Effects of Formulated Diet on Feed Utilization of Climbing Perch, *Anabas testudineus* (Bloch, 1792)

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ABSTRACT

An experiment was conducted to find the appropriate feeding diets and their effects on the growth, survival rate and feed efficiency on climbing perch (*Anabas testudineus*). The experiment was carried out for duration of 50 days with 3 treatments in 6 still tanks each of size 150×40×40 centimeter using three types of feed (Feed A, Feed B, and Feed C) for 6 replica (TA1, TA2, TB1, Tb2,TC1, and TC2). 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. Survival rate, SGR, FCR, PER, ADG, Condition factor and Feed efficiency and proximate composition of fish were determined at initial stage, 15, 30, and 50 days of the experiment. Besides several water quality parameter were determined which were found suitable for the experiment as well as for the fishes. From the overall situation, 37% protein containing feed (feed A) was found better for all the estimated parameters.

آثارالتغذية المُنَظَمةِ والمُتكَافئةِ علي مُعَدَل نمو يرقات أسماك *Anabas testudineus* (Bloch 1792), Climbing Perch

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الكلمات الدالة

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المُستلخص

تم إجراء تجربة حقلية لغرض دراسة التغذية الأنسب من حيث الكفاءة الغذائية ومُعَدَل بقائها وآثارها على نموأسماك (Climbing Perch, *Anabas testudineus*). أجريت التجربة على مدى50يوماً تخللتها (3) مُعَالجَات في عدد (6) حاويات (صهاريج) كل واحدة منها من بحجم (150×40 ×40 سم^3). تم استخدام 3 أنواع من علف التغذية (النوع A، النوع B، و النوع C) بتكرار6 مرات مُتَشَابهه (1AT/ 2AT/ 1BT/ 2BT/ 1CT/ و2CT). بلغ قياس معدل النمو من حيث الطول والوزن (14.5± 0.4 مم و0.95 ± 0.05 جرام) على التوالي. تمت تغذية عينات التجربة لمرتين يومياً بمعدل (10 %) في التغذية الأولى تنخفض إلى (5 %) في التغذية الثانية من وزن الجسم لعينات التجربة في كل يوم. أظهرت النتائج أن معدل نمو اليرقات (العينات) قد اختلفت معنوياً وبشكل واضح ($P<0.05$) في توافق مع اختلاف حمية التغذية. أظهرت التجربة أيضاً أن معدل البقاء على قيد الحياة قد بلغ (SGR/ FCR/ PER/ ADG). تم تحديد عامل الكفاءة الغذائية ومعدل النمو التقريبي في عينات التجربة في (3) مراحل متتابعة بعد (15) يوماً ثم بعد (30) يوماً وأخيراً عند نهاية مدي التجربة بعد (50) يوماً من بدايتها. إلى جانب اعتماد العديد من معايير جودة نوعية المياه الأنسب للتجربة ولعينات التجربة، وجد أن نوعية المياه المحتوية على نسبة بروتين (37 %) (تغذية للنوع A) هي الأنسب في المعايير المُعتَمَدَة .

Introduction

The success of commercial aquaculture depends on the availability of suitable diets that are efficiently digested and provide the required nutrients for optimum growth (Al Mahmud *et al.,* 2012). At now aquaculture practice has moved from traditional to intensive () and in this case supplementary feeding plays a large role (Hossain *et al.,* 2012; Begum and Minar, 2012). Besides the whole nutritional requirements of fish largely depends upon the supplementary feed (Al Mahmud, *et al.,* 2012).

Protein is required by all animals for body maintenance and growth and that the protein level needed for these functions varies with the species and culture environment (Mahfuj *et al.,* 2012; Hossain *et al.,* 2012; Minar *et al.,* 2012). 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. Since feeds cost is one of the highest recurring cost in intensive and semi intensive aquaculture. So it is necessary to formulate low cost fish feed from locally available feed ingredients that are economically beneficial for fish farmers (Al Mahmud, *et al.,* 2012).

Koi fish (*Anabas testudineus*) is a suitable fish species in a country like Bangladesh to culture in garden ditches, ponds and paddy field (Alam, *et al.,* 2010); (Begum and Minar, 2012). The objective of this study was to investigate the growth and feed utilization of (*Anabas testudineus*) (small and large size). The results of the study will help to propose suitable feeding levels and feeding frequencies for climbing perch nursing and culture.

Materials and Methods

The experiment was conducted in 6 still tanks of equal size (150×40×40 cm) for a period of 50 days at Section of Fish Technology Research, Institute of Food Science and Technology, Bangladesh Council of Scientific and Industrial Research, Dhanmondi, Dhaka, Bangladesh. Three different feeds with six replications (2 replication of each) were used in this experiment to observe growth performance, feed efficiency, FCR, PER of *A. testudineus.*

(1) Fry Source

The fry of (*Anabas testudineus*) had an average length between 7.3-9.3cm and average weight 3.53-8.41 gm were collected from the paddy field of *Chandpur, Matlab, Kalipur* Bangladesh. The collected fish were kept in aluminium container and were bought to the experimental site for carrying out the investigations.

(2) Experimental Design

Six still tanks of 150×40×40 cm that can contain 150 litre/still tanks each were used in this experiment. The tanks were divided into six replications namely treatment TA1 and TA2 for feed A, TB1 and TB2 for feed B, and TC1 and TC2 for feed C. The fish tanks were kept at the top of the roof of the research building connected with water pipes for regular water supply and aeration.

(3) Preparation of the Tanks and Release of Fry

The properly washed tanks were subjected to be filled with well cleaned water approximately two weeks before stocking the collected fish. They were subjected by providing different pipes for water entering and aeration systems respectively. After the preparation of the tank the collected fingerlings were gently acclimatized with the tank water and released carefully.

(4) Management of the Tanks & Fry

The tanks were cleaned to get rid from the faces and waste of feed for ensuring better environment for the fish. 17 fish were stocked per aquarium. The fishes were fed two times in a day.

(5) Proximate Analysis of the Test Feed

Proximate compositions of the test of feeds were determined following the standard methods given by Association of official Analytical Chemists (AOAC, 1995) in the laboratory. The proximate composition of different feeds is shown in table,1.

Table 1: Proximate Analysis of Test Feed

Diets	Feed A	Feed B	Feed C
Moisture (%)	11	11	11
Protein (%)	37	33	30
Fat (%)	8	7	6
Ash (%)	12.66	14.33	13.75
Carbohydrate (%)	32	34	40

(6) Feeding Trial of Fish

The feeding trial was carried out for a period of fifteen days. According to fish size and weight a required amount of fish feed were given two times a day into the experimental tanks. The fishes were grouped in batches and each of the two batches was given one category of feed at different time interval. Fish weight and length were recorded to find out the biological parameters such as feed efficiency, FCR, condition factor, ADG, PER etc. The survival rate of the fish was also determined. Known amount of fish feed were given. Analyses of fish for biochemical composition were also carried out at different intervals.

(7) Determine the Water Quality Parameter

The water temperature (^{0}C) of the tank was recorded daily with the help of a thermometer, Dissolved Oxygen (DO), Chloride, Water hardness, Alkalinity, Carbon di oxide (CO_2), Nitrate nitrogen (NO_3-N), Ammonia nitrogen (NH_3-N), Nitrite nitrogen (NO_2-N) was measured by using a direct reading Spectrophotometer known as Hach kit, pH was measured through pH meter (Model-445, UK).

(8) Estimated Parameter

Fish weight gain (g), Specific Growth Rate (SGR), Feed Conversion ratio (FCR), survival rate were determined through the method of (Castell and Tiews, 1980). The other estimated parameter was given below that were done throughout the experiments are:

(8.1) Protein efficiency ratio (PER): Protein efficiency ratio was calculated by using the following formula:

$$\text{PER} = \frac{\text{Total weight gained}}{\text{Protein Fed}}$$

(8.2) Feed Efficiency: Feed Efficiency was determined by the following formula

$$\text{Feed Efficiency} = \frac{\text{Weight gained in the wet weight}}{\text{Feed intake in the dry weight}} X\ 100$$

(8.3) Condition factor or potential index: The potential index or condition factor was calculated by the formula as suggested by (Hile, 1936)

(9) Statistical Analysis

The data were calculated by using SPSS 11.5 software.

Results

Detailed result of the study on the growth performance, survival rate, water quality parameter and all other aspects reared in the six still tanks fed on three different diet as recorded in during the period of study are presented below:

(1) Proximate Composition of Fish

The values of proximate composition of the experimental fish *Anabas testudineus* rearing in 6 different tanks fed on three types of fish feed have been represented in the table 2

Table 2: Proximate Composition of *Anabas testudineus* in Different Interval

Experiment Days	Diets	Level of Protein (%)	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Before feeding trial	TA1	37	81.73	13.10	1.65	1.20
	TA2	37	81.11	13.04	1.62	1.17
	TB1	33	81.52	12.80	1.55	1.10
	TB2	33	81.6	12.75	1.53	1.12
	TC1	30	82.13	12.30	1.52	1.05
	TC2	30	82.18	12.25	153	1.04
At the end of 15 days rearing	TA1	37	78.63	14.80	1.90	1.71
	TA2	37	78.80	14.63	1.87	1.71
	TB1	33	80.50	13.42	1.37	1.70
	TB2	33	80.71	13.33	1.29	1.63
	TC1	30	81.20	12.98	1.19	1.62
	TC2	30	81.25	12.91	1.16	1.60
At the end of 30 days rearing	TA1	37	78.63	14.80	1.90	1.71
	TA2	37	78.80	14.63	1.63	1.70
	TB1	33	80.50	13.42	1.87	1.63
	TB2	33	80.71	13.33	1.37	1.62
	TC1	30	81.20	12.98	1.29	1.60
	TC2	30	81.25	12.91	1.16	1.58
At the end of 50 days rearing	TA1	37	77.34	16.20	1.98	2.50
	TA2	37	77.51	16.12	1.95	2.43
	TB1	33	78.95	14.65	1.79	2.01
	TB2	33	79.83	14.61	1.75	1.83
	TC1	30	80.68	14.05	1.68	1.61
	TC2	30	80.73	13.98	1.65	1.58

(2) Survival Rate

The values of survival rate of the experimental fish *Anabas testudineus* fed on three types of fish feed have been represented in the table 3. From the table it has been observed that the values of the survival rate were ranged in 88.23-94% (TA1, TA2, and TB2), 88.23-94% (TB2), 76.47-88.23% (TC1) and 70.56-88.23% (TC2) respectively.

Table 3: Survival Rate (%) of *Anabas testudineus* in Different Interval

Days of Experiment	Treatment Parameter	TA1	TA2	TB1	TB2	TC1	TC2
15 days at study period	Initial total number of fish	17	17	17	17	17	17
	Final total number of fish	16	16	16	16	15	15
	Survival rate (%)	94	94	94	94	88.23	88.23
30 days at study period	Initial total number of fish	17	17	17	17	17	17
	Final total number of fish	15	15	16	15	14	14
	Survival rate (%)	88.23	88.23	94	88.23	82.35	82.35
50 days at study period	Initial total number of fish	17	17	17	17	17	17
	Final total number of fish	15	15	15	14	13	12
	Survival rate (%)	88.23	88.23	88.23	82.35	76.47	70.58

(3) Condition Factor

The values of condition Factor (table 4) ranges from 1.04-1.32 for feed type A, 0.97-1.23 for feed type B and .85-1.11 for feed type C.

Table 4: Condition Factor of *Anabas testudineus* in Different Interval

Days of experiment	Treatment Parameter	TA1	TA2	TB1	TB2	TC1	TC2
15 days at study period	Initial total length (cm)	9.3° 0.14	8.0° 0.13	8.0° 0.14	8.0° 0.13	8.3° 0.13	7.3° 0.14
	Final total length (cm)	10 ° 0.14	9° 0.14	9° 0.14	9° 0.13	8.7 ° 0.13	7.7 ° 0.14
	Length gained (cm)	0.7	1. 0	1. 0	0.6	0.4	0.4
	Initial weight (mg)	143	125	116	108	90	60
	Final weight (mg)	173	155	146	130	110	72
	Weight gained (mg)	30	30	30	22	20	12
	Condition factor	1.08	1.32	125	1.04	1.11	1.05
30 days at study period	Initial total length (cm)	9.3° 0.14	8.0° 0.13	8.0° 0.14	8.0° 0.13	8.3° 0.13	7.3° 0.14
	Final total length (cm)	11 ° 0.14	10° 0.13	10° 0.14	10° 0.13	9.7 ° 0.13	8.7° 0.14
	Length gained (cm)	1.7	2. 0	2. 0	1.6	1.4	1.4
	Initial weight (mg)	143	125	116	108	90	60
	Final weight (mg)	206	185	171	158	135	90
	Weight gained (mg)	63	60	55	50	45	30
	Condition factor	1.03	1.23	1.16	1.05	1.05	.97
50 days at study period	Initial total length (cm)	9.3° 0.14	8.0° 0.13	8.0° 0.14	8.0° 0.13	8.3° 0.13	7.3° 0.14
	Final total length (cm)	12.5 ° 0.14	11° 0.13	10.8° 0.14	10.7° 0.14	10.5 ° 0.13	9.8 ° 0.14
	Length gained (cm)	3.20	3. 0	3. 0	2.9	2.9	2.6
	Initial weight (mg)	143	125	116	108	90	60
	Final weight (mg)	250	220	210	190	160	110
	Weight gained (mg)	107	95	94	82	70	50
	Condition factor	0.85	1.10	1.11	1.10	1.06	0.97

(4) Average Daily Gain (ADG) and Specific Growth Rate (SGR %)

The values of ADG at the end of 15, 30 and 50 days study period (table 5) ranges from 0.125-0.142g (TA1), 0.125-0.133g (TA2), 0.114-0.125g (TB1), 0.091-0.117g (TB2), 0.088-0.107g (TC1), and 0.066-0.08g respectively. The fishes in TA2 showed higher ADG than other tanks. The SGR (%) values ranges from 1.24-2.17 for 15 days, 1.16-2.0 for 30 days and 1.37-2.0 for 50 days respectively.

Table 5: ADG and SGR (%) of *Anabas testudineus* in Different Interval

Days of Experiment	Treatment Parameter	TA1	TA2	TB1	TB2	TC1	TC2
15 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	173	155	146	130	110	72
	Total weight gained (mg)	30	30	30	22	20	12
	ADG	0.125	0.125	0.125	0.091	0.088	0.066
	Initial mean total weight	8.41° 0.02	7.35° 0.03	6.82° 0.02	6.35° 0.02	5.29° 0.01	3.53° 0.02
	Final mean total weight	10.81° 0.02	9.25° 0.03	9.12° 0.03	7.65° 0.02	7.33 °0.01	4.8 °0.01
	SGR (%)	1.67	1.83	1.26	1.24	2.17	2.04

30 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	206	185	171	158	135	90
	Total weight gained (mg)	63	60	55	50	45	30
	ADG	0.140	0.133	0.114	0.110	0.107	0.071
	Initial mean total weight	8.41° 0.02	7.35° 0.03	6.82° 0.02	6.35° 0.03	5.29° 0.01	3.53° 0.02
	Final mean total weight	13.73° 0.02	12.33° 0.03	10.68° 0.03	10.53° 0.02	9.64 ° 0.01	6.42 ° 0.02
	SGR (%)	1.63	1.72	1.16	1.68	2.0	2.0
50 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	250	220	210	190	160	110
	Total weight gained (mg)	107	95	94	82	70	50
	ADG	0.142	0.126	0.125	0.117	0.107	0.088
	Initial mean total weight	8.41° 0.02	7.35° 0.03	6.82° 0.02	6.35° 0.02	5.29° 0.01	3.53° 0.02
	Final mean total weight	16.66 °0.02	7.35° 0.03	6.82° 0.02	6.35° 0.02	5.29 °0.01	3.53 °0.02
	SGR (%)	1.37	1.38	1.44	1.52	1.70	2.00

(5) Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and Feed Efficiency:

Feed conversion ratio (FCR), protein efficiency ratio (PER) and feed efficiency in table 6 and figure 1.

Table 6: FCR and PER and Feed Efficiency of *Anabas testudineus* in Different Interval

Days of experiment	Test diet	TA1	TA2	TB1	TB2	TC1	TC2
15 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	173	155	146	130	110	72
	Total weight gained (mg)	30	30	30	22	20	12
	Total feed intake (actual) g	85	82	99	80	80	53
	Moisture content in diet (%)	11	11	11	11	10	10
	Feed intake (dry wt. basis)	75	73	88	71	71	47
	Feed intake/fish/day (dry wt. basis)(g)	.31	.30	.36	.29	.29	.19
	Protein fed	31.45	30.34	32.67	29.37	27	17.4
	FCR¤	2.5	2.43	2.93	3.22	3.55	3.91
	PER¦	.95	.98	.91	.75	.74	.69
	Feed efficiency (%)*	40	41.01	34.09	30.98	28.16	25.53
30 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	206	185	171	158	135	90
	Total weight gained (mg)	63	60	55	50	45	30
	Total feed intake (actual) g	162	165	190	177	180	119
	Moisture content in diet (%)	11	11	11	11	10	10
	Feed intake (dry wt. basis)	144	147	169	157	162	107
	Feed intake/fish/day (dry wt. basis)(g)	.32	.33	.35	.33	.36	.25
	Protein fed	59.94	61.05	62.7	58.41	54	35.7
	FCR¤	2.28	2.45	3.07	3.14	3.6	3.56
	PER¦	1.05	.98	.88	.86	.83	.84
	Feed efficiency (%)*	43.75	40.81	32.54	31.84	27.77	28.03
50 days at study period	Protein levels (%)	37.0	37.0	37.0	37.0	37.0	37.0
	Initial total weight (mg)	143	125	116	108	90	60
	Final total weight (mg)	250	220	210	190	160	110
	Total weight gained (mg)	107	95	94	82	70	50
	Total feed intake (actual) g	283	275	320	297	297	198
	Moisture content in diet (%)	11	11	11	11	10	10
	Feed intake (dry wt. basis)	252	244	284	267	267	178
	Feed intake/fish/day (dry wt. basis)(g)	.34	.33	.38	.36	.41	.30
	Protein fed	104.71	101.75	105.6	98.01	89.1	59.4
	FCR¤	2.35	2.57	3.02	3.25	3.81	3.74
	PER¦	1.02	.93	.89	.84	.79	.84
	Feed efficiency (%)*	42.46	38.86	33.09	31.06	26.21	28.08

*¤Dry weight of fed/Wet weight gained= FCR/ ¦Total weight gained/Protein Fed= PER/ *weight gained in wet weight/ Feed intake in dry weight X100= Feed Efficiency*

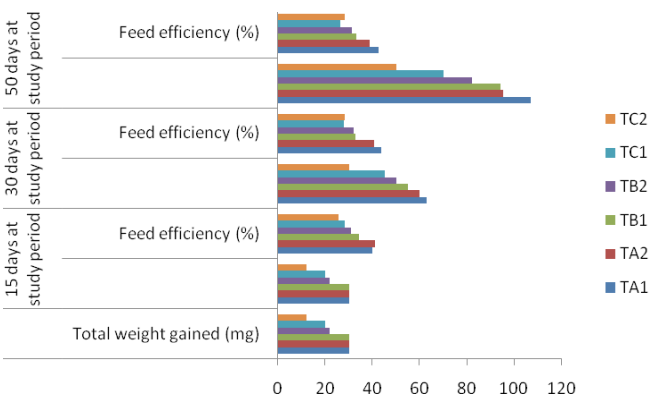

Figure 1: Weight Gained and Feed Efficiency of *Anabas testudineus* on Diets Containing Different Level of Proteins.

(6) Water Quality Parameter

The values of water temperature ranged from 27.5^{0}C to 30^{0}C for TA1, 27.6^{0}C to 30^{0}C for TA2, 27.2^{0}C to 30^{0}C for TB1, 27.2 to 29.5^{0}C for TB2, 27^{0}C to 29^{0}C for TC1 and 27.1^{0}C to 29^{0}C for TC2. The other value of DO, pH, Chloride, Hardness, Carbon dioxide, Alkalinity, Nitrate-nitrogen, Nitrite-nitrogen, Ammonia nitrogen is in table 7 & figures 2-4.

Table 7: Estimated Water Quality Parameter for 6 Tanks TA1, TA2, TB1, TB2, TC1, and TC2.

Parameter	Sampling, Tank TA1 & TA2							
	TA1				TA2			
	Initial	15 days	30 days	50 days	Initial	15 day	30 days	50 days
Temperature (^{0}C)	27.5	28	29	30	27.6	28.2	29.5	30
DO (mg/L)	8	9	8.5	8	8	8.5	9	8
pH	7.1	7.2	7.3	7.2	7.2	7.1	7.3	7.2
Chloride (mg/L)	120	90	120	150	120	90	90	120
Hardness (mg/L)	102	119.7	102.6	102.6	102.6	119.7	119.7	102.6
CO_2 (mg/L)	15	20	15	25	15	25	20	15
Alkalinity (mg/L)	85	68.4	68.5	85.5	85.5	85.5	68.4	68.4
NO_3-N (mg/L)	.12	.30	.50	1	.12	.09	.50	.10
NO_2-N(mg/L)	.002	.004	.00	.012	0	.002	.004	.012
NH_3-N (mg/L)	0	.05	.08	.10	0	.05	.07	.10

Parameter	Sampling, Tank TB1 & TB2							
	TB1				TB2			
	Initial	15 days	30 days	50 days	Initial	15 day	30 days	50 days
Temperature (^{0}C)	27.2	27.5	29	30	27.2	27.5	28.5	29.5
DO (mg/L)	8	10	9.5	8	8	9	9.5	8.5
pH	7.1	7.2	7.1	7.3	7.2	6.9	6.9	8.5
Chloride (mg/L)	120	120	90	120	120	90	90	120
Hardness (mg/L)	102.6	102.6	109.7	102.6	102.6	119.7	119.7	102.6
CO_2 (mg/L)	15	15	25	20	15	20	25	20
Alkalinity (mg/L)	85	85.5	68.4	85.5	68.4	68.4	68.4	68.4
NO_3-N (mg/L)	.12	.12	.60	.85	.12	.75	1	.45
NO_2-N(mg/L)	0	0	.012	.003	0	.012	.008	.005
NH_3-N (mg/L)	.10	0	.45	.52	0	.10	.08	.06

Parameter	Sampling, Tank TC1 & TC2							
	TC1				TC2			
	Initial	15 days	30 days	50 days	Initial	15 day	30 days	50 days
Temperature (^{0}C)	27	27	28	29	27.1	27	27.8	29
DO (mg/L)	8	7	7.5	8	8	8.5	9	9
pH	7.1	6.9	7.1	6.9	7.1	7.1	6.9	7.1
Chloride (mg/L)	120	90	120	90	120	120	90	120
Hardness (mg/L)	102.6	119.7	102.6	119.7	102.6	102.6	102.6	102.6
CO_2 (mg/L)	15	25	25	20	15	20	20	25
Alkalinity (mg/L)	85.5	85.5	68.4	68.4	85.5	85.5	68.4	85.4
NO_3-N (mg/L)	.12	.70	.30	1	.12	.15	.36	1
NO_2-N(mg/L)	0	.004	.008	.012	0	.002	.003	.012
NH_3-N (mg/L)	.01	.88	.50	.66	.04	.10	.25	.59

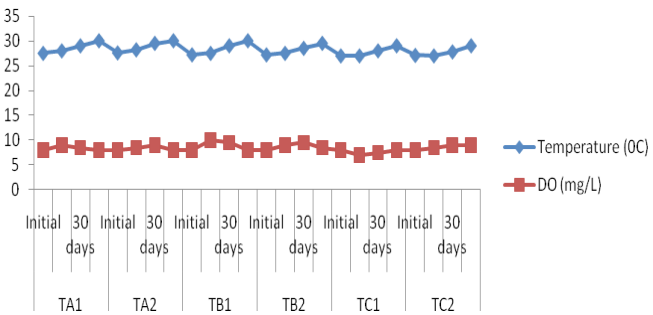

Figure 2: Temperature and DO throughout the Experiment Period

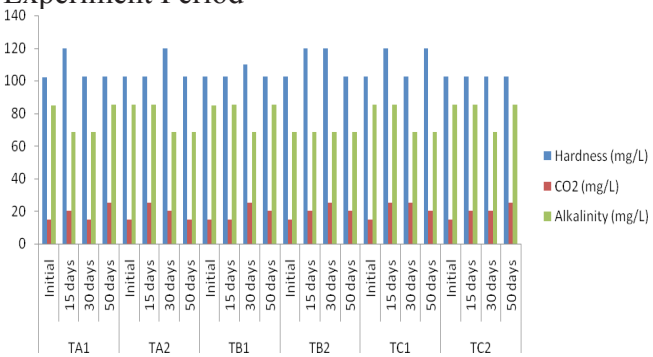

Figure 3: Hardness Carbon di oxide and Alkalinity throughout the Experiment Period

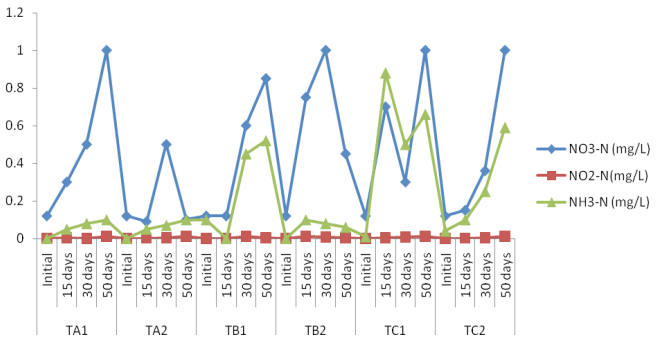

Figure 4: NO_3-N, NO_2-N and NH_3-N throughout the Experiment Period

Discussion

For successful culture of any fish suitable feed is one of the most important prerequisites. Availability of quality feed or ingredients of feed are the vital factors that affect commercial fish culture. In the study three levels of protein was used to prepare the 6 types of feed. Among the feeds, feed A contained highest protein percentage followed by Feed B and C. Better Survival rate, ADG, FCR, PER, Feed efficiency were observed in fish fed with Feed A. Feed B 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).

(1) Survival Rate

After 50 days of culture period, fish in TC2 showed the lowest survival rate that was 70.58% and the highest survival rate was 94% (for TA1, TA2, TB1 and for TB2 at the time of 15days of experiment). This finding is similar to the findings of (Mookerjee and Mazumdar, 1946) where by using prepared (containing 35%-45% protein) they observed survival rate of *Anabas testudineus* ranging from75%-89%. High survival rate of climbing perch was also reported by (Rao, 1968). So climbing perch can be an excellent candidate for aquaculture than other culture species. Rearing fish using artificial food gave higher survival rate. The present results were higher at treatment 1 and 2 for Feed A and treatment 1 and 2 for Feed B, but lower at treatment 1 and 2 for Feed C. In general, Feed A gave the best results among experimental treatments.

(2) Specific Growth Rate

It is evident from the results of SGR values of *Anabas testudineus* fish fed Feed-A which represented in table 3 that with the increase of age the values of SGR decrease. From this point of view the formulated feed A 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 who identify 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 and his epigram. "Organism age fastest, when they are young" is expressed by (Medawars, 1945) fifth law. The SGR% value of koi fish in our experiment also shows the same trend mentioned in (Medawars, 1945) fifth law.

(3) Feed Conversion ratio (FCR)

FCR were higher in the diets with the lowest protein content for the entire replica and all the time intervals when the parameter was estimated. In this experiment fish fed Feed C had the highest FCR for all the times of experiment than other two. (Doolgindachabaporn, 1994) found that the FCR value of *Anabas testudineus* ranges from 1.8-3.0. (Chakraborty, 1999) found that the FCR value of *Labeo rohita* 1.30-1.99. The above findings are similarities with us. (Potongkam 1972) reported that FCR of climbing perch fed on trash fish and pellet were 2.07 and 1.89, respectively.

(4) Average Daily Gain

In the present study, the average daily gain of fish were ranged from 0.125-.142g (TA1), 0.125-.133g (TA2), 0.114-.125 (TB1), 0.091-.117 (TB2), 0088-0.107g (TC1) and 0.066-.08 (TC2) respectively.

(5) Protein Efficiency Ratio

It has been observed that the given values of protein efficiency ratio in case of *Anabas testudineus* fish feed on formulated feed containing different levels of protein and reared in different tanks that the fish feed containing 37% levels of protein in tank TA1 and TA2 have shown better protein efficiency ratio value (0.93-1.05) in comparison with the other prepared fish feed B and C in the tank no

TB1, TB2, TC1 and TC2 (ranged from 0.9-2.1). (Mustafa, *et. al.* 1995) in a study of formulated fish feed diet observed protein efficiency ratio ranged from 1.31-1.60 but not similar with our findings.

(6) Condition Factor

The values of condition factor of *Anabas testudineus* fish that are represented in the table indicated better condition for the fish fed on formulated feed (tank TA1 and TA2). The values of the condition factor of the fish ranged from 0.85-1.32. The values are nearer to 1. The findings have got similarities with those of (Saha, *et. al.,* 1998) who has got this value of condition factor as nearer to one in case of *Clarias batrachus* fed on formulated diets. (Rahman, *et al.* 1997) in a study on the survival and growth of catfish after giving selected supplemental feeds got the values of condition factor between.81 to .87 which coincides with our findings.

(7) Water Quality Parameters in the Experiment

During the experimental period, most water parameters in still tank were in suitable ranges for fish growth. Dissolve oxygen ranged from 7 to 9.5 mg/l whereas temperature ranged from 27 to 30°C, pH 6.98.5, Chloride 90-120 mg/l, Hardness 102-119.7 mg/l, CO_2 15-20 mg/L, Alkalinity 68.4 -85.5 mg/L, NO_3-N .12-1 mg/L, NO_2-N .012-.12 mg/L and NH_3-N 0-.88 mg/L. The water temperature and dissolved oxygen in all experimental tanks are showed in table 7. Although there were little fluctuation in the parameters of water temperature and dissolved oxygen concentration from morning to afternoon in three treatments of experiment, but the ranges of these values were still suitable for the growth of climbing perch fry (Boyd, 1982).

Conclusion

Koi fish (*Anabas testudineus)* is traditionally a popular type of fish in this region. This fish is highly popular for its high nourishing quality and prolonged freshness. It is found in most of the fresh water bodies and is abundantly available from June to September. Objective of the experiment was included to find the feed utilization by the experimental fish (*Anabas testudineus)* up to 50 days. Optimum level of protein for the fish growths was also determined. 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. Observing the overall performance at last it can be said that Feed A is the most effective feed among the three categories of prepared fish feed in the laboratory.

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