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Effects of Water Salinity on Feeding Efficiencies, Growth Performances and Survival Rate of Thai Strain Koi, *Anabas testudineus* (Bloch, 1792)

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Abstract: The study was carried in three rectangular glass tanks with two replications of each where the first tank was considered as control, C (salinity 0 ppt), the second as Treatment 1, T_1 (8 ppt) and the third as Treatment 2, T_2(10 ppt). 72 fry (average weight 2.5g) were stocked in these tanks at one feeding rates (3% of body weight) in a 1 X 2 factorial experiment. The fishes were fed at morning and afternoon in a day. Average food conversion ratios (FCR) were found 2.67±0.371, 2.27±0.351 and 2.07±0.56 in C, T_1 and T_2 where average protein efficiency ratios (PER) were 0.67±0.078, 0.8±0.056 and 0.76±0.068 in three tanks respectively. The feed efficiency (FE) were T_1: 22.31±3.07%, T_2: 21.38±2.99% and C: 26.42±2.93% and specific growth rate (SGR) were 0.67±0.139 %/d in the C, 0.99±0.357%/d in T_1 and 0.79±0.326%/d in T_2 respectively. Average daily gain (ADG) was found higher in T_1 (0.15±.011 g/d), than in C (0.12±0.305 g/d) and in T_2 (0.14±0.037 g/d). The condition factor (CF) was 0.29±0.030 % in C, 0.38±0.019 % in T_1 and 0.35±0.022 % in T_2. The final weight gain (g) was obtained 35.94±0.402g, 36.07±0.4g and 36.03±0.316g in C, T_1 and T_2 where final length gain (cm) was obtained 7.56±0.184cm, 7.68±0.18cm and 7.49±0.17cm in C, T_1 and T_2 respectively. Also survival rates were found 91.67%, 100% and 95.83% in C, T_1 and T_2. The proximate compositions of fishes were also better in T_1 than that of T_2 and C. Water quality parameters were also found better in T_1 than that of T_2 and C. It was observed that feeding efficiencies and growth performances were better in T_1 than that of T_2 and C. The best growth was found from T_1 and lower growth was found from C in case of Thai strain koi (*Anabas testudineus*). The present study revealed that Thai Strain Koi can tolerate a wide range of salinity and also better growth could be possible to find than in freshwater.

Key words: Water parameters · Condition factor · Salinity · Feeding efficiency · Growth · Thai Strain Koi

INTRODUCTION

Bangladesh has the third largest aquatic fish biodiversity in Asia, after China and India, with about 800 species in fresh, brackish and marine waters [1]. Approximately half of its 138 million populations are considered to be poor and very vulnerable to climate change [2]. Floods, tropical cyclones, storms surges and droughts are likely to become more frequent and severe in the coming years. Due to climate change, salinity intrusion is increasingly becoming an important impediment for the expansion and augmentation of aquaculture production in Bangladesh especially in the estuarine and coastal region. All of these changes threaten the food security, livelihoods and health of the poor. Where, poor growth and nutrition are the two major impediments in the fields of fish culture around the world including Bangladesh. So it is essential to determine the culture system of different important fish species in captive condition. The climbing perch, *A. Testudineus,* locally known as koi fish, is an important indigenous fish species of Bangladesh. In freshwater, the main habitats of Thai Strain Koi are in low lying swamps, marsh lands, lakes, canals, pools, small pits and puddles [3]. Although, they occur both in fresh and brackish waters [4]. The geographical habitats of this species is in India, Pakistan, Bangladesh, Ceylon, Burma, Sri-Lanka, Thailand, China (Cochin, Tong-king, southern part), Philippines, Polynesia and Malaya [3], [5], [6]. Thai Strain Koi fish is endowed with air breathing organ, which enables it to withstand very low dissolved oxygen (DO) environment and can grow well in almost all kinds of water bodies.

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The fish is very hardy and can be stocked at very high densities and are suitable for culture in small water bodies [7]. It contains very high amount of physiologically available iron and copper essentially needed for hemoglobin synthesis as well as possess easily digestible fat of very low melting point and many essential amino acids [8]. The study will be lead to find out whether the Thai strain koi could survive up to a salinity level, if so to determine the salinity level and also to find out high salinity level on which the maximum production of the species will be gain. Thus, we could be able to produce high amount of Thai strain koi to fulfill the huge demand of animal protein in Bangladeshi costal region especially in the tidal zone. The result of the study will enhances our current adaptation knowledge which helps to build strategy against climate change stress in the coastal zone. The objectives of this research are-

- To determine the effects of salinity on the proximate composition in Thai Strain Koi, that's why the end product quality will ensure.
- To have better understanding on the effects of increasing water salinity on feeding efficiency, growth performance and survival rate of Thai strain koi.
- To observe and determine the optimum salinity range at which the fry of Thai strain koi (age: 21+ days) could culture and to find the affordable salinity level on which the production of the species reaches a maximum level.

MATERIALS AND METHODS

Experimental Fish and Acclimation in the Laboratory: The Thai strain of Koi fish, *Anabas testudineus* fry's were used as experimental species obtained from earthen ponds of Integrated Agro Industries Limited, Noakhali, Bangladesh. 72 samples were used for the studies. The fish was conditioned in the laboratory and condition over a period of three days. There was no feeding during conditioning. Before experimental stocking the fish was fasted for 3 days to evacuate their previous gut contents. After fasting, length (cm) and weight (g) of total batch fishes were measured individually at 7 days interval to determine the feeding ration. The good fish was selected with same size during fasting when week fish was culled out by removing the dead ones. After fasting the fish was given sample diet to determine the feeding ration.

Table 1: Experimental design

Treatments	Replicates (150 liters each)	Stocking density/treatment	Feeding frequency (Twice a day)
Control	R_1	12	Morning
0 ppt	R_2	12	Afternoon
Treatment 1	R_1	12	Morning
(T_1) 8 ppt	R_2	12	Afternoon
Treatment 2 (T_2)	R_1	12	Morning
10ppt	R_2	12	Afternoon

Experimental Design: The fish fry's were cultured in captive environment in the flow-through glass tanks (150 L) where the flow rate maintained into the tanks was 1 L/min. Air blower was used for aeration. Six glass tanks were filled with tape water and placed inside in the Laboratory, Department of Fisheries and Marine Science, Noakhali Science and Technology University, Bangladesh [see Table 1]. The tanks were given continuous tape water supply and air diffusion by using air stone. The fish was fed twice a day i.e., morning and afternoon. The fish was fed 3% of their body weight.

Experimental and Indicator Variable: The experimental variable were the levels of salinity (0 ppt as control; two levels of water salinity was used in the current study i.e., treatment 1 (T_1) with 8 ppt and treatment 2 (T_2) with 10 ppt). There were three aspects of this study such as feeding efficiencies, growth performances and survival rate. Feed conversion ratio (FCR), protein efficiency ratio (PER), feeding efficiency, average daily gain (ADG), specific growth rate (SGR), conditioning factor were measured as the indicators of feeding efficiencies. Water salinity, dissolved oxygen (DO), temperature, pH and transparency in the glass tanks were also monitored at 7 days interval.

Sampling: The culture potentiality was assessed by recording the rate of growth in terms of gain in length (cm) and in weight (g) of fish. The samples were taken from each experimental unit by using a small seine net after 7 days interval. Weight was taken with a digital balance (Scout *Pro* Balance – Model: SP402) and length with a measuring scale. All the data recorded in my personal laptop computer and then finally calculated the average length and weight of fishes according to treatment on each sampling day. Water quality parameters were monitored in the culture tanks at the time of fish sampling.

Feeding Efficiencies: Feeding efficiencies mainly are feed conversion ratio (FCR), protein efficiency ratio (PER), feed efficiency (FE), specific growth rate (SGR), average daily gain (ADG) and condition factor (CF).

Survival Rate: Survival rates were measured on the basis of total fish harvested at the end of each fortnight until the end of the study. The survival rate was calculated by using the following formula [9]:

$$\text{Survival rate (\%)} = \frac{\text{No. Of actual fish survived}}{\text{No. Of actual fish stocked}} \times 100$$

Feed and Carcass Analysis: The experimental diet was ground to a fine power by using a mortar and pestle, analyzed for moisture, crude protein, crude lipids and ash and nitrogen free extract.

Water Quality Monitoring: Physicochemical parameters like temperature, pH, dissolved oxygen (DO), hardness, salinity and transparency of the water were measured at 7 days interval [See Table 2]. Temperature was recorded by using a Celsius thermometer. DO, pH, hardness, salinity and transparency were measured directly by a portable digital DO meter (Model: HI9146), a digital pH meter (Model: HI 96107), hardness test kit (Model: HI 3812), salinity refractometer (Model: REF201/211/201bp) and a sacchi disc respectively. Where pH meter was decently adjusted with buffer solution pH-7 and refractometer was also properly oriented with 0 ppt salinity, before taking a measurement. On the spot, recording of water temperature (°c), dissolved oxygen (DO), pH, hardness, salinity (ppt) and transparency (cm) were done in the morning (9-10 am).

Statistical Analysis: The effect of salinity on feeding efficiencies, growth performances and survival rate on Thai strain of Koi fish, *Anabas testudineus* (Bloch, 1792) assessed with one-way ANOVA. The tanks were placed following completely randomized design (CRD) method. SGR, PER, FCR, ADG and feeding efficiency were transformed into square root transformations before analysis. Statistical analysis was performed by DMRT and one way analysis of variance (ANOVA) to test the significance ($p<0.05$) of variation between the treatment value through SPSS 11.5 Statistical Software (2010).

RESULTS

The study had five aspects which are feeding efficiencies, growth performances, survival rate and proximate composition of Thai Strain Koi fish body (*Anabas testudineus)* and feed and also water quality parameters of culture system.

Feeding Efficiencies: The highest FCR 2.67±0.371 was found in the control while the lowest FCR 2.07±0.567 was measured in treatment 2. FCR 2.27±0.351 observed in the treatment 1 was significantly lower than that of control and higher than that of treatment 2 [see Table 3].

PER was highest in the treatment 1: 0.8±0.056 and lowest in the control 0.67±0.078. However, PER in the treatment 2: 0.76±0.068 was significantly higher than that of control and lower than treatment 1 [see Table 4].

Table 2: Water quality parameters in different treatment systems, average for two replicates

Water quality Parameters	Treatment	1st Week	2nd week	3rd Week	4th week	5th week	6th week	7th week	MeanValue ±SE
Temp. (°C)	C	29.0	29.2	29.5	30.0	29.2	30.4	30.6	29.7±0.222
	T_1	28.0	28.4	28.7	29.5	29.8	30.0	30.2	29.23±0.3
	T_2	28.4	28.7	29.0	29.3	29.8	30.0	30.0	29.31±0.225
pH	C	7.5	7.6	7.6	7.7	7.8	7.8	7.9	7.7±0.049
	T_1	7.1	7.2	7.3	7.3	7.4	7.5	7.5	7.33±0.052
	T_2	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.5±0.0.076
D.O (ppm)	C	3.7	4.0	4.3	4.6	5.0	5.25	5.4	4.61±0.225
	T_1	3.47	4.14	4.48	4.72	5.23	5.65	5.87	4.79±0.298
	T_2	3.98	4.12	4.62	5.0	5.21	5.67	5.78	4.91±0.248
Hardness	C	182.75	183.64	183.87	184.65	185.0	185.2	185.25	184.34±0.33
	T_1	211.16	211.55	212.12	212.89	213.78	214.46	215.68	213.1±0.574
	T_2	225.45	226.1	226.48	227.11	227.38	228.25	228.78	227.08±0.412
Transparency (cm)	C	19.25	19.0	19.75	20.70	20.2	20.4	20.54	19.98±0.23
	T_1	16.30	16.2	16.0	16.45	16.2	16.48	16.54	16.31±0.067
	T_2	13.78	13.96	14.24	14.0	13.74	13.82	14.05	13.94±0.062
NH_3 (mg/l)	C	0.82	0.81	0.83	0.82	0.81	0.82	0.83	0.82±0.002
	T_1	0.62	0.61	0.62	0.63	0.64	0.63	0.65	0.63±0.005
	T_2	0.52	0.55	0.54	0.53	0.56	0.56	0.57	0.55±0.006

Table 3: FCR values in three treatments

	Average FCR ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	2.85	2.57	2.16
2nd week	2.21	2.18	1.22
3rd week	2.67	2.26	2.13
4th week	2.31	1.95	1.88
5th week	2.45	2.41	2.29
6th week	2.08	1.76	1.73
7th week	3.12	2.78	3.07
Mean Value	2.67±0.371[a]	2.27±0.351[a]	2.07±0.567[a]

Table 4: PER values in three treatments

	Average PER ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	0.53	0.72	0.65
2nd week	0.76	0.81	0.8
3rd week	0.62	0.84	0.81
4th week	0.68	0.75	0.72
5th week	0.73	0.88	0.86
6th week	0.64	0.76	0.74
7th week	0.72	0.82	0.78
Mean Value	0.67±0.078[a]	0.8±0.056[b]	0.76±0.068[a]

Table 5: FE values in three treatments

	Average FE ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	22.34	17.87	16.85
2nd week	23.45	18.97	17.65
3rd week	25.18	22.54	21.67
4th week	28.67	25.76	24.26
5th week	26.52	24.12	22.68
6th week	28.46	21.43	22.24
7th week	30.34	25.45	24.28
Mean Value	26.42±2.93[a]	22.31±3.07[b]	21.38±2.99[b]

Although there was no significant differences in the feed efficiency (FE) across all treatments (T_1: 22.31±3.07, T_2: 21.38±2.99 and control: 26.42±2.93), the feed efficiency was high in the control and declined gradually between two treatments [see Table 5].

The highest SGR (0.99±0.357 %/d) was measured in the treatment 1 while the lowest SGR (0.67±0.139 %/d) was found in the control. However, the SGR (0.79±0.326 %/d) observed in the treatment 2 was significantly lower than that of treatment 1 and higher that the control [see Table 6].

The highest ADG (0.15±.011 g/d) found in the fish was in treatment 1 while the lowest ADG (0.12±0.305 g/d) found in the fish was in control. However, the ADG (0.14±0.037 g/d) measured in the treatment 2 was significantly lower than treatment 1 and higher than that of control [see Table 7].

Table 6: SGR values in three treatments

	Average SGR ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	0.76	0.45	0.34
2nd week	0.86	0.85	0.63
3rd week	0.56	1.12	0.95
4th week	0.45	0.83	0.68
5th week	0.66	1.56	1.25
6th week	0.78	1.25	1.12
7th week	0.65	0.85	0.56
Mean Value	0.67±0.139[a]	0.99±0.357[a]	0.79±0.326[a]

Table 7: ADG values in three treatments

	Average ADG ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	0.12	0.08	0.07
2nd week	0.11	0.15	0.12
3rd week	0.13	0.16	0.14
4th week	0.12	0.15	0.14
5th week	0.14	0.18	0.16
6th week	0.13	0.2	0.18
7th week	0.11	0.14	0.15
Mean Value	0.12±0.305[a]	0.15±0.011[a]	0.14±0.037[a]

Table 8: CF values in three treatments

	Average CF ratios of three experimental systems		
Time of Sampling	Control	Treatment 1	Treatment 2
1st week	0.3	0.35	0.32
2nd week	0.31	0.4	0.38
3rd week	0.25	0.39	0.37
4th week	0.32	0.38	0.35
5th week	0.26	0.37	0.34
6th week	0.28	0.41	0.38
7th week	0.33	0.38	0.35
Mean Value	0.29±0.030[a]	0.38±0.019[b]	0.35±0.022[a]

The condition factor k was highest (0.38±0.019 %) in the treatment 1 and lowest in the control (0.29±0.030 %). However, condition factor (0.35±0.022 %) in the treatment 2 was similar to those of control and treatment 1 [see Table 8].

Survival Rate (%): The survival rate of Thai strain Koi fish (*Anabas testudineus)* during the period of experiment was 91.67%, 100% and 95.83% in C, T_1 and T_2 respectively, although similar stocking density was maintained in all treatments.

Growth Performance: In the present study, the final weight gain (g) was obtained 35.94±0.402g, 36.07±0.4g and 36.03±0.316g in C, T_1 and T_2, where the initial weight was 2.92±0.163g, 3.66±0.285g and 3.63±0.19g in C, T_1 and T_2

Table 9: Proximate composition of the feed

Sample	Moist (%)	Protein (%)	Fat (%)	Ash (%)	N-free extract (%)
Initial feed	10.53±0.270	31.15±0.551	6.30±0.448	18.55±0.386	33.47±0.444
Grower feed	9.12±0.225	28.19±0.346	5.50±0.346	19.68±0.451	37.51±0.347

Table 10: Proximate compositions of Thai Strain Koi fish

Sample	Moist (%)	Protein (%)	Fat (%)	Ash (%)
Initial fish	$79.29±0.005^a$	$12.25±0.001^d$	$2.86±0.007^d$	$5.10±0.007^a$
Control	$72.62±0.005^b$	$16.32±0.001^c$	$6.47±0.009^a$	$2.87±0.007^b$
T-1 (8ppt)	$67.86±0.001^c$	$18.62±0.004^a$	$6.02±0.009^b$	$2.03±0.009^c$
T-2 (10ppt)	$65.28±0.002^d$	$17.78±0.005^b$	$5.54±0.001^c$	$1.78±0.009^d$

Means within each comparison in the same column with the different superscripts letters differ significantly (P <0.05) and Means within each comparison in the same column with the same superscripts letters are not significantly different (P > 0.05).

respectively for 50 days experimental period at the end of experiment. Also the initial length (cm) was incurred 3.95±0.17cm, 4.69±0.272cm, 4.66±0.203cm in C, T_1 and T_2, where the final length was 7.56±0.184cm, 7.68±0.18cm and 7.49±0.17cm severally.

Proximate Composition of Feed and Fish Body: The Table 9 indicates the proximate composition of feed that were used for the fingerlings of Thai strain Koi fish (*Anabas testudineus)* and Table 10 shows the proximate composition of fish that were measured at the end of experiment.

DISCUSSION

Mookerjee and Mazumdar [10], observed that, growth and production in fish culture are generally dependent on the daily feed consumption, qualities of feed and feeding frequency. Jana and Chakrobarty [11], suggest the growth, reproductive potentials and survival of each species are affected by the nutrient conditions of the culture media.

In conducted experiments, the highest FCR in the control could be due to less utilization of feed while low FCR in the treatment 2 (2.07±0.567) and T_1 (2.27±0.351) might be explained by better utilization. Doolgindachabapom [12], observed similar FCR (1.8 to 3.0) in Koi brood fish. Gaumet *et al*. [13], found that FCR were lower in a diluted environment in case of juvenile turbot suggest that growth conditions could be improved by adaptation to brackish waters. The highest PER was found in the treatment 1 (0.8±0.056%) followed by treatment 2 (0.76±0.068%) and lowest in the control (0.67±0.078%). Woo and Kelly [6], found that protein efficiency ratios (PER) of sea bream cultured at 15 ppt were consistently higher than those at other salinities. Likongwe *et al*. [14], observed highest PER at 8 ppt salinity in *Oreochromis niloticus*. Feed efficiency was similar across all treatments and controls. However, there was a decreasing trend in the feed efficiency with increasing levels of salinity. This decreasing trend in feeding efficiency in treatments indicates the effectiveness of salinity and their benefit to use [15]. ADG and SGR were highest in the treatment 1 followed by treatment 2 and lowest in the control. Imsland *et al.* [16], observed that the specific growth rates (SGR) of *Hippoglossus hippoglossus* at 15 ppt (SGR: 1.29 ± 0.03) and 25 ppt (SGR: 1.25 ± 0.04). In the present study, the highest final weight gain (g) and final length gain (cm) was obtained in T_1 than that of control and T_2 respectively for 50 days experimental period. Bray and Lawrance [17], found highest mean final weights in case of *Penaeus vannamei* when they are cultured in 5 and 15 ppt salinities. Farnandes *et al.* [18], found that salinity improved the growth of females *Oreochromis niloticus* that was accompanied by the highest plasma T_3 levels. Imsland *et al.* [16], observed that the final mean weight of *Hippoglossus hippoglossus* at 15 ppt and 25 ppt was significantly larger than other salinities. Lam and Sharma [19], found that the growth and development of carp larvae increased with increasing salinity from fresh water to 10% sea water. Likongwe *et al*. [14], observed higher final mean weight at 12 ppt salinity in *Oreochromis niloticus*. Secor *et al*. [20], found that growth of *Morone saxatilis* was approximately 40% higher at 7 ppt than at 0.5 ppt. Suresh and Lin [21], showed that a range of (10-20) ppt is optimal for growth in Tilapia. Woo and Kelly [6], found that growth rates of sea bream cultured at 15 ppt were consistently higher than those at other salinities. It seems that when saline water used for culture in case of Thai strain Koi fish (Anabas *testudineus)*, higher production can be achieved and growth is high in 8 ppt than in 10 ppt and higher than control. The survival rate of Thai strain Koi fish

(*Anabas testudineus)* during the period of experiment was 91.67%, 100% and 95.83% in C, T_1 and T_2. Stickney [22], stated that the effect of salinity on survival rate depends on the ability of body fluid for tolerate changes of osmolality and ion concentrations. High survival rate of climbing perch was also reported by Rao and Seshagiri [23]. Fielder *et al.* [24], observed that survival of *Pagrus auratus* larvae was best within the salinity range of 20 – 35 ppt. Lam and Sharma [19], found that the survival rate of carp larvae increased with increasing salinity from fresh water to 10% sea water. The results of this study showed that different levels of salinity had affected to the growth performance where, the best growth was achieved at 8 ppt and 10 ppt. It has been observed that the Protein (%) in initial feed was 31.15±0.551% and in grower feed was 28.19±0.346%. Doolgindachabapom [12], recommended that the feed containing 30.6% protein as the best feed formula in terms of growth and mortality for *Anabas* fry, though fish fed 27% protein feed showed the best performance. Hasan [25], found that, lipids are primarily included in formulated diet to maximize their protein sparing effect by being a source of energy. In this study the lipid (%) in initial feed was 6.30±0.448% and in grower feed was 5.50±0.346%, which is similar to the findings of Luquet [26], who stated that dietary lipid levels of 5 to 6% are often used in tilapia diet. The moisture content (%) in initial feed was 10.53±0.270% and in grower feed was 9.12±0.225 %, indicated to have the less number of microbial load [27]. The moisture content (%) of raw fish range was 65.28±0.002 to 79.29±0.005 which is more or less similar to the findings of Begum and Minar [28], where they found the estimated moisture content (%) for G. *Chapra, C. Soborna, A. Punctata, C psendeutropius atherinoides, P. Sarana* was 76.01, 77.91, 75.46, 76.60, 71.3. Mahfuz *et al.* [29], found the moisture was 72.41 for *L. Bata* and 71.75 for *L. Gonia*. On the other hand the moisture content for T_1 was 67.86±0.001% and T_2 was 65.28±0.002% which showed significant variation ($P < 0.05$) from the normal one. The protein content (%) of raw fish range was 12.25±0.001 to 18.62±0.004 which were much more similar with the findings of Mazumder *et al.* [30], in *G. Chapra* and *P. Chola.* The lipid content of the initial experimented fish sample was observed 2.86±0.007% and finally 6.47±0.009% in control, 6.02±0.009% in T_1 and 5.54±0.001% in T_2. This species usually contain more amount of oil than any other marine estuarine fishes. Stansby [31], in his experiment on proximate composition of Pacific Cod (*Gadus macrocephalus*) and Mackerel (*Scomber scombrus*) found that Pacific cod contained higher percentage of lipid content in comparison to Mackerel. The ash content of experimented fish was 2.87±0.007% in control, 2.03±0.009% in T_1 and 1.78±0.009% in T_2. Devadsan *et al.* [32], found lower amount of ash content in six freshwater fishes *L. Rohita* (1.31%), *Catla catla* (0.93%), *Cirrihinus cirrhosus* (1.40%), *L. Calabasu* (1.02%), *Mystus seeghala* (0.91%) and *Wallagu attu*(0.72%).

Generally moisture content shows inverse relationship with lipid content [29]. According to Stansby [31] and Salam *et al.* [33], proximate composition of fish flesh varied with species variation, age, season and feeding habit of the fish.

CONCLUSION

Climate change can impact the pattern of biodiversity through changes in species' distributions. The impacts affecting aquatic systems and fisheries especially in estuarine and marine areas are raising sea level, intrusion of marine waters in coastal region, increasing global warming and changing rainfall patterns. To enumerate these effect aquaculture crop diversification is needed. Aforesaid Thai strain koi was taken under consideration for the salinity tolerances and culture potentials. Currents research simulation has proved that Thai strain koi species would enable more efficient successful aquaculture operations and substitution for freshwater fish species in the coastal region of Bangladesh where salinity intrusion water is one of the major problems.

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