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REPRODUCTIVE BEHAVIOR AND HATCHABILITY OF *Tilapia guineensis* IN PLASTIC TANKS IN LAGOS, NIGERIA

M.M. Abdullahi, M.R. Ajijo and M.A. Matanmi

Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos, Nigeria

ABSTRACT

Reproductive behavior and hatching rate of *Tilapia guineensis* eggs were observed in outdoor shrimp hatchery of Nigerian Institute for Oceanography and Marine Research (NIOMR), Lagos. Six male and female broodstock of *T. guineensis* were stocked in plastic tanks measuring 0.9m X 0.8m X 0.8m. Average total body weight and length paired ranged from 50.0-80.4g and 14.0-16.3cm respectively. The average body weight and length were 62.5g and 15.0cm respectively. Spawning was observed between 2-5days after pairing while the yolk sac absorption occurred within 4-5days. The paired fish were fed with top feed (4.5mm) at 3% of body weight. The mean fecundity observed was 872 eggs per female spawner with average egg diameter of 1.80mm. Hatching of eggs was observed between 48-50hours after fertilization. Egg hatchability ranged from 55.5-95.1% at a mean temperature of 27.4^{o}C. This study report on the reproductive behavior and hatching rates of *T. guineensis* eggs in plastic tanks. Successful propagation of *T. guineensis* in plastic tanks and appreciable hatching rates will increase availability of T. *guineensis* all year round and increase aquaculture production of *T. guineensis* in Nigeria.

Keyswords: *Tilapia guineensis*; reproduction; hatchability; plastic tank

INTRODUCTION

Tilapia possess an impressive range of attributes that make them ideal for aquaculture. Tilapia offers the possibility of commercial and cheaply grown protein sources where wild capture fisheries are being depleted (Mandal *et al*., 2009; and Ajiboye and Okonji, 2014). The species is cultured in a wide range of environmental conditions and tolerates stress induced by handling (Tsadik and Bart, 2007). *T. guineensis* is euryhailine species found along West Coast of Africa. They are typical substrate spawner, display firm bonding during courtship with prolonged association with the pair establishing and defending a territory, and they build spawning nest within the established territory (Legendre and Ecoutin, 1989; Keremah and Ndah, 2013).

In recent times, there has been an increase in the culture of tilapia because of increase in demand for fish food, fish meal and other fisheries products. One of the factors responsible for the low level of fish production from brackish water environment is the scarcity of fingerlings of brackish water fish species such as *T. guineensis*. As of now demand for *T. guineensis* fingerlings has far outstripped supply in recent times (Uzukwu *et al.*, 2013). The

availability of fingerlings of *T. guineensis* in the wild are seasonal, hence the hatchery propagation of *T. guineensis* to bridge the seasonality of the fingerling from the wild. The data on the reproductive behavior of *T. guineensis* in captivity are rather scarce and inadequate. This study presents the reproductive behavior and hatchability of *T. guineensis* in plastic tanks.

MATERIALS AND METHOD

Experimental Site

The study was conducted between May and July, 2017 at the Department of Aquaculture, Shrimp Hatchery Complex, Nigerian Institute for Oceanography and Marine Research (NIOMR), located on Latitude $6^0$25'13.58"N and Longitude $3^0$24'26.02"E Lagos, South West, Nigeria, with average temperature of 27^0C, average annual rainfall of 1673 mm and relative humidity of 84.7%.

Collection of Brood fish

Adult *T. guineensis* broodstock reared for about 5 months with average body length of 15 cm and weight of 62.5 g were obtained from NIOMR Brackish Water Station Buguma, River State. The live fish were packed in polythene bags, oxygenated and transported in air-conditioned vehicle. The fish collected were separated into male and female and acclimatized in two circular tanks of $3m^3$ for a period of 4 weeks and Broodstock were fed with TOP FEED commercial extruded floating feed at 3% body weight and feeding is done twice daily.

Natural Spawning in Aquaria

Broodstock of *T. guineensis* selected for spawning were separated into males and females. The weight of the broodstock was determined with aid of Ohaus digital scale, pioneer PA214. They were then stocked at the rate of 1 male: 1 female per plastic tank measuring 0.9m x 0.8m x 0.8m and containing 250 L of water. The broodstock were observed in the plastic tank to spawn naturally. They were not fed but water was aerated and changed twice weekly. After spawning the eggs were counted and egg size was determined by use of Olympus trinocular microscope equipped with photoscope digital camera DCM35E (350kpixels). The male and female broodstock were removed 3-4days after the eggs hatched into swim up fry. The fry was siphoned into a bowl and counted. Equations below were used to determined relative fecudity and hatchability percentage.

Relative fecundity. This was calculated as described by Billard (1990) in Kahkesh *et al*. (2010):

$$\text{Re}\,lative\ \text{fecudity} = \frac{number\ of\ \text{spawn eggs}}{\text{body weight}}\, x100$$

Percent hatchability was determined by direct counting of fry in each experimental unit to obtain a known weight. The total numbers of hatchlings were then estimated using gravimetric method. It was calculated as in Akinwande *et al.* (2012) as follows:

$$\text{Percent hatchability } (\%) = \frac{number\ of \text{ hatched fry}}{\text{total number of eggs}} x100$$

Water Quality Monitoring

Water temperatures, pH, and Ammonia were monitored daily with a mercury-bulb thermometer (0-100^{0}C), pH meter and lamotte test kit respectively. The fish tanks were continuously aerated to ensure enough dissolved oxygen.

Data Analysis

Data collected on water quality were subjected to analysis of variance (ANOVA), and the analysis was carried out using the SPSS V: 15.0 package for Windows.

RESULTS

Reproductive Behavior

The female broodstock were observed to spawn 2-5days after pairing. Prior to spawning, the female brood fish cleaned the corner of the tank where eggs will be dispersed. The females laid eggs by spreading the eggs at a corner of the tank while the males spread milt on the eggs by swimming over them. The eggs were observed to adhere to the wall of the tanks for 24 – 36 hours before being detached and aggregated by the female to a corner of the tank. The eggs were then moved to other corners of the tank intermittently. Protection, parental care and ventilation of eggs were carried out by both parents. Fertilized eggs were observed to be removed from unfertilized eggs by the male parent with the aid of the mouth. They were deposited at another corner of the tank where the female ventilated the eggs. Hatching of eggs started 48 – 50 hours after fertilization. The fry were protected and ventilated by both parents as they were guarded from one corner of the tank to another.

Figure1: Spawned egg adhering to a corner of plastic tank

Figure 2: Eggs aggregated to a corner of the tank by the female

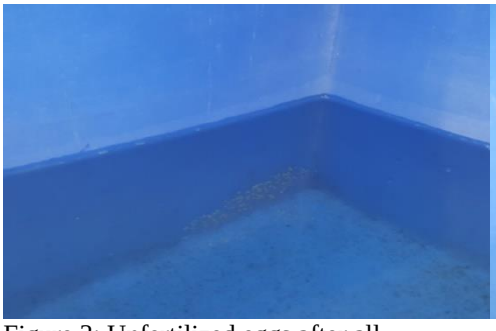

Figure 3: Unfertilized eggs after all fertilized eggs removed by male parent

Figure 4: Fertilized eggs carried to the female parent at another corner of the tank

Table 1 indicate spawning and hatching rate *T. guineensis* stocked in plastic tanks. The average total body length of the broodstock ranged from 14.0-16.3cm, while the mean value was 15.0cm. Average total body weight ranged from 50.0-80.4g, while the mean value was 62.5g. Spawning takes place between 21-23days. Egg diameter ranged from 1.49-1.89mm, while the mean value was 1.80mm. relative fecundity ranged from 835-1,928, while mean value was 1090. Average number of hatched eggs ranged from 672-1040, while mean value was 872. Hatching rates calculated ranged from 55.5-95.1%, while the mean value was 74.9%.

Table 2 indicate water quality parameters observed during the experiment. Temperature ranged from 26.0-29.0^{0}C. pH ranged from 7.50-8.00. Ammonia ranged from 0.05-0.50mg/L. Dissolved oxygen ranged from 4.50-6.50mg/L.

Table 1: Spawning and hatching rate of *T. guineensis* eggs stocked in Plastic tanks

Parameters	Tank 1	Tank 2	Tank 3	Mean Value
Pairing ratio	1:1	1:1	1:1	
Average total body length broodstock (cm)	14	14.7	16.3	15
Average total body weight of broodstock (g)	50	57	80.4	62.5
Spawning time after pairing (days)	2	2	5	3
Spawning frequency (days)	21	23	21	21
Egg Diameter (mm)	1.49	1.62	1.89	1.80
Average number of eggs per broodstock	964	1,094	1,211	1090
Relative fecundity	1,928	1,919	835	1,395
Hatchability (%)	94.2	95.1	55.5	74.9
Duration of yolk absorption (days)	5	4	5	4.6

Table 2: Mean values of water quality parameter recorded during the spawning period

Parameter	T1			T2			T3		
	Mean ±SD	Min.	Max.	Mean ±SD	Min.	Max.	Mean ±SD	Min.	Max.
Temperature (ºC)	27.42±0.95	26.00	29.00	27.38±0.96	26.00	29.00	27.41±0.99	26.20	29.00
pH	7.70±0.17	7.50	8.00	7.69±0.15	7.50	8.0	7.64±0.16	7.50	8.00
Ammonia (mg/L)	0.16±0.18	0.05	0.50	0.10±0.06	0.04	0.20	0.07±0.06	0.12	0.30
Dissolved oxygen (mg/L)	5.12±0.47	4.50	6.50	5.31±0.60	4.50	6.50	5.28±0.41	4.50	6.00

DISCUSSION

Reproductive Behavior

The result in this study on reproductive behavior of *T. guineensis* showed that before spawning takes place female brood fish cleaned the edges of the tank where eggs will be dispersed. The females laid eggs by spreading the eggs at a corner of the tank while the males spread milt on the eggs by swimming over them. This is similar to what was reported from the wild on *T. guineensis* (Campbell, 1987).

Relative Fecundity

The result of relative fecundity obtained from this study 835-1395 eggs with mean value 1090eggs and is within the range 451-2100 eggs reported by Etim*et al*. (1989), and 1035-11170 eggs obtained by Fagade (1978). Bagenal and Braum (1978) reported that fecundity of fish varies widely among some species, size and age. Variation could be due to differential abundance of food. Average total length and weight of broodstock in this study ranged from 14.0-16.3cm and 50.0-80.4g respectively. These are higher than values 8.0-9.0 cm and 21-35g obtained by Legendre (1983) and Niyonkuru (2012). The results obtained in this study is supported by Bome *et al.* (1995). The weight range obtained is between 35.7 and 113.0g. He reported that fecundity increases with egg size.

Eggs and Hatchability

In this study egg diameter obtained ranged from 1.49-1.89mm with mean value of 1.80mm. This is similar to Keremah and Ndah (2013) with mean value 1.48mm for *T. guineensis.* Also, it falls within the range reported for *Tilapia zilli* eggs diameter 1.1 to 2.0mm (Jegede and Fowole, 2006). The number of eggs recorded for each tank 904, 1094 and 1211 while hatching rates were 94.2, 95.1 and 55.5% for tank 1, 2 and 3 respectively. This fall within the range reported by Keremah and Ndah (2013) who reported number of eggs produced as 1269 with hatching rate of 74.9%, but the low hatching rates observed in tank 3 could be due to bad eggs. Yolk absorption was observed for 4 - 5 days depending on temperature, this agreed with what was reported by (Keremah and Ndah, 2013).

Water Quality Parameters

This experiment was carried out in fresh water, *Tilapia guineensis* is euryhaline species can spawn in water environment ranging from 0 to 17 ppt Uka and Sikoki (2011). Temperature ranged between 26-29^{o}C in this study fall within optimal range reported by Boyd, (1979) for better performance. This is also similar to report by Philippart and Ruwet (1982) with temperature range of 14 to 33^{0}C. pH recorded fall within desirable and acceptable range 7.5 to 8.00. *T. guineensis* can tolerate wide range of pH 5 to 10 but grow and survived best in pH of 6 to 9 (Dannis *et al.,* 2009). Ammonia value falls within acceptable range of 0.07±0.06 to 0.16±0.18. Dissolved oxygen in this study ranged from 4.5-6.5 which is similar to value (4.2-6.2mg/L) reported by Keremah and Ndah (2013) for *T. guineensis* spawned in glass aquaria.

CONCLUSION

The successful propagation *T. guineensis* in plastic tanks under fresh water environment depends on understanding of reproductive behavior of *T. guineensis*. Thus, this will further enhance hatchability and survival of fry during and after spawning. Therefore, increase in *T. guineensis* propagation will further boost the availability of the seed all year round in stocking of aquaculture system in Nigeria.

REFERENCES

Ajiboye, O.O. and Okonji V.A. (2014) Effect of sex reversal and feed type on growth performance and body composition on nile Tilapia (*O. Niloticus*) reared in a semi flow-through culture system. *Nigerian Journal of Agriculture, Food and Environment*, 10(4):81-86.

Bagenal, T.B., & Braum, E.B. (1978). Eggs and Early Life History. *In*: *Methods for Assessment of Fish Production in Fresh Waters. In*: Ricker, W.E. (Ed.). Blackwell Scientific Publications Limited, Oxford, England, UK, pp: 165-201.

Bome, Q.T., Marshal, N. B. Blaxter, J. H. S. (1995). *Biology of Fisher* (2nd Edn.) BOS Scientific publishers (Taylor and frames group), Oxfordshire.

Boyd, C.E. (1979). water quality in warm water fish ponds Craftmaster Printers Inc. Opelica, Alabama. U.S.A. p.359.

Campbell, D. (1987). A Review of the Biology and Culture of *Tilapia guineensis.* Working Paper, ARAC/87/WP/3,WNDP/FAO/NIOMR Project RAF/82/009, p.15.

Dennis, P. DeLong, Thomas M. Losordoand and James E. Rakocy (2009). Tank Culture of Tilapia, Southern regional aquaculture centre, Publication No. 282, 8p

Etim, L., Etcheri, I. & Umoren, O. (1989). Aspects of the reproductive biology of *Tilapia guineensis* (Perciformes: Cichlidae) in Editas pond, Nigeria. *Journal of African Zoology*, 103: 127 – 134.

Fagade, S.O. (1978). On the biology of *Tilapia guineensis* (Dumeril) from Lekki Lagoon, Lagos State, Nigeria. *Nigerian Journal of Science*, 12(1&2): 73 – 85.

Jegede, O.I. and Fawole, O.O. (2006). Fecundity and egg size variation in *Tilapia zilli* (Gervais) and *Tilapia mariae.*

Keremah, R.I. and Ndah, A.P., (2013). Aspects of the reproductive biology of *Tilapia guineensis* (Bleeker, 1862) under laboratory conditions. *Greener J. Biological Sci.* 3 (3):123-126.

Legendre, M. and Ecoutin, J.M. (1989). Suitability of Brackish water tilapia species from the Ivory Coast from Lagoon aquaculture. 1 – Reproduction. *Aquatic Living Resources*, 2: 71-79.

Legendre, M. (1983). Observations Préliminaires sur la Croissance et le Comportementenélevage de Sarotherodonmelanotheron (Ruppel 1852) et de Tilapia guineensis (Bleeker 1862) enLaguneEbrie (Cote d'Ivoire) lDoc. Sc. Cent. Rech. Oceanogr. Abidjan Vol XIV; No. 2, Decembre 1983, 1–36.

Mandal, S. C., Hassan, M., Rahman, M. S., Manik, M. H., Mamud, Z. H. and Islam, M. D. S. (2009). Coliform bacteria in ile tilapia, *Oreochromis niloticus*of Shrimp-*Gher*, pond and fish market. *World Journal of Fish and Marine Sciences*, 1(3): 160-166

Niyonkuru, C. (2012). A Comparative ecological approach of the length–weight relationships and condition factor of *Sarotherodon melanotheron* Rüppell, 1852 and

Tilapia Guineensis (Bleeker 1862) in Lakes Nokoué and Ahémé (Bénin, West Africa), *International Journal of Business, Humanities and Technology*, 2(3): 41-50

Philipart, J-Cl. and J-Cl. Ruwet, (1982). Ecology and distribution of tilapias. p 15–59. in: R.S.V. Pullin and R.H. Lowe-McConnell (eds.) The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p International Center for Living Aquatic Resources Management, Manila, Philippines.

Tsadik, G. G. and Bart, A. N. (2007). Effects of feeding, stocking density and water-flow rate on fecundity, spawning frequency and egg quality of Nile tilapia, *Oreochromis niloticus* (L.). *Aquaculture*, 272: 380- 388.

Uka, A. and Sikoki, F.D. (2011). Effects of salinity on the reproduction of *Tilapia guineensis* in Niger Delta. *J. Aquatic Sci*., 26(1): 43-48.

Uzukwu, P.U. Aranyo, A.A. and Uzukwu, C.O. (2013). Relationship among *Tilapia guineensi*s fingering abundance and water quality variation in a Brackish water reservoir in Lagos. *Journal of Fisheries and Aquatic Science*, 8:257-26.