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COMPARATIVE ASSESSMENT OF GROWTH PERFORMANCE AND SURVIVAL RATE OF *Oreochromis niloticus* FRY REARED IN DIFFERENT COLOURS OF CULTURE MEDIUM (PLASTIC BOWLS)

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ABSTRACT
This study was performed to compare the growth and survival rate of *Oreochromis niloticus* fry in different colours of plastic bowl (50 liters) for 10 weeks. Fry of *O. niloticus* (mean weight 0.08 g and body length of 0.53 cm) were stocked at 20 fish per bowl (white, red, black, green and blue bowls) in triplicates. They were fed with 45% Crude Protein Coppen feed at 5% body weight. Feeding was done twice daily, between 8 to 9 am and 4 to 5 pm. At harvest, the growth was significantly highest in black bowl but lowest survival of 52.7% ($p<0.05$). White bowl shows the highest survival rate of 91.3% but the fish camouflaged to the colour of the bowl (albino). Green bowl showed the best condition factor with survival rate of 89.40%. There was significant difference ($p<0.05$) in mean weight gain (8.62, 8.06, 8.45, 9.37 and 8.44) in white, red, green, black and blue bowls, respectively. The study concluded that the use of plastic bowl in culturing of fry is promising and economical, thereby reducing the cost of pond and tank construction.

Keywords: Tilapia, colour, growth performance, plastic bowl

INTRODUCTION

Tilapia, African freshwater fish, categorized within the family *Cichlidae*, inhabits various regions across the African continent, excluding areas such as the northern Atlas Mountains and Southwest Africa (McAndrew, 2000). The African Nile basin alone hosts approximately 700 known Cichlid species (El-Sayed, 2017). Among these, Philippart and Ruwet's research identified 76 distinct tilapia species throughout Africa (Philippart & Ruwet, 1982). According to Froese and Pauly, (2017), the Cichlidae family encompasses a total of 52 tilapia species, including 32 species classified under Oreochromis, thirteen (13) under Sarotherodon, and seven (7) under the Tilapia genus.

Tilapia is one of the most important finfish in aquaculture after Carps, with global production reaching 3.6 million tons in 2008, an increase from 2.5 million tons in 2007 (Megbowon & Mojekwu, 2014). In 1960, only two countries in Africa had record of tilapia production. They were Egypt (2100 MT) and Nigeria (1299 MT). It is however sad today that tilapia production in Egypt exceeds 500,000 MT while Nigeria produces only about 50,000 MT (Megbowon, 2011). The demand for tilapia in Nigeria is high but farmers lack the skills of producing large size of the fish under culture condition (Megbowon *et al.*, 2009).

As of 2020, Nile tilapia farming was widespread across 30 African countries. Over the years, its production surged significantly, starting from a mere 27,000 metric tons in 1990 to a remarkable 1,287,053 metric tons by 2019. This remarkable increase accounted for 95.4% of tilapia farming output in Africa and constituted approximately 68% of aquaculture production in inland waters on the continent. Furthermore, Nile tilapia cultivation contributed substantially, representing 28% of the global output for this species. Nile tilapia (*Oreochromis niloticus*) (Linnaeus, 1758) is, by far, the most widely cultured tilapia species, due to its economic value as one of the most important farmed fish species in the world (FAO, 2021).

The type and colour of the culture medium used and their management have a significant influence on fish profitability (Ross & Waten, 1995). According to Hankins *et al.* (1995), fish culture medium and their accessories add up to a large portion of farm capital. The need for the choice of best colour of culture medium for *Oreochromis niloticus* arises to optimize fish farm profitability and also help the poor farmers to use cheap medium like plastic bowls, other than construction of pond and tanks. Therefore, the aim of this study was to evaluate the growth and survival rate of *Oreochromis niloticus* fry in different colours of plastic bowls.

MATERIALS AND METHODS

Experimental procedure

Total number of 300 *Oreochromis niloticus* fry (mean weight, 0.08 g and length of 0.53 cm) where hatched at Federal University of Agriculture Makurdi, Benue State, Nigeria Fish Farm in a hapa inserted in earthen pond. They were acclimatized in a glass aquarium till after which it have consumed their yolk (3 days). The fish were randomly stocked at 20 fish each in white, red, black, green and blue plastic bowls of 50 liters' volume in a triplicate. They were fed with 45% Coppens feed at 5% body weight. Daily feeding was divided into two halves and the fish were fed between 8-9 am and 4-5 pm. Two weeks (2) sampling of fish was done to know their weight and to adjust the amount of feed administered to the fish.

Water quality parameters were determined on a weekly basis during the experimental period. The water quality parameters measured were temperature, Dissolved oxygen (DO), pH and total hardness. Length and weight measurement of the fish were made at the start of the experiment and continued after two weeks till the end of the experiment using a plastic meter rule and sensitive weighing balance. Daily mortality of fish in the entire bowl was recorded. This experiment was conducted for 10 weeks, from November to January, at the fish hatchery of Department of Fisheries and Aquaculture, Federal University of Agriculture Makurdi, Benue State, Nigeria. Uneaten feed and waste products were siphoned out of the bowls with a rubber tube and water was properly aerated using air pump throughout the period of study.

Biological performance of test fish was evaluated using the technique, as employed by Reginald and James (2014) as follows: Mean Weight gain (MWG) = W_2-W_1, where W_1 and W_2 are initial and final body weights of fish in gram.

Percentage weight gain (PWG), % = Wt-W_0 X 100/W_0 where Wt= final weight at end of experiment, W_0 = weight (g) at start of the experiment. Condition factor (K) =100W/L where Wand Lare the observed total weight of fish (g) and total length (cm) of a fish. Feed conversion ratio (FCR) = Feed intake (g)/weight gain (g).

Statistical analysis

Data obtained from this study was subjected to analysis of Variance ANOVA (Wahua, 1999). Duncan's multiple range test (Duncan, 1955) was used to compare differences among treatments mean. SPSS 16.0 was used for the Analysis

RESULTS AND DISCUSSION

Table 1 shows the summary of the results obtained for growth responses of *Oreochromis niloticus* fry raised in different colour of plastic bowl. There was a general increase in weight and length in all the fish during the experiment although there were different growth responses.

Table 1: Growth responses of *Oreochromis niloticus* fry cultured in different colours of plastic bowls

Parameter	White	Red	Green	Black	Blue
No. of fish stocked	60	60	60	60	60
Initial length of fish (cm)	0.53	0.53	0.53	0.53	0.53
Initial weight of fish (cm)	0.08	0.08	0.08	0.08	0.08
final length of fish (cm)	10.30	9.70	9.20	10.90	10.10
final weight of fish (cm)	8.70	8.14	8.53	9.45	8.52
Weight gain	8.62	8.06	8.45	9.37	8.44
%weight gain	10775	10075	10562.5	11712.5	10550
Survival rate %	91.30	78.71	89.40	52.71	86.80
Condition factor (K)	0.92	1.05	1.30	0.84	0.96

The mean weights of fish in the bowls were 8.7, 8.14, 8.53, 9.37 and 8.44 g in the white, red, green, black and blue bowls, respectively. Mortality was recorded highest in black bowl although with highest growth rate. Survival was also highest in white bowl, although the fish camouflaged to the colour of the bowl – i.e. they all turned albino. The green bowl showed the best condition factor (well-being in terms of growth and survival) during the experiment. Water quality parameter values are shown in Table 2.

Table 2: Mean and range values of water quality parameters for *Oreochromis niloticus* fry cultured in different colours of plastic bowls

Parameter	White	Red	Green	Black	Blue
Temperature (^oC)	24.35 ± 0.08^d	23.9 ± 0.08^b	23.45 ± 0.08^b	23.7 ± 0.08^c	23.2 ± 0.08^a
	(23.7-25.6)	(23.3-24.1)	(23.4-23.7)	(23.4-24.8)	(22.8-23.8)
DO	6.17 ± 0.16^e	6.10 ± 0.16^d	$5.910.16^c$	5.35 ± 0.16^a	5.72 ± 0.16^b
	(5.90-6.43)	(5.8-6.7)	(5.6-6.42)	(5.3-5.42)	(5.57-5.92)
pH	8.30 ± 0.15^e	7.81 ± 0.15^b	7.50 ± 0.15^a	8.11 ± 0.15^c	8.13 ± 0.15^d
	(7.89-8.74)	(7.53-8.00)	(7.42-7.60)	(7.61-8.59)	(7.48-8.70)
Electric conductivity	839 ± 0.96^e	826 ± 0.96^d	814 ± 0.96^c	801 ± 0.96^b	790 ± 0.96^a
	(816-865)	(798-834)	(782-836)	(787-821)	(752-812)
TDS	419 ± 0.54^e	408 ± 0.54^c	400 ± 0.54^b	414 ± 0.54^d	395 ± 0.54^a

Values with different letter of superscript for a given parameter in the same horizontal row are significantly different (P<0.05)

The well-being of a fish is dependent on the management, culture and colour of facility used in raising them. The growth responses of *Oreochromis niloticus* fry raised in different colored plastic bowls showed varied and significant results, providing insights into how environmental conditions affect aquaculture. The mean weight gains of the fish in different treatments varied slightly. Fish in the white bowl were uniform in size; fish in black bowl grew larger in size compared to the other treatments. This was probably because the black bowl absorbed heat which warmed the water since the experiment took place during the dry season.

The black bowl produced the highest weight gain (9.37 g) but had the lowest survival rate (52.71%), likely due to the lowest dissolved oxygen levels (5.35 mg/L) recorded among the treatments. This finding aligns with Buentello *et al.* (2000), who emphasized the critical role of dissolved oxygen in fish survival. Conversely, the white bowl had the highest survival rate (91.30%)

and the highest dissolved oxygen levels (6.17 mg/L), although all fish turned albino, likely due to environmental color influence, echoing studies by Portz *et al.* (2006) and Dopeikar *et al.* (2024) on the effects of tank color on fish growth and stress responses.

The green bowl, with a condition factor of 1.30, indicated optimal growth and survival conditions, suggesting a balanced environment. Water quality parameters such as temperature (22.8-25.6°C) were slightly below the optimal range for tropical fish as recommended by Boyd (1979) and Viveen *et al.* (1985), potentially affecting growth performance.

The high survival rate in the white bowl can probably be ascribed to the significantly higher concentration of dissolved oxygen compared to other treatments. Survival rate in this experiment was in disagreement with Olukunle (2013) who had high survival rate of fry raised in concrete tank. High mortality rate in black bowl was probably as a result of low dissolved oxygen compared to other treatments.

Furthermore, studies on other fish species bolster these findings: Asian seabass juveniles and hybrid catfish cultured in red tanks demonstrated significantly higher weight gain (WG), specific growth rate (SGR), and protein efficiency ratio (PER) compared to those in blue tanks, along with lower feed conversion ratio (FCR) in red tanks, highlighting the role of tank colour in enhancing food visibility and feed efficiency (Saszik & Bilotta, 2001; Ninwichian *et al.*, 2022; Morshedi *et al.*, 2022). Moreover, the FCR of juvenile common carp cultured inred background meaningfully decreased compared to other colours (Ebrahimi, 2011). The ability to see food more clearly in a contrasting tank environment reduces the energy expended in searching for food, thereby contributing to improved growth rates and feed utilization efficiency (Rodríguez & Lewis, 1997; Saszik & Bilotta, 2001; Ninwichian *et al.*, 2018; Ninwichian *et al.*, 2022).

However, pH and electrical conductivity remained within acceptable limits as per Boyd (1982) and Viveen *et al.* (1985). Despite the lower temperatures, the white bowl fish had a uniform size, which could be attributed to the higher dissolved oxygen levels. The findings differ from Olukunle (2013), who reported higher survival rates in concrete tanks, indicating that tank material and design significantly influence water quality and fish health. Additionally, the study's observation that fish in black bowls grew larger due to heat absorption, warming the water during the dry season, further supports the importance of tank color and temperature management in aquaculture (Ebeling & Timmons, 2012).

The mean temperature ranges in all the experiments were low. This was in disagreement with Boyd (1979) and Viveen *et al.* (1985) temperature recommendation for tropical fish optimum growth and nutrient utilization. Other water quality parameters observed, including DO, pH, Electric conductivity were within environmental parameters recommended and reported by Boyd (1982) and Viveen *et al.* (1985).

CONCLUSION

This study shows that the use of different colours of plastic bowls in raising tilapia fry is not only an economical means of culturing fish but can also achieve high growth and survival rate. The black bowl showed highest growth rate with low survival rate, while the white bowl had the highest survival rate but changed the fish colour. The green bowl showed the best growth and survival rate. However, farmers should be encouraged to use plastic bowl in raising tilapia fry since it is cheap when compared with pond, tank, glass aquarium, etc.

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