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Article

Effects of stocking density on the growth rate of gold fish fry reared in hapa

Md. Saroar Hossain Shajib[1], Baadruzzoha Sarker[2], Abdulla-Al-Asif[1,3*], Md. Mizanur Rahman[4], Md. Abu Zafar[5] and Amir Hossain[6]

[1]Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
[2]Production Officer, BRAC Fish Hatchery, Satgao, Sreemongal, Moulvibazar, Sylhet 3214, Bangladesh
[3]Department of Fisheries and Marine Bioscience, Faculty of Biological Science and Technology, Jessore University of Science and Technology, Jessore 7408, Bangladesh
[4]Youth Training Center, Department of Youth Development, Jamalpur, Bangladesh
[5]Department of Aquaculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh
[6]Department of Fisheries Biology and Genetics, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

*Corresponding author: Abdulla-Al-Asif, Department of Aquaculture, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. Phone: +8801716838294; E-mail: jessoreboyhemel@gmail.com

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Abstract: The present study was conducted to investigate effects of stocking density on growth performances of gold fish (*Carassius auratus*) in hapas. Experiment was conducted for a month with three treatments where three stocking densities were T_1 (10 fry/hapa), T_2 (15 fry/hapa) andT_3 (20 fry/hapa) each having three replications which were selected randomly. In the present experiment hapa (3ft × 2ft × 2ft) with 1 mm mesh net was used. Gold fish fry having a mean body weight of 0.007 g were used in all treatments. Fishes were fed at the rate of 10% of their body weight containing 34.11% protein. Water quality parameters were monitored at 10 days interval and the ranges were –temperature 24.75 to 27.75 ^oC, dissolved oxygen 3.68 to 4.09 mg/L, p^H 7.3 to 8.16, ammonia 0.3 to 1 mg/L, nitrite 0.01 to 0.03 mg/L, phosphate 0.6 to 1 mg/L and alkalinity 119 to 187 mg/L. At the growth performances were evaluated by comparing mean final body weight, specific growth rate and food conversion ratio. The present study showed that the gold fish fry in T_1 resulted the best mean final weight gain (1.188 g) followed by T_2 (0.834 g) and T_3 (0.686 g). The SGR ranged between 6.64 and 7.43% per day and FCR ranged between 3.56 and 4.12 with T_1 showing the lowest FCR. The survival rate (%) ranged between 76.67% to 85.67%. From the present experiment it was found that individual fish growth rate was decreased with the increase of stocking density.

Keywords: gold fish; hapa; growth; survival

1. Introduction

Aquarium fish keeping is one of the most eager hobbies in the world today hence aquarium fish rearing and culture practice is increasing day by day. Hapa system is one of the most important techniques for fry rearing of gold fish. Stocking density management measures practiced in Bangladesh are not based on scientific knowledge, thus resulting the poor growth and survival of gold fish. *Carassius auratus* is one of the most indispensable fish species of freshwater ornamental fishery. It is a kind of fish that vastly chosen by artistic minded people because of variety of colors, species diversity, attractive and, and high tolerance to environmental demands (Gumus *et al*., 2016). At present, this practice is growing day by day in our country and used as a symbol of status. There are some recurrent ornamental fishes such as Platy (*Xiphophorous maculatus*), Sword tail (*Xiphophorous helleri*), Zebra fish (*Danio rerio*), Tiger barb (*Puntias tetrazona*), Glass fishes (*Chanda ranga*), and colisa (*Colisa fasciatus*), Gold fish (*Carassius auratus*), Guppy (*Poecilia reticulata*), Molly (*Poecilia* spp.) etc. Among these fishes gold fish *C. auratus* is the most diversely kept aquarium fish species. It is a freshwater fish under the family Cyprinidae belongs to order Cypriniformes (Habib *et al*., 2014). The present experiment has been designed to know the effects of stocking density on the growth performance, survival rate at different stocking densities and determine the suitable stocking density for rearing of gold fish fry in hapa.

2. Materials and methods

2.1. Study area and periods

The experiment hapas were set in a brood stock pond size five decimal at the south west side of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh for a period of 30 days from 21 October 2011 to 20 November 2011.

2.2. Construction and installation of hapa

The hapas were rectangular shaped, made up of high density polyethylene (HDPE) net. The size of each hapa was 3ft×2ft×2ft. The rearing hapa was placed with a 1 mm mesh net, which prevented the fish and food from escaping the hapa. The hapas were tied fixed with the bamboo pole by nylon ropes at time of suspension, about 1 ft of the upper portion of the hapas were always kept above the water level. For experiment hapas were number as 1 to 9 and were divided into three treatment groups T_1, T_2 and T_3 each having three hapas. The stocking densities in T_1, T_2 and T_3 were 10 fry/ hapa, 15 fry/ hapa and 20 fry/ hapa.

2.3. Experiment design

The hapas were selected randomly to accommodate the relevant treatments. The experimental design is shown in Table 1.

Table 1. Experimental design.

Treatment	Replication	Stocking density/hapa
T_1	R_1	10
	R_2	
	R_3	
T2	R_1	15
	R_2	
	R_3	
T3	R_1	20
	R_2	
	R_3	

2.4. Feeds and Feeding

Twelve day old fry of gold fish were used in this experiment. The fry had an initial average total length of 0.55 cm and weight 0.007 g. At the starting of the experiment formulated feed commercial name is spectra hexa a nursery feed was supplied two times daily at 9.00 am and 4.00 pm at the rate of 10 % of their body weight which contain 34% protein.

2.5. Sampling

Sampling was done at 10 days interval by using scope net to observe fish growth and the feeding rate.

2.6. Estimation of growth performance of gold fish

During each sampling 5 gold fish fries were collected from each hapa, their lengths were measured by meter scale and weights were recorded by electronic balance.

To evaluate the fish growth the following parameters were used

Weight gain (g) = Mean final weight (g) – Mean initial weight (g)

Percent weight gain (g) = $\frac{\text{Mean final weight (g)} - \text{Mean initial weight (g)}}{\text{Mean initial weight (g)}} X\ 100$

$$\text{Specific growth rate } (\%) = \frac{\text{loge W2} - \text{loge W1}}{\text{T2} - \text{T1}} X\ 100$$

Where,

W_1= The initial live body weight(g) at time T_1 (day)

W_2= The final live body weight (g) at timeT_2 (day)

T_1 =Time at the initial of the experiment

T_2 = Time at the end of the experiment

Food conversion ratio (FCR) = $\frac{\text{Feed fed of fish}}{\text{Live weight gain of fish}}$

Survival (%) = $\frac{\text{No.of fish harvested}}{\text{No.of fish stovked}} X\ 100$

2.7. Estimation of water quality parameters

Water temperature (°C) from each system was recorded by an ordinary thermometer, p^H was measured by a digital p^H meter (p^H meter L20 METTLER TOLEDO), dissolved oxygen measured by dissolved oxygen meter (Model Oxi 3150i), ammonia measured by ammonia testing kit, nitrite measured by nitrite testing kit, phosphate measured by phosphate testing kit and alkalinity measured by alkalinity testing kits.

2.8. Data analysis

The data obtained on the growth of fish, FCR and survival rate were statistically analyzed to see whether the influence of different treatments on these parameters were significant or not. One way analysis of variance (ANOVA) was done with the help of SPSS (Statistical Package for the Social Sciences).

3. Results

3.1. Growth and survival performance of gold fish fry

The evaluation of growth performance of fish in different treatments average weight and length were calculated and are shown in Table 2.

Table 2. Growth performance of gold fish fry observer in different treatments during the study period.

Treatment	Replication	Stocking density fry/hapa	1st sampling		2nd sampling		3rd sampling		Total average	
			Average weight(g)	Average length (cm)	Average weight (g)	Average length (cm)	Average weight (g)	Average length (cm)	Average weight (g)	Average length (cm)
T_1	R_1	10	0.185	1.4	0.714	2.34	1.24	3.15	1.188	3.06
	R_2	10	0.188	1.5	0.682	2.36	1.15	2.98		
	R_3	10	0.197	1.4	0.684	2.41	1.18	3.07		
T_2	R_1	15	0.173	1.3	0.476	2.18	0.78	2.75	0.834	2.76
	R_2	15	0.156	1.2	0.562	2.07	0.91	2.71		
	R_3	15	0.168	1.3	0.458	2.14	0.83	2.83		
T_3	R_1	20	0.136	1.0	0.366	1.94	0.63	2.38	0.686	2.45
	R_2	20	0.109	0.9	0.456	1.87	0.65	2.41		
	R_3	20	0.105	0.9	0.408	1.91	0.70	2.53		

The evaluation of growth performance of fish in different treatments in terms of weight gain, percent of weight gain, specific growth rate, food conversion ratio and survival rate were calculated and are shown in Table 3.

Table 3. Average (Mean ± SE) values of growth parameters under different treatments throughout the study period.

Parameters	Treatment		
	T_1	T_2	T_3
Mean initial weight (g)	0.007±0.00	0.007±0.00	0.007±0.00
Mean final weight (g)	1.188±0.048	0.834±0.067	0.686±0.093
Mean weight gain (g)	1.181±0.048	0.827±0.067	0.679±0.093
Percentage weight gain	16871.43±685.71	11814.29±957.14	9700±1328.57
Specific growth rate	7.43±2.78	6.92±3.26	6.64±3.74
Feed conversion ratio	3.56±0.01	3.91±0.00	4.12±0.01
Survival rate (%)	85.67±0.44	81.87±0.71	76.67±0.58

3.1.1. Mean weight gain

The present study mean value of weight gain gold fish fry were 1.181±0.048g, 0.827±0.067 and 0.679±0.093g in treatment $T_{1,}$ T_2 and T_3 respectively. The highest mean value of weight gain was found from treatment T_1 (1.181±0.048) whereas the lowest mean weight gain was found from T_3 (0.679±0.093) (Figure 1).

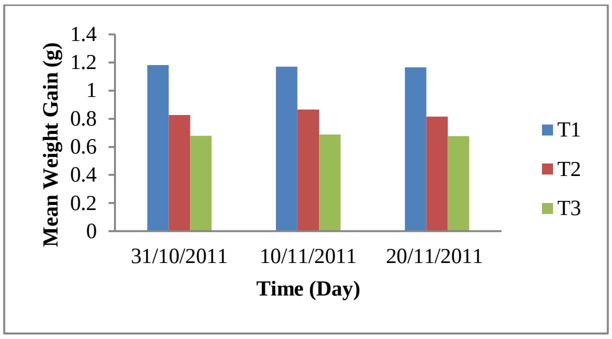

Figure 1. Mean value of weight gain of gold fish fry.

3.1.2. Percent weight gain

The mean values of percent weight gain of gold fish fry were 16871.43±685.71, 11814.29±957.14 and 9700±1328.57 in treatment $T_{1,}$ T_2 and T_3 respectively. The highest mean value (16871.43±685.71) of percent weight gain was found in $T_{1,}$ whereas the lowest mean value (9700±1328.57) of percent weight gain was found in treatment T_3 (Figure 2).

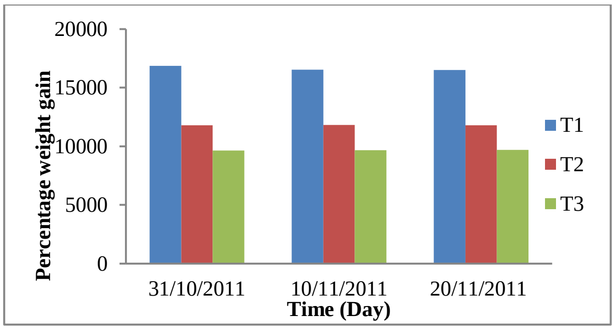

Figure 2. Mean values of percent weight gain of gold fish fry.

3.1.3. Specific growth rate percent per day

The value of specific growth rate of gold fish fry observed as 7.43%, 6.92% and 6.64% per day in treatments $T_{1,}$ T_2 and T_3 respectively were high compared to published the gold fish which were between 0.443 to 0.499% per day. These higher growth rates are probably because of gold fish were related to the good water quality in the pond and the food delivered to the fish the whole time of the culture period is very nutritious (Figure 3).

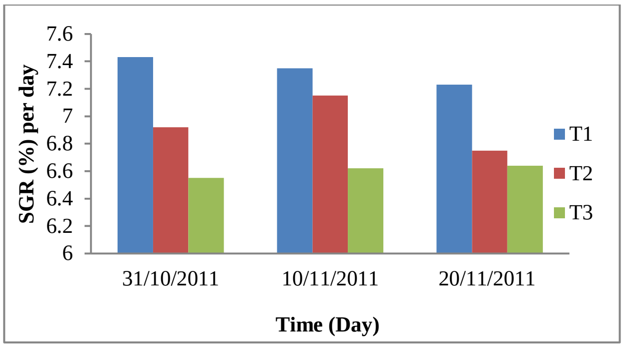

Figure 3. Specific growth rate of gold fish fry.

3.1.4. Food conversion ratio

The values of food conversion ratio were observed as 3.56, 3.91 and 4.12 in treatment T_1,T_2 and T_3 respectively. The highest food conversion ratio was observed in T_3 and the lowest food conversion ratio was observed in T_1. We observed lower FCR at lower stocking densities and higher FCR at higher stocking densities (Figure 4).

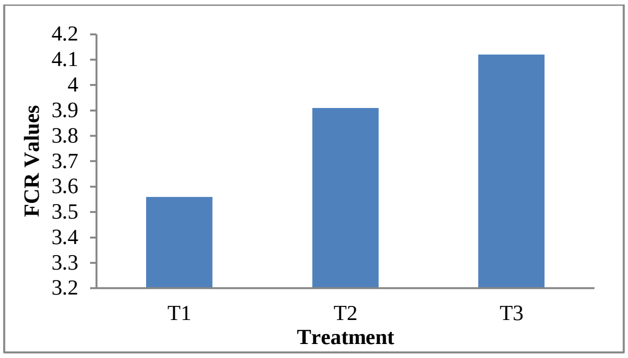

Figure 4. Food conversion ratio.

3.1.5. Survivability (%)

The values of survivability were observed as 85.67%, 81.87% and 76.67% in treatment T_1, T_2 and T_3 respectively. The highest survivability was observed in T_1 and the lowest survivability was observed in T_3. Survival rate was found to be negatively influenced by different stocking density showed the highest survivability. It might be due to high competition for food and space among the fishes (Figure 5).

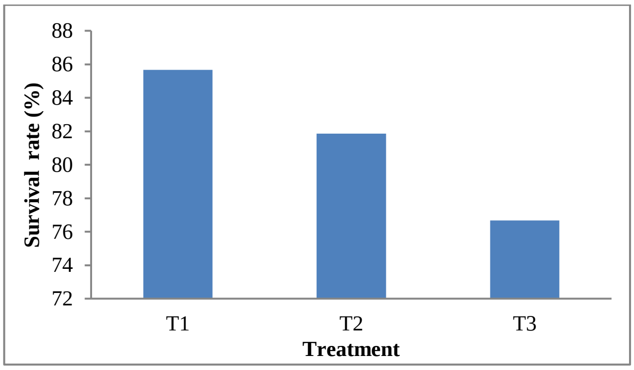

Figure 5. Survivability during experimental periods.

3.2. Water quality parameters

The average mean values of each water quality parameter such as temperature, p^H, dissolved oxygen, ammonium, nitrite, phosphate and alkalinity during the experimental period is presented in Table 4.

Table 4. Average (Mean ± SE) values of water quality parameters under different treatments throughout the study period.

Treatment	Temperature(°C)	Dissolved oxygen (mg/L)	P^H	NH_4^+ (mg/L)	NO_2^- (mg/L)	PO_4 (mg/L)	Alkalinity (mg/L)
T_1	27.50	4.00	7.43	0.57	0.013	0.80	136
T_2	27.75	3.81	7.60	0.73	0.015	0.88	164
T_3	25.25	3.73	7.90	0.93	0.027	0.86	164

3.2.1. Water Temperature

The present study water temperature ranged from 24.75 to 27.75 ˚C during the study period. The maximum water temperature was 27.75 ˚C in treatment T_2 in October and the minimal water temperature was found 24.75 ˚C in treatment T_1 in November. The mean values of water temperature were recorded as 27.68±0.54, 26.36±0.33 and 25.11±0.27 in treatment T_1, T_2 and T_3 respectively (Figure 6).

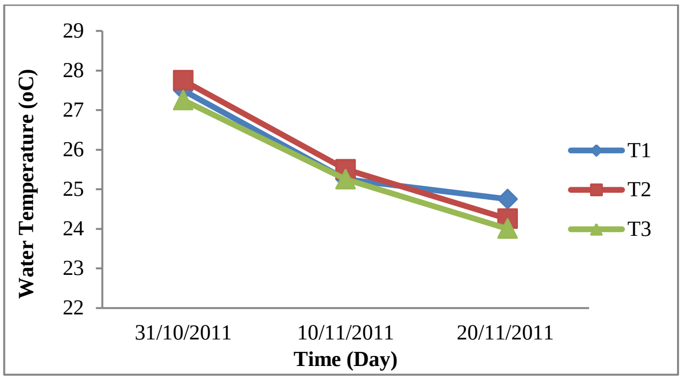

Figure 6.Water temperature during experimental periods.

3.2.2. Dissolved oxygen (mg/L)

Dissolved oxygen content of the ponds was found to range from 3.68 to 4.09 mg/L during the study period. The maximum dissolved oxygen content was 4.09 mg/L in treatment T_1 in October and the minimal dissolved oxygen was 3.68 mg/L found in treatment T_3 in November. The mean values of dissolved oxygen were recorded as 4.00±0.08 mg/L, 3.81±0.09 mg/L and 3.73±0.08 mg/L in treatment T_1, T_2 and T_3 respectively (Figure 7).

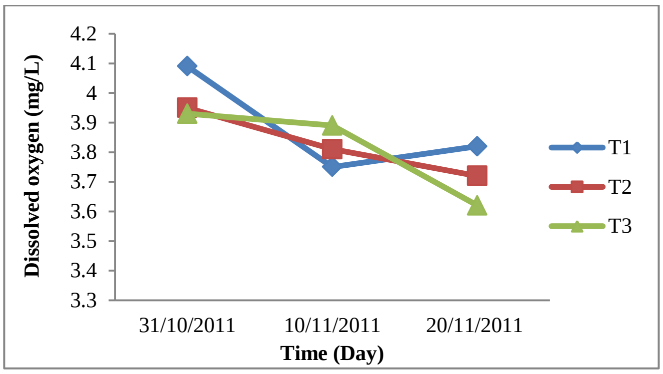

Figure 7. Dissolved oxygen content of the ponds during experimental periods.

3.2.3. p^H Value

The p^H values were found to range from 7.30 to 8.16 during the study period. The highest value of P^H 8.16 was recorded from treatment T_2 in November and the lowest value 7.30 was recorded from treatment T_1 in October. The mean values of P^H were observed as 7.43±0.16, 7.60±0.17 and 7.90±0.28 in treatment T_1, T_2 and T_3 respectively (Figure 8).

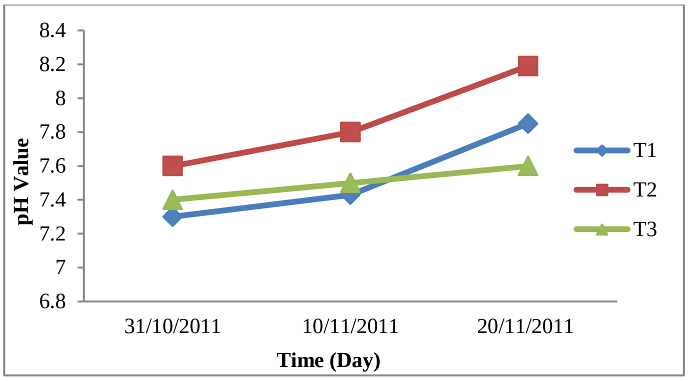

Figure 8. p^H values during experimental periods.

3.2.4. Ammonia (NH_4^+ mg/L)

The values of water ammonia were noted to vary from 0.3 mg/L to1 mg/L. Remarkable variation of water ammonia was found in the ponds throughout the study period with the minimum value of 0.3 mg/L from treatment T_1 in October and the maximum value of 1.1 mg/L from treatment T_3 in November. The mean values of water ammonia were observed as 0.57±0.25mg/L, 0.73±0.15 mg/L and 0.93±0.21 mg/L in treatment $T_{1,}$ T_2 and T_3 respectively (Figure 9).

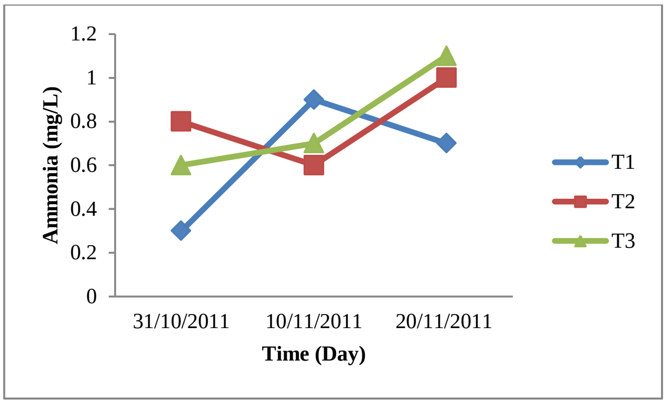

Figure 9. Values of water ammonia during experimental periods.

3.2.1. Nitrite (NO_2^- mg/L)

Values of nitrite were noted to vary from 0.01 mg/L to 0.03 mg/L. Mean value of water nitrite were observed as 0.013±0.01 mg/L, 0.015±0.01 mg/L and 0.027±0.01 mg/L in treatment $T_{1,}$ T_2 and T_3 respectively (Figure 10).

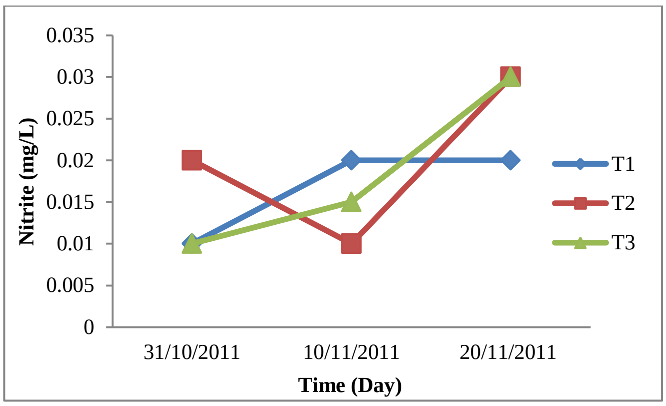

Figure 10.Values of nitrite during experimental periods.

3.2.2. Phosphate (PO_4 mg/L)
The values of water phosphate were noted to vary from 0.6 mg/L to 1mg/L. Remarkable variation of water phosphate was found in the ponds throughout the study period with the minimum value of 0.6 mg/L from treatment T_3 in October and the maximum value of 1 mg/L from treatment T_1 in November. The mean values of water phosphate were observed as 0.80±0.20 mg/L, 0.88±0.13 mg/L and 0.86±0.09 mg/L in treatment T_1, T_2 and T_3 respectively (Figure 11).

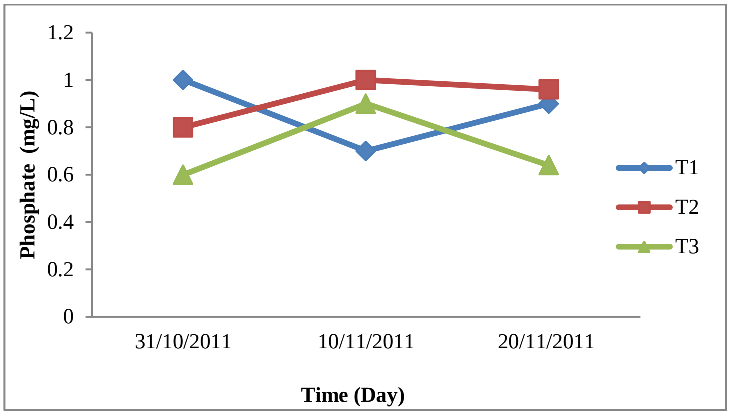

Figure 11. Water phosphate during experimental periods.

3.2.3. Alkalinity (mg/L)
The values of water alkalinity were noted to vary from 119 mg/L to 187 mg/L. Remarkable variation of water alkalinity was found in the ponds throughout the study period with the minimum value of 119 mg/L from treatment T_1 in October and the maximum value of 187mg/L from treatment T_2 in November. The mean values of water alkalinity were observed as 136±17 mg/L, 164.33±25.96 mg/L and 164.33±9.81 mg/L in treatment T1, T_2 and T_3 respectively (Figure 12).

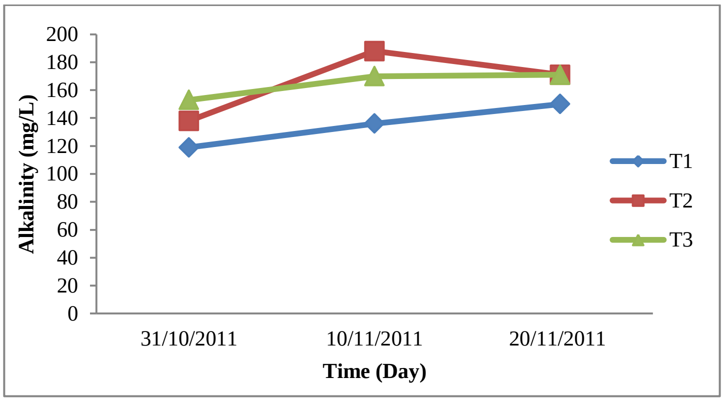

Figure 12. Water alkalinity during experimental periods.

4. Discussion
In the present study, the mean values of weight gain of gold fish fry were 1.181±0.048 g, 7±0.067 g and 0.679±0.093 g in treatment T_1, T_2 and T_3 respectively. The highest mean t gain was found from treatment T_1 (1.181±0.048 g) whereas the lowest mean gain was found from treatment T3 (0.679±0.093 g). The values are slightly higher the findings of Daniel *et al.* (2010) who recorded average weight of crucian ranged from 34.61 to 42.60 mg of wet body weight within 14th day of rearing. Kujawa (2004), Kwiatkowski *et al.* (2008), recorded crucian carp body weight ranged 1.3 to 3.0 mg. Rcma and Gouveia (2005) recorded 0.9 mg of wet body weight of fish. Similar study was conducted by Samad *et al.* (2016); Islam *et al.* (2017); Rahman *et al.* (2017); Rahman *et al.* (2016); Anka *et al.* (2016); Ali *et al.* (2016); Zaman *et al.* (2017) and Haq *et al.* (2017); they got relevant results. It was observed that the highest weight gain of gold fish fry was obtained from anent T_1 which might be due to lower stocking density and lower competition for lowest weight gain was obtained from T_3 which might be due to comparatively her stocking density so the feeding competition may occur among the species. In the

present study, the mean values of percent weight gain of gold fish fry were 71.43±685.7, 11814.29±957.14 and 9700-11328.57% in treatment T_1, T_2 and T_3 respectively. The highest mean (±SE) value (16871.431-685.70 of percent weight gain was in treatment T_1 whereas the lowest mean (*SE) value (9700×1328.57) of percent weight gain was found in treatment T_3. The results indicated that the percent weight gained in different stocking densities which coincides with the findings of Begum (2009) found percent weight gain ranged from 7986 to 9406%. Study of Ali *et al.* (2016); Zaman *et al.* (2017) and Haq *et al.* (2017) was also relevant with present study.The percent weight gain of present study was lower than findings; this might be due to the temperature difference between regions and natural productivity of the ponds. The other reason might be due to the difference of culture season. The values of specific growth rate of gold fish fry were observed as 7.43, 6.92 and 6.64% per day in treatments T1 T2 and T3 respectively. The growth rate of crucian carp in this study was one of the highest than the findings of Daniel *et al.* (2010) who found SCR = 20.06 to 17.38 Woe) in lower stocking density. Kwiatkowski *et al.* (2008), Kujawa *et al.* (2010), Wolnicki *et al.* (2009) recorded specific growth rate ranged 18.05 and 16.21 (%), 17.06 and 12.14 (%), 20.63(%) respectively. Similar study was conducted by Samad *et al.* (2016); Islam *et al.* (2017); Rahman *et al.* (2017); Rahman *et al.* (2016);Anka *et al.* (2016); Ali *et al.* (2016); Zaman *et al.* (2017) and Haq *et al.* (2017); they got relevant results.They obtained the highest values of specific growth rate at lowest stocking densities. Rema and Gouveia (2005) achieved specific growth rate of gold fish 22.66(% di). The difference of SGR values of *C. auratus* in the present study might be due to the temperature difference between regions and natural productivity of the ponds. The other reason might be due to the difference of culture season.In the present study, the values of food conversion ratio (FCR) varied between 3.562 and 4.12. The present findings agreed with the findings of Hasan (2007) and Begum and Vijayaraghavan, (1999) who recorded food conversion ratio (FCR) values to range from 1.82 to 2.03 and 1.03 to 1.20 respectively on tilapia (*T. niloticus*) culture at the field laboratory ponds situated behind the Faculty of Fisheries, Bangladesh Agricultural university, Mymensingh. They observed lower FCR at lower stocking densities and higher FCR at higher stocking densities. This results is more or less similar with the study of Rahman *et al.* (2016); Ali *et al.* (2016); Zaman *et al.* (2017); Haq *et al.* (2017) and Anka *et al.* (2016). The highest survivability was recorded in treatment T_1, (85.67%) and the lowest Survivability was in treatment T_3 (76.67%). A similar survival rate was observed by Daniel *et al.* (2010) ranged from 76.9 to 90.0%. Similar study was conducted by Samad *et al.* (2016); Islam *et al.* (2017); Rahman *et al.* (2017); Rahman *et al.* (2016) and Anka *et al.* (2016); their results were also similar. Survival rate was found to be relatively influenced by different stocking densities such as the lowest stocking density owed the highest survivability. It might be due to high competition for food and space on the fishes. In the present study, the water temperature ranged from 24.75°C to 27.75°C with a mean 26.36±0.32°C for the culture of gold fish (*Carassius auratus*), which might be fluctuated due to seasonal change, changes of sun brightness and time of the day. The dings of the present study were more or less similar to Cooper (2006), who stated that water temperatures, ranged between 23°C and 29°C with a difference of 6°C. Ahmed *et al.* (2016); Shabuj *et al.* (2016); Rahman *et al.* (2015); Ali *et al.* (2016b) and Islam *et al.* (2016) conducted similar study and results of temperature were more or less similar. Higher temperatures reduce the amount of oxygen content in the water, reducing the tank's stocking density. Ortega-Salas and Reyes-Bustamante (2006), Hossain *et al.* (1999) and Kohinoor (2000) observed the suitable temperature for aquatic production are 21 to 30°C, 28.00°C 31.83°C and 18.5 to 3.9°C respectively, which was slightly higher than the findings of present study. It is necessary to continuously maintain the dissolved oxygen optimum levels of above 4 to 8 mg/l according to Boyd (1998). In the present study, the dissolved oxygen varied from 3.68 to 4.09 mg/L with a mean value of 3.8110.09 p/I., which is slightly lower than the findings of Ortega-Salas and Reyes-Bustamante (2006) who observed dissolved oxygen ranges from 5.5 to 7 ppm for the culture of goldfish (*C. auratus*). Hossain *et al.* (1999) and Kohinoor (2000) showed that dissolved oxygen concentration pond water varied from 3.8 to 6.9 mg/I, 2.04 to 5 mg/L and 3.50 to 7.50 mg/L for Indian major carps and punti, which was also more or less similar to the findings of the present study. Shabuj *et al.* (2016); Rahman *et al.* (2015); Ali *et al.* (2016b); Ahmed *et al.* (2016) and Islam *et al.* (2016) conducted similar study and rate of dissolved oxygen level were more or less similar. In the present study, pH varied from 7.30 to 8.16 with the mean value of 7.60-1-0.17 which as also more or less similar to the findings of Cooper (2006). The reared *C. auratus* successfully in pH ranges between 6.0 and 8.3 in different types of filter systems. Ortega-Salas and Reyes-Bustamante (2006) reported pH between 7 and 8, which is more or less similar to the present results. Ali *et al.* (2016b); Shabuj *et al.* (2016); Rahman *et al.* (2015); Ahmed *et al.* (2016) and Islam *et al.* (2016) conducted similar study and pH level were more or less similar. According to Boyd (1998) the optimum ranges of ammonia (NI14+ mg/L) should be less an 0.3. In the present study, ammonia (NH4+) concentration ranged from 0.3 mg/I, to 0 mg/L with the mean values of 0.57+0.25 mg/L, 0.73×0.15 mg/L and 0.93±0.21 mg/L, hick was more or less similar to the findings of Rashid (2008) who found ammonia H4+) varied from 0.08 to 1.52 mg/L respectively. Hossain *et al.* (2003)

found that ammonia (NH4) in different treatments is varied from 0.004 to 0.077 mg/L that was insistent to the findings of present study. Similar study were conducted by Samad *et al.* (2016); Islam *et al.* (2017); Rahman *et al.* (2017); Shabuj *et al.* (2016); Rahman *et al.* (2015); Ali *et al.* (2016b); Rahman *et al.* (2016) and Anka *et al.* (2016); their results were also similar. Nitrite can be associated with ammonia concentration in the water body. The recommended concentration of nitrite is about <0.1 mg/L. According to Boyd (1998) the optimum ranges of nitrite, less than 0.3 mg/L. In the present study, nitrite concentration ranged from 0.01 mg/L to 0.03 mg/I, with the mean values of 0.013±0.01 mg/L, 0.01510.01 mg/L and 0.02710.01 mg/L, which was more or less similar to the findings of (Begum and Vijayaraghavan, 1999) who found that nitrite-nitrogen varied from 0.008 to 0.026 mg/L and 0 to 0.029 mg/L, respectively. Similar study were conducted by Samad *et al.* (2016); Islam *et al.* (2017); Rahman *et al.* (2017); Rahman *et al.* (2016) and Anka *et al.* (2016); their results were also similar. In the present study, phosphate ranged from 0.6 to 1 mg/L which was more or less similar to the findings of Rahman (2003) who reported that PO_4-P concentration varied from 0.78 to 2.5 mg/L in different treatments. The findings of Hasan (2007), Begum and Vijayaraghavan, (1999) and Sarker *et al.* (2003) were found to vary from 0.52 to 3.02 mg/L, 0.55 to 1.75 mg/L, 0.52 to 3.02 mg/L and 0.05 to 2.6 mg/L, respectively. Ahmed *et al.* (2016) and Islam *et al.* (2016) conducted similar study and rate of Phosphate were more or less similar. Hossain *et al.* (2003) found that phosphate in different treatments is varied from 0.52 mg/L to 3.02 mg/L that has consistent to the findings of present study. According to Alikunhi (1957) total alkalinity more than 100 ppm should be present in highly productive water bodies. Optimum range of alkalinity is 20 to 200 mg/L according to Boyd (1998). The values of water alkalinity were noted to vary from 119 mg/L to 187 mg/L with the minimum values of 119 mg/L from treatment in October and the maximum values of 187 mg/L from treatment T_2 in November. Flura *et al.* (2015) found the similar results on alkalinity measures. The mean values of water phosphate were observed as 136±17.00 mg/L, 164.3345.96 mg/L and 164.3319.81 mg/L in treatments T_1, T_2 and T_3 respectively.

5. Conclusions

Stipulation efficient fry rearing techniques were developed; it will be possible to meet the local demand of gold fish. After conducting the present study; it could be concluded that the optimum stocking density for gold fish fry is 10 fry/ hapais favorable to growth, survivability and feed conversion ratio, these were called the most important factor during conducted aquaculture practice, at captive condition.

Conflict of interest

None to declare.

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