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ORIGINAL ARTICLE

Potential for the culture of *Tilapia guineensis* (Bleeker 1862): A comparative growth performance with Nile tilapia (*Oreochromis niloticus*) in a fresh water pond

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ABSTRACT
A 10-week trial was conducted to study the culture potential of *Tilapia guineensis* by comparing its growth performance with Nile tilapia (*Oreochromis niloticus*) in a hapa-in-pond system. Mixed sex juveniles (29.90 ± 0.05g) of each of the species were stocked at a rate of 10 fish/m^2 and fed with a 38% crude protein commercial diet for a period of 10 weeks. The two treatments were replicated thrice. Results from the study showed that *T. guineensis* exhibited similar ($p > 0.05$) final body weight (63.08 ± 4.46g) as *O. niloticus* (62.86 ± 2.67g). The specific growth rates between the two treatments (1.07 ± 0.07 %/day for *O. niloticus* and 1.05 ± 0.11%/day for *T. guineensis*) were also not significantly different. Gross yield and survival rates were observed to be higher in *O. niloticus* (1149.69 ± 60.87g; 87.50 ± 2.89%) than *T. guineensis* (1044.02 ± 98.90g; 82.50 ± 1.77%) although the differences were not statistically significant ($p > 0.05$). The study concluded that under prevailing experimental conditions, *T. guineensis* could equally be considered for culture in freshwater ponds as *O. niloticus* and extended to some brackish water environments as well.

Keywords: Aquaculture, brackish water, growth rate, *Tilapia guineensis*

Introduction

Tilapias have become inevitably vital in the production of farmed fish around the world (Food and Agriculture Organization, 2016). There are more than 70 types of tilapias globally, however, nine are utilized essentially in farming (Modadugu & Belen, 2004). *Oreochromis niloticus* is the most cultured species in many parts of the world and is responsible for the significant increase in worldwide tilapia production from culture (Pullin, 1991; Coward, & Bromage, 2005). The preference for Nile tilapia in aquaculture is due to its hardiness and suitability for cultivation in a wide cluster of culture frameworks, running from extensive, low-input to intensive culture (Mensah, Attipoe, & Ashun-Johnson, 2013). Undoubtedly, aquaculture holds the key to continuous fish production amidst the incumbent decline of world capture fish stocks (FAO, 2016). However, the limited number of quality *O. niloticus* fingerlings is still a major challenge especially in some parts of Ghana (Asase, Nunoo & Attipoe, 2016).

Oreochromis niloticus and *Tilapia guineensis* share much similar range of habitat but the latter is not well known for culture although its potential could be harnessed through improvement in genetic selection, growth rates and nutritional studies. *T. guineensis* is a euryhaline fish species found along the West Coast of Africa (Philippart & Ruwet, 1982). There is an increasing interest in this species for culture purposes in Ghana, particularly in areas of high or variable salinities, characteristic of the estuaries and extensive lagoon systems where either the Nile tilapia can neither tolerate the prevailing saline conditions nor easily available (Koranteng, 2004). According to Ofori-Danson, Abban, and Amevenku (1993), *T. guineensis* and *Sarotherodon melanotheron* are the two main types of tilapia with monetary significance in Ghana's saline catch fisheries because they are native to all the river basins in the country. Meanwhile the single native species, *Oreochromis nilotocus* is limited naturally to the Volta basin (Ofori-Danson, 2002).

Therefore, it is necessary to expand studies on the ecology, biology, management and culture potential of other freshwater and saline fishes. These fish species include; mango tilapia (*Sarotherodon galilaeus*), black-chinned tilapia (*Sarotherodon. melanotheron*) and *T. guineensis*, which is the least studied amongst the aforementioned species in spite of its broad distribution across the West coast of Africa (Philipart & Ruwet, 1982).

Information on the growth rate superiority of *T. guineensis* and its major culture indicators such as feed conversion ratio, condition factor, survival and other physical and biological adaptation factors will equip fish farmers to improve on their production in areas where this species are readily available. This will also reduce additional costs and mortality that are incurred by procuring *O. niloticus* fingerlings from distant hatcheries in the country. This study therefore aimed at ascertaining the culture potential of *T. guineensis* by comparing its growth performance with *O. niloticus* in a freshwater earthen pond. The null hypothesis for this study is that there are no significant difference between the growth indicators measured for both *T. guineensis* and *O. niloticus* at the end of the experiment whiles the alternative hypothesis is that there are significant differences in the growth indicators measured.

Materials and Methods

Study area

The experiment was conducted in a freshwater earthen pond at the Aquaculture Demonstration Center of the Department of Fisheries and Water Resources, University of Energy and Natural Resources, Sunyani. The experiment lasted for ten weeks between January and March, 2017. The site (longitude 07˚20'44.948'N, latitude 02˚21'37.99'W) is located at Berlin Top, Sunyani. Juveniles of *O. niloticus* and *T. guineensis* used in the study were obtained in ponds at the center.

Fish stocking and feeding

Six hapas of sizes 2 m^2 made of mosquito netting were sewn and securely fixed in a 2115 m^2 earthen pond by using bamboo sticks to represent a triplicated experimental set up. Mixed sex juveniles of *O. niloticus* and *T. guineensis* with an average weight of 29.5 ± 0.21g (standard length; 9.78 ± 0.31 cm) were randomly stocked in the hapas. Twenty specimens were placed in each hapa at a stocking density of 10 fish/m^2. Fish were fed four times daily (10:00GMT, 12:00GMT, 14:00GMT and 16:00GMT) with 2.5mm pelleted commercial feed with crude protein, 38%. Feeding rate started initially at 7% of fish body weight and was sequentially reduced to 5% and finally 3.5% towards the end of the experiment.

Growth parameters and monitoring

All the fishes in each treatment were weighed biweekly with a digital scale to the nearest ± 0.1g and standard lengths were also measured to the nearest ± 0.1 cm using a measuring board. The average weights recorded were used to monitor growth and to calculate the growth parameters: Weight Gain (WG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR). Other parameters estimated were Gross Yield (GY) and Survival.

$$WG = \text{mean final weight (g)} - \text{mean initial weight (g)}$$

$$SGR = (\ln \text{final weight} - \ln \text{initial weight}) \times 100 \times [\text{time (days)}]^{-1}$$

(Watanabe *et al.*, 1990)

$$FCR = \text{dry weight of feed consumed (g)} / \text{fish weight gain (g)}$$

$$GY \text{ (per hapa)} = \text{average final weight (g)} \times \text{total number of survivors}$$

$$\text{Survival (\%)} = (\text{No. of fish harvested} / \text{No. of fish stocked}) \times 100$$

Water quality measurements

Throughout the culture period, the pH, dissolved oxygen (DO), temperature, total dissolved solids (TDS) and salinity of the pond water were measured biweekly before and after data collection in the morning and afternoon using a Hanna multi-parameter probe (H19829).

Statistical analysis

Data was entered into SPSS spreadsheet (version 20) for statistical inferences. All data were subjected to independent t-test analysis of means to check for significant differences between treatments using SPSS. Graphs were drawn with Microsoft Excel (version 2013).

Results

Figure 1 shows the growth pattern of both treatments over the culture period and Table 1 presents a summary of the growth performance and survival rates. There were no significant differences ($p > 0.05$) found in any of the growth performance indicators between the two treatments. Similar specific growth rates were recorded in treatment one (1.07 ± 0.07 %/day) and two (1.05 ± 0.11%/day) as no significant differences were found. However, *T. guineensis* gained an observed higher final weight (63.08 ± 4.64g) and standard length (12.07

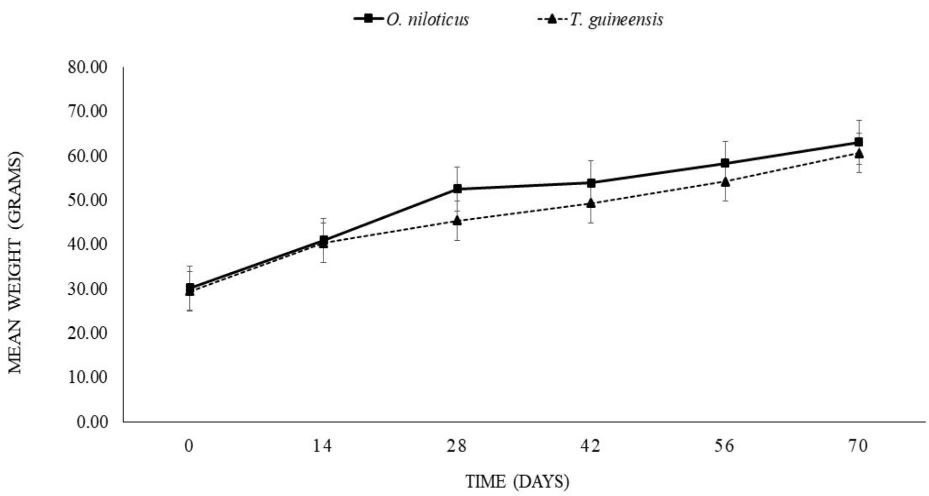

Figure 1: Growth pattern of *O. niloticus* and *T. guineensis* fingerlings cultured for a period of three months

Table 1 - Growth performance of *O. niloticus* and *T. guineensis* cultured for three months.

Species	Growth parameter							
	Initial weight (g)	Initial length (cm)	Final weight (g)	Final length	SGR (%/day)	FCR	Gross yield (g)	Survival (%)
O. niloticus (T1)	29.66 ± 0.09	9.73 ± 4.42	62.86 ± 2.67	12.02 ± 2.31	1.07 ± 0.07	4.82 ± 0.66	1149.69 ± 60.87	87.50 ± 2.89
T. guineensis (T2)	30.13 ± 0.00	9.81 ± 2.61	63.08 ± 4.64	12.07 ± 3.80	1.05 ± 0.11	5.34 ± 0.54	1044.02 ± 98.90	82.50 ± 1.77

Means (± S.E) for each growth parameter were not significantly different ($P > 0.05$) among the two species

± 3.80cm) than *O. niloticus* (62.86 ± 2.67g; 12.02 ± 2.31cm) over the culture period. Feed conversion ratio was generally poor in both treatments and treatment one had a higher value of 5.34 ± 0.54. Treatment two had comparatively better gross yield (1149.69 ± 60.87g) than treatment two. There was no significant difference between the survival rates of both treatments. However *O. niloticus* had higher survival (87.50 ± 2.89%) than *T. guineensis* (82.50 ± 1.77%). Results of water quality parameters monitored over the culture period are presented in Table 2. Average values recorded for dissolved oxygen, pH, total dissolved solids, salinity and temperature were all within the acceptable optimal range for tilapia growth. There were no significant differences ($p > 0.05$) observed in the parameters measured for each treatment.

Discussion

Aquaculture has a tremendous potential to bridge the huge fish demand deficit in Ghana. Due to the challenges faced by some farmers in acquiring *O. niloticus* fingerlings, it is necessary to find other alternatives for the grossly demanded tilapia species in Ghana. Studying the culture potential of *T. guineensis* is a way of providing such an alternative. In the present study, no significant differences were found amongst the two treatments with respect to the growth parameters measured. The similarity in growth performance shown by *T. guineensis* compared to *O. niloticus* in the present study has contradicted the results of other related studies (Sorphen & Preston, 2001; Koumi, Atse, & Kouame, 2009; Offem, Ikpi, & Ayotunde, 2009) that

Table 2 - Mean (S.E) water quality parameters measured in hapas during fish culture period.

Species	Water quality parameter				
	Temperature (^oC)	pH	DO (ppm)	Salinity (mg/l)	TDS (ppm)
O. niloticus (T1)	28.04 ± 1.15	8.42 ± 0.19	3.30 ± 0.26	0.13 ± 0.01	140.31 ± 8.53
T. guineensis (T2)	28.83 ± 1.20	8.40 ± 0.16	3.19 ± 0.21	0.13 ± 0.01	142.33 ± 8.54

Means (± S.E) for each water quality parameter in respective hapas were not significantly different ($P > 0.05$) among the two species found differences. The result on final body weight for *O. niloticus* in the present study is very close to the findings reported by Sorphen and Preston (2001), who found a final body weight of 71.4 ± 1.76g in earthen ponds fertilized with effluent.

The feeds given to the fish in both treatments were underused as confirmed by the feed conversion ratios recorded in the present study (4.8 -5.3). This can be attributed to the irregularities in feeding as well as waste feeds that resulted from an observed aggressive attack on hapas by external fishes in the pond whenever experimental fishes were being fed. This aggressiveness increases water turbulence leading to feed loss (Schmittou, 2006). Nevertheless, FCR values for the present study were similar to that of Siddiqui, Howlader, and Adam (1991), where *Oreochromis niloticus* fed on a commercially prepared diet had FCR values ranging from 3.7 to 4.9.

The overall survival for both treatments in this experiment (85%) were low compared to survival rates reported by Chakraborty & Banerjee (2010), Alhassan, Abarike, & Ayisi (2012) and Mensah *et al.* (2013) for Nile tilapia. This difference could be attributed mainly to the differences in the physico-chemical parameters of the culture environment because good water quality correlates positively with welfare and survival of cultured organisms (Baldwin, 2010). The values for different water quality parameters remained within safe limits accepted for tilapia growth. The mean temperature for *T. guineensis* (28.83 °C) and *O. niloticus* (28.04°C) and dissolved oxygen concentrations (3.19 and 3.30 mg/l respectively) were within the safe limits recommended for aquaculture (Hillary & Claude, 1997; Liti *et al.*, 2005 and Xu, Liu, Cui, & Miao, 2006). However, *O. niloticus* has been reported to be able to survive in very low dissolved oxygen levels of about 0.1mg/l (Balarin & Hatton, 1979). The pH values (8.40) and (8.42) for treatment one and treatment two respectively were in agreement with the recommended levels for aquaculture (6.5 to 9) (Lubambula, 1997; Satya & Timothy, 2004 and Liti *et al.*, 2005).

In conclusion, this study clearly demonstrated that similar growth rate between *T. guineensis* and *O. niloticus* was possible under the prevailing experimental conditions. *T. guineensis* can therefore be an alternative for farmers where there are difficulties in procuring *O. niloticus* fingerlings for culture.

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