	2.8	40	3.51
T_2	15	1.0	24	1.9	35	3.52	53	5.89	66	7.3
T_3	14.5	0.95	21	1.75	30	2.8	45	4.73	56	5.82
T_4	14.2	0.92	20	1.65	28	2.58	42	4.44	51	5.4

Table 4: Growth parameters of *A. testudenius* fed on different feeds after the trail period of 60 days.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Initial length (mm)	14	15	14.5	14.2
Final length (mm)	40	66	56	51
Initial weight (g)	0.9	1.0	0.95	0.92
Final weight (g)	3.5	7.3	5.82	5.4
Condition factor	0.83	0.83	0.78	0.71
FCR	4.63	2.88	3.50	3.92
Specific growth rate (% day/fish)	0.98	1.43	1.30	1.26

Means in the same row with different superscripts are significantly different (P<0.05).

Table 5: Total number of fish and survival rate during the trail period of 60 days (replications combined). where "No." = number of fish and "S.R." = survival rate (%).

Feed (Treatments)	Sampling day									
	1		15		30		45		60	
	No.	S.R.	No.	S.R.	No.	S.R.	No.	S.R.	No.	S.R.
T_1	100	100	92	92	84	84	78	78	74	74
T_2	100	100	95	95	91	91	87	87	85	85
T_3	100	100	91	91	87	87	83	83	81	81
T_4	100	100	89	89	85	85	81	81	79	79

Table 6: Biomass of the fry of *A. testudineus* during the trail period of 60 days in grams (replications averaged).

Feed (Treatments)	Sampling day				
	1	15	30	45	60
T_1	90	124.2	161.28	218.4	259.74
T_2	100	180.5	320.32	512.43	620.5
T_3	95	159.25	243.6	392.59	471.42
T_4	92	146.85	219.3	359.64	426.6

Table 7: Water quality parameters during the trail period of 60 days.

Parameters	**T_1**	**T_2**	**T_3**	**T_4**
Average temp. (^{0}C)	29.6	28.8	29.2	29.8
Average pH	7.9	8.1	7.6	7.8
Average DO (mg/l)	5.7	6.2	5.9	5.5

3.5 Statistical Result

ANOVA was done with a view to finding out any significant difference among the SGR%, Feed efficiency and Survival (%) of *A. testudineus* fry on Sabinco Feed and three types of formulated Feed in four pairs of experimental tanks with replications. The F value from the result of SGR (%), Feed efficiency and Survival had been found to be 5.63, 310.94 and 2.8. SGR (%) and Feed efficiency are significant at 5% level but Survival is non-significant. Duncan's New Multiple Range Test is done with a view to finding out which fish feed will be the best in bringing growth and increasing weight, length etc. with proportional amount of nutrients.

4. Discussion

Availability of quality feed or ingredients of feed are the vital factors that affect commercial fish culture. In the present study Feed II was Sabinco Feed and Feed I, Feed III and IV were prepared from locally available ingredients. Among the feeds, Feed II contained highest protein percentage (dry matter basis) followed by Feed III, IV and I.

Better growth, survival and FCR were observed in fish fed with Feed II. Feed III produced second highest growth and survival. Growth and production in fish culture are generally dependent on the daily feed consumption, qualities of feed and feeding frequency (Mookerjee and Mazumdar, 1946). According to Chakraborty *et al.* (1995) the growth of carp (*Cyprinus carpio)* increases with protein levels, and there was an approximately linear increase of growth with feeding level for any given diet.

At the end of the present experiment on rearing fish in concrete tanks, the best growth was observed in treatment II with fish fed dietary that contained 50.92% protein. Results showed that fish fed on Sabinco feed grew with the weight gain of 0.11 g/day and SGR of 1.43%/day that were significantly higher ($p<0.05$) compared to other treatments. The significant lower growth was observed in fish fed Feed-I where the growth rate and SGR were 0.04 g/day and 0.98%/day, respectively. There was no significant difference

($p<0.05$) between treatment III and IV. The mean weight and length of fish in treatment II were the highest because of high protein content in the test diets.

In the present experiment maximum average length and weight were 66 mm and 7.3 g respectively obtained from the treatment fed with Sabinco feed (containing 50.92% protein). The experimented result is in agreement with the report of Sangrattanakhul, C. (1989) in which he estimated required dietary protein level for climbing perch ranged from 35-45%. Doolgindachabaporn (1994) also recommended that the feed containing 38.6% protein as the best feed formula in term of growth and survival for *Anabas* fry. Mookerjee, H.K. and S.R. Mazumdar, 1946, tested the performance of different diets containing 30, 34.7, 39.5, 44.1 and 48.9% protein in dry weight basis and reported that 39.5% protein is optimum in diet for commercial rearing of *Anabas testudineus*. In this experiment, the highest growth and survival were found with the Sabinco Feed containing 50.92% protein. In a trial conducted by Ray and Patra (1989) they indicated that climbing perch can achieve a rate of growth from 0.5-0.9 g/day when culture in earthen pond. The daily weight gain was observed in fish fed Feed-II that was 0.11 g/day. The experimented result is in agreement with the report of Sangrattanakhul (1989) reported that the ADG of *A. testudincus* fish ranging from (0.10-0.12). The above finding has more or less similarities with us.

It is evident from the results of SGR values of *A. testudineus* fish fed on Sabinco Feed and other formulated feeds with the increase of age the value of SGR decreases. From this point of view the formulated feed II gives best result in comparison with the other three feed. This finding resembles the Medawars (1945) fifth law "the specific growth declines more and more slowly as the organism increases in age". Minot (1908) was the first person to recognize that for most animals the specific growth rate is highest early in life and that it typically decreases with increasing age, becoming zero in some animals. The SGR% value of koi fish in our experiment also shows the same trend.

FCR were higher in the diets with the lowest protein content. In this experiment fish fed Feed I had the highest FCR that is 4.63. Fish fed Sabinco feed performed the lowest (2.88), and no significant differences were found in treatment III and treatment IV that was 3.50 and 3.92 respectively at ($p<0.05$) level. Doolgindachabaporn, (1994) found that the FCR value of *A. testudineus* ranges from 1.8-3.0. The above findings had similarities with us. Potongkam (1972) reported that FCR of climbing perch fed on trash fish and pellet were 2.07 and 1.89, respectively. In this study, feed conversion ratio was higher at higher feeding level due to feed losses increased with feeding level. Moreover, increase of feed conversion ratio at feeding rates might result from the in-completed digestion of feed (Rao, 1971).

During nursing period, most water parameters in cemented tanks were in suitable ranges for fish growth. Dissolve oxygen ranged from 5.5 to 6.2 mg/l whereas temperature ranged from 28 to 29.8˚C. Although there were little fluctuation in the parameters of water temperature and dissolved oxygen concentration from morning to afternoon in four treatments of experiment the ranges of these values were still suitable for the growth of climbing perch fry (Khan *et al.*, 1996).

5. Conclusion

The investigation reported the effect of some artificial feeds on growth, survival and biomass of the fry of *A. testudineus*. Optimum level of protein for the fish growths was also determined. Sabinco and three formulated fish feeds were used in the feeding and rearing trial of the fish. Different bio parameters, such as condition factor, survival rate, feed conversion ratio (FCR), specific growth rate (SGR) etc. were used to see the growth performance and feed utilization during the study period. Data were analyzed statistically using ANOVA & DMRT (Duncan's New Multiple Range Test). Probabilities of 0.05 were considered statistically significant. Based on results of this experiment, it can be concluded that the culture of climbing perch in tanks using Sabinco and Feed III feed can be applied in order to improve the income of farmers in our country. The feed containing 50.92% protein resulted in the best growth, survival, FCR and yield of climbing perch, which can be recommended for the culture of climbing perch.

Acknowledgement:

All appreciations go to almighty Allah who creates us and this beautiful earth, manages each and every thing soundly. We would also like to thank the administration of Tongi Fish seeds multiplication Farm, DOF and Department of Fisheries, University of Dhaka for giving us all the facilities to conduct the research work successfully.

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12/24/2009