Sindh Univ. Res. Jour. (Sci. Ser.) Vol. 51 (01) 113-118 (2019)

http://doi.org/10.26692/sujo/2019.01.21

SINDH UNIVERSITY RESEARCH JOURNAL (SCIENCE SERIES)

Comparative Study to Investigate the Impact of Salinity on Breeding of tilapia-Red (*Oreochromis niloticus*×*O. mossambicus*)and tilapia-Nilotica(*O. niloticus*)in Captivity

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Received 10thMay2018 and Revised 20th December 2018

Abstract: Present study was conducted to get mass seed production of tilapia species, tilapia-Red (*Oreochromis niloticus* × *O. mossambicus*) and tilapia-Nilotica (*O. niloticus*) on different salinity (0‰ to 30‰ with 5% increment). Sexually mature and healthy brooders females having body weight of 145g-160g and male 140g-162g were selected andstocked in to net enclosure (hapa). Male and female ratio was 1:3 during experiment brooders were fed with formulated floating diet having 35% CP, 2% of total biomass in a day. Eggsfrom mouth of females were collected on weekly basis and incubated artificially. Results showed that highest degree of eggs, fertility rate and survival rateof hatchlings were obtained on salinity up to 20‰ (red tilapia)and up to 15‰(nile tilapia). Number of eggs/g / body weight were also calculated and found higher among both species i.e. 4.0 to 4.3 per female on 0‰ to 20‰in red tilapia and 0‰-15‰ in nile tilapia. Temperature of water was (28.5±0.2℃), dissolved oxygen (06.25±0.01 mg/L), pH-level (7.2±0.03) and ammonia-concentration (less than 0.021±0.001 mg/L) were monitored throughout the study period. Water quality parameters remained within the recommended range. Out-comes of current findings advise that tilapia-Red breed effectively up to 20‰ salinity with 70% survival rate of fry and Nile tilapia, *O. niloticus*can breed successfully up to 15‰ salinity with 90% survival of fry.

Keywords: Tilapia-Red, tilapia Nilotica, Breeding, Salinity, Survival.

1. INTRODUCTION

Fish is the nutritious diet for human consumption because it contains essential amino acids, fatty acids, proteins, minerals, vitamins (Bogard *et al*., 2015). Fish production is gradually decreased due to over and illegal fishing and sudden climate change. So that, the fish is cultivated by artificial and semi-artificial farming (FAO, 2018, Bogard *et al*., 2015). Due to above facts aquaculture contribute 51% of the global total production (FAO, 2018, Kevin *et al.*, 2015). Fish product documented the uppermost growth in price, equally in national and foreign market today, associated to any other food element (Kevin *et al*., 2015).

Tilapia (*Oreochromis* spp.) are known as the 2nd most important candidate for aqua-culture after carp fishes. Tilapia have been cultured in many countries including Pakistan and are native to Africa (Chowdhury in 2011; Jaspe*et al*., in 2011; Daud-pota*et al*., in 2014; Daud-pota *et al*., in 2016). FAO (2011) reported that, the global tilapia production in early 1990s was about 500,000 metric tons. The production was increased about 3.5 million metric tons in 2011, 2.7% of the total in 2012 and 3.4% in 2013 and further expected to increase about 3.9 million metric tons because they are acceptable worldwide by middle class and upscale producers.

Tilapia have been known for disease resistant species, also, survive and breed easily under controlled environment up to 6-8 times in a year, become mature within 2 months, omnivores and can grow easily in an extreme condition (Daudpota *et al.*, 2014 and 2016). Pakistan is located in tropical belt distinguish by extreme weather conditions i.e. high temperature and insufficient rainfall, due to which, the major portion of under-ground water has become saline. This problem creates low growth, insignificant productivity and fewer profitability in aquaculture industries of Pakistan. Tilapia fishes are mainly cultured in an open fresh water environment depending upon local conditions such as in plastic tanks, earthen ponds, or net enclosures in ponds termed "hapa" (Nandlal *et a*l., 2004). Although, saline water areas, brackish water ponds and/or sea cages are also used for culturing tilapia species (Cnaani-and-Hulata, in 2011; Jaspe *et al.*, in 2011; Ahmadi *et al*., in 2015).

The strain of Nile tilapia capable to tolerate salinity up to 25ppt, Mozambique tilapia up to 40 ppt and Red Tilapia up to 32ppt (Jaspe *et al.*, 2011; PCAMRD,1998). They are omnivore fishes and can be adapted easily on formulated feed, survive at extreme conditions than carps and breed easily in captivity (Iqbal *et al*., in 2012 Ronald *et al*., in 2014). Basic requirement for

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maintainable aquaculture is obtainability of fish-seeds, which is overcome by introducing artificial breeding of fish species under suitable condition, therefore, it is helpful to accomplish the demands of fish culturists (Iqbal *et al.*, 2012; Kevin *et al.*, 2015). Furthermore, the current research were conducted to measure the impact of varying salinity levels upon the breeding of 2 species of tilapia (Red and Nile) strain under manageable environment.

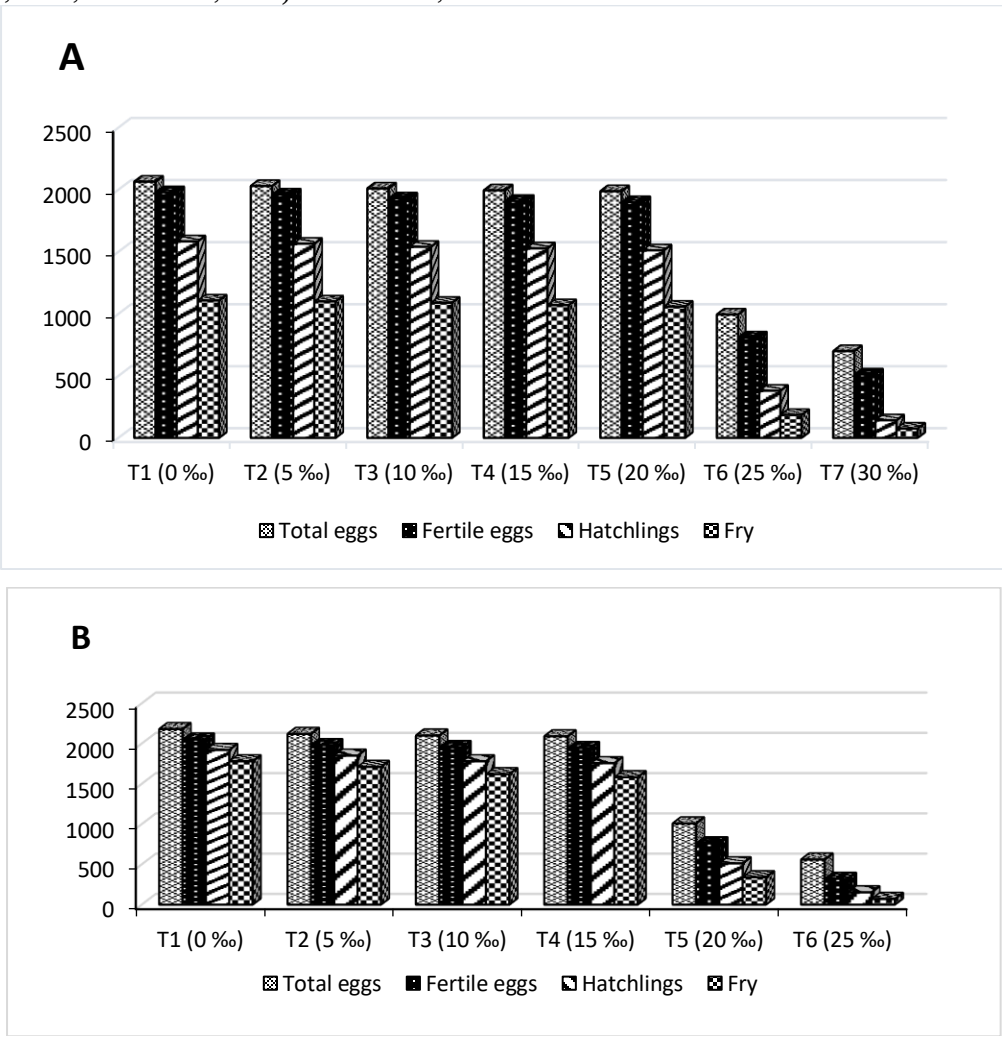

Fig.1. Breeding parameters of tilapia species on different salinity levels A. Red tilapia and B. Nile tilapia.

2. MATERIALS AND METHODS

Brooders selection: Brooders incurrent research was used total 104 numbers from which 78 were female and 26were male, having 18.0-18.6 cm in length and 145-162 gram in weight respectively. They were selected by morphological characteristics than kept into breeding hapa made by nylon net in tanks as following treatments: for tilapia red (T-1, 0‰), (T-2, 5‰), (T-3, 10‰), (T-4, 15‰), (T-5, 20‰), (T-6, 25‰) and (T-7, 30‰), while for nile tilapia (T-1, 0‰), (T-2, 5‰), (T-3, 10‰), (T-4, 15‰),(T-5, 20‰) and (T-6, 25‰).

***Food and feeding*:** Floating extruded pelleted feed containing protein (40%), fat (5.8%), fiber (6.7%), moisture (9.8%) and ash (8.4%) supplied at the rate 2% of whole biomass 2 time daily (7-days per week) during the breeding period.

Embryonic development: After 7-10 days of post stocking broods were assembled at one place inside-hapa with the support of bamboo-rod and mother tilapia mouth were monitored for collection of fertile eggs. Collected eggs were washed before stocking into incubatory jars where eggs were complete embryonic development stages. Quantity of eggs collected in a gram was calculated by dividing with total number of eggs collected from each female spawn by the weight of the fish. Hatched egg-yolk fry shifted into nursing phase for more development till the egg yolk finished.

Water-quality analysis: Temperature of the water tanks monitored at morning (8-am) and evening (4-pm)from each tank daily with mercury thermometer, dissolve oxygen (DO) level was monitored daily with a moveable testing-kit model (Merck-KGaA, 64271) made in Germany. pH was monitored with waterproof (EzDO 6011) pH meter made in Taiwan and ammonia was determine using portable test kitmodel (Merck KGaA, 64271) made bythe Germany after 7th day of every week.

Data analysis: Data of eggs, hatching and survival of fry in Red tilapia and Nile tilapia were calculated using one-way analyzing of variance (ANOVA) with the help of Minitab-17 version, statistical-software. Egg fertility, hatching ratio, survival-ratio and eggs/g/body weight were calculated by the formula (Okwiri-Brian 2015).Fertilization (%) =No. of fertilized eggs/Total No. of eggs collected x 100, Hatchability (%) =No. of hatched eggs/ No. of incubated eggs x 100, Survival (%) =Final No. of seed/Initial No. of seed x 100, Egg body weight^{-1} = Total No. of eggs obtained/Total weight of female (g)

3. RESULTS

The study was performed to investigate the impact various levels of salinity on fecundity, fertility, hatchability and survival of tilapia species (Red and Nile). Study shows that among the various salinity levels Red tilapia give higher results up to 20‰ and Nile tilapia up to 15‰. Highest number of eggs, fertility rate, hatching rate and fry survival of Red tilapia were obtained from T_1 (0‰) to T_5 (20‰) while significantly lowest ($p \leq 0.05$) results were obtained in T_6 (25‰) and T_7 (30‰). Greater number of eggs, fertility of eggs, hatching ratio and fry survival of Nile tilapia were found among T_1 (0‰) to T_4 (15‰) while significantly lowest ($p \leq 0.05$) results were obtained in T_5 (20‰) and T_6(25‰) shown in **(Fig. 1).** In the present research number of eggs/ grams body-weight were calculated in all treatments and observed that the higher degree of eggs was obtained from T_1-T_5 (0‰ to 20‰)respectively in Red tilapia while Nile tilapia give higher results from T_1-T_4 (0‰ to 15‰)respectively, but above-mentioned levels of salinity eggs were found inversely proportional with body weight **(Fig. 2).**

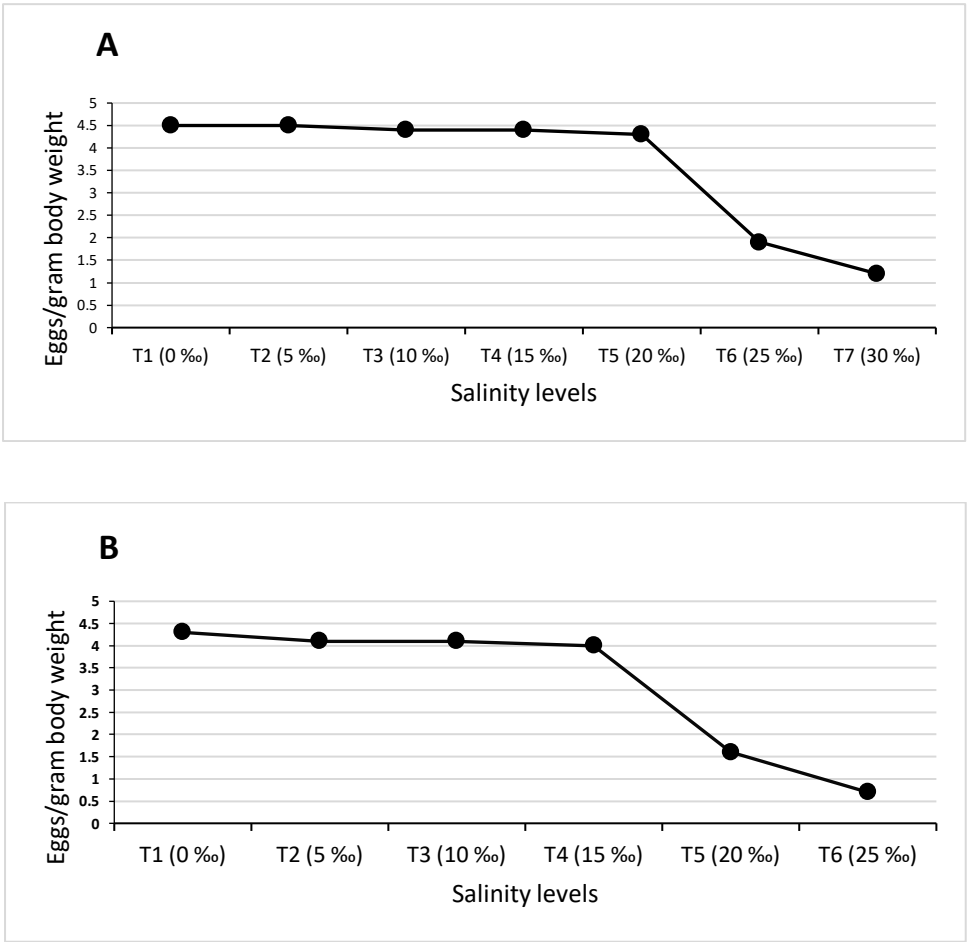

Fig. 2. Graph shows eggs per gram body weight upon different salinity levels in Red tilapia (A) and Nile tilapia(B).

Embryonic, larval and juvenile stages was observed i.e. zygote to cleavage, blastula, gastrula, pharyngula, hatching, early larva, late larva, early juvenile and late juvenile **(Table 1).**

Physio-chemical parameters like water-temperature (28.5±0.2°C), dissolved oxygen (6.25±0.01 ml/L), pH range (7.2±0.03 mg/L) and ammonia (less than 0.021±0.001 mg/L) were monitored throughout the study period **(Fig. 3).**

Table 1. Developmental stages of Red tilapia and Nile tilapia during the study period.

Developmental stages		Days post-fertilization
Embryonic stages	Cleavage (2 – 32 cells)	1
	Blastula	1
	Gastrula	2
	Pharyngula	3-4
	Hatching	4-5
Larval stages	Early larva	5-6
	Late larva	9-12
Juvenile Stages	Early juvenile	13-15
	Late juvenile	23-28

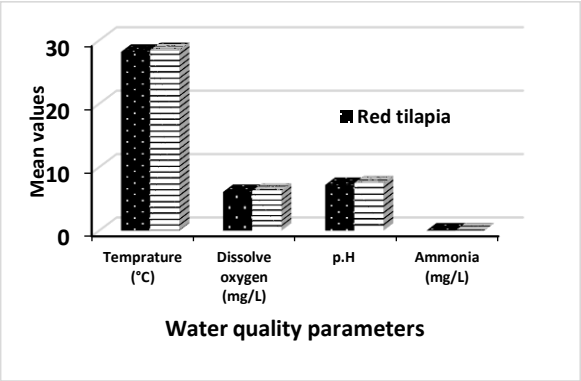

Fig. 3. Physio-chemical parameters of water were recorded during the study period.

4. DISCUSSION

Current experiment work give knowledge regarding capability to produced highest eggs of cichlids species especially Red tilapia and Nile tilapia on vary in salinity grades. In this study higher number of fertilized-eggs were calculated between treatment one to treatment five in red tilapia and for Nile tilapia higher results were achieved on treatments one to four. These findings show little bit similar egg production efficiency to one another and are greater from previous research of (Okwiri-Brian 2015) they achieved 82-85 percent fertile-eggs on tilapianilotica by various tanks bottom colour. Rodriguez-with co-workers 2015, find 66.7-percent, 71.8-percent and 65-percent fertilized eggs on various salinity grades i.e. 0-‰, 5-‰ and 15-‰ in Red Tilapia, which are less or from present study of red tilapia (1-5) andnile tilapia (1-4) treatments. Hafeez-ur-Rehman with co-authors 2015, obtained 67– 81 percent fertilized ratio with HCG+HMG and HCG+Ova-priminspiring hormones on snake-head (*Channamarulius)*.Pervious findings of Akinwande and his co-authors 2012, achieved 80 percent fertility ratio in*Clarias species* (intra-specific hybrids) these outcomes are similar with present findings of red tilapia(1-5) and nile tilapia (1-4). Findings of the past research observed by Martins with coworkers 2015 on impact of salinity upon induced breeding of silver-catfish, *Rhamdiaquelen* were 85 percent to 93 percent which are in between the current findings.In the present outcomes, hatching ratio was also higher among treatment 1-5 of red tilapia and among 1-4 treatments of nile tilapia.Almeida with coworkers 2013 reported 89 percent to 92 percent hatch out rate on various strains of tilapia nilotica at freshwater these are little bit greater than present findings. Akinwande with coworkers 2012 got 79.1 percent to 83.3 percent hatching rate in *Clarias* spp. These are in between to current study of red tilapia treatment 1-5 and nile tilapia treatment 1-4.

Young Sulem with co-authors 2008, obtained higher hatching percentage65.3upon different turbidity grades for *Clarias gariepinus* which is slightly lesser than the current findings of red tilapia treatment 1-5 and nile tilapia treatment 1-4.Survival rate of fry were 70% - 92.7% in present studies from treatment 1-5 in red tilapia and treatment 1-4 in nile tilapia these findings are in contrast with (Abdel-Hakim with coworkers 2008) they have obtained survival ratio in *Cyprinus carpio* fry upon various percentages of urea+NaCl. In the previous findings (Olufeagba and Okomoda, 2015) survival percentage range between 10.47-90.4 were obtained upon maternal and investigational crosses in *H. longifilis* our outcomes are among these reports. Degree of eggs per gram body weight were obtained 4.5–4.0 among 1-5 treatment of red tilapia and 1-4 in nile tilapia in the current findings which are in between with the past findings reported by Ahmed with coworkers 2007 they got 1 to 5 eggs in a gram body weight from tilapia-nilotica. Differences in present results are might be due to environmental and geographical variation.

Water quality parameters of the present study were monitored and found suitable for both species of tilapia in breeding periods and more or less same with the outcomes from previous researchers(Ahmed and coworkers 2007; Valetal *et al.*, 2013; Hussain, 2004, Daudpota with coworkers 2016). They reported that

water temperature ranged 22–30°C, Dissolve oxygen range 4–8mg/L, pH range between 6.5–9.0 mg/L, ammonia ranged 0.01 – 0.1mg/L. all values of the mentioned above parameters were acceptable levels for the best growing performance and breeding of tilapia.

5. CONCLUSION

Present study results prove that tilapia Red can spawn effectively up to 20‰ salinity and Niletilapia can spawn effectively up to 15‰ salinity with higher egg fertility, hatchability and survival rate of fry. Both species can play significant role in the promotion of coastal aquaculture or in those areas where underground salinity effected agricultural land due to this land did not give good growth.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the research grant (No. AS 020/2017-19)entitled "Fish Breeding and Culture Technology Development in Coastal Region of Pakistan" provided by ALP, PARC, Islamabad. The senior author isalso grateful to the HEC for providing fellowship to complete this work as a part of Ph.D. research.

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