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Effects of Different Tank Colours on Growth Performance and Survival Rate of African Catfish Juveniles (*Clarias gariepinus*, Burchell 1822)

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Abstract

The effects of different tank colours on growth performance and survival of *Clarias gariepinus* juveniles were investigated. Triplicate groups of 25 juveniles (6.07±0.93g) was assigned each into plastic tanks representing three treatments as: Blue, green, and orange. The fish were daily hand-fed at 5% body weight at 07:00 and 17:00 hr for 84 days. Growth parameters such as Mean Weight Gain (MWG), Specific Growth Rate (SGR) and Feed Conversion Ratio (FCR) were measured using standard formula. Survival rate were calculated following standard formula. Results showed that African catfish cultured in the blue tanks had higher ($P<0.05$) final mean weight (68.79±17.36 g) and MWG (62.29±16.77 g) and lower FCR (2.61±0.11). Fish in treatment groups exhibited only a slighted variation in SGR ($P>0.05$), though fish maintained in blue tanks showed better percent increases (1.19±0.09 %.day^{-1}). Survival varied from 95.23±8.25 to 100.00±0.00 %, with highest survival in the orange tanks (100.00±0.00 %).

Keywords:

African catfish, tank colour, juvenile, growth performance, survival

Introduction

Fish farming is a lucrative business thriving in urban and rural areas of Nigeria where it provides reliable and cheap source of animal protein for people. The choice of farmed fish has increased because its being considered as safe, sustainable, and nutritious source of food. The popular farming system among Nigeria fish farmers is pond culture, usually in plastic, concrete, and earthen ponds. Plastic tanks is however much more preferred than concrete and earthen ponds due to the flexibility, less capital and space involved. Plastic ponds are movable/flexible and available in different sizes, shapes, and colours, which make it convenient for farmers to get and use for their fish farming activities.

The debate on the size and shapes of tanks has been on stocking density, which mean the more the stocking density the bigger the size of the tank. However, the choice of the background colour in tanks

is often by chance and not with any serious consideration. Studies on several fish species has indicated that tank background colour is an important factor to consider in fish culture (Martinez-Cardenas and Purser, 2007). El-Sayed and El-Ghobashy, (2011) revealed that certain tank substrate colour has been shown to affect growth and survival, and stress response in fish under culture condition. Merighe *et al*., (2004) opined that background colour may induce a variety of responses in relation to food intake, stress, growth, survival, and even social interaction of fish. Therefore, there is need to investigate the compatibility of fish with tank background colours for best growth performance and survivability.

Recently, many studies including Dada (2010), Okomoda *et al.*, (2017), Alabi and Ocholi (2018), and Krasteva *et al*. (2020) have established the effects of tank colour on Catfish fry/fingerling growth and survival. However, there is dearth of information on this subject in juvenile catfish and especially in Semi-arid zone of Nigeria. This study therefore evaluates the effects of different tank colours on growth performance, and survival rates of *C. gariepinus* juveniles. This will contribute to tank colour selection for growing of African catfish under culture conditions.

MATERIALS AND METHODS

Study area: The experiment was carried out at the Fish hatchery complex of Federal College of Freshwater Fisheries Technology, Baga, Borno State, Nigeria. The Fish hatchery is situated at the College temporary site within Lake Chad Research Institute, Maiduguri and lies within Latitudes $11^0$51'43" N and Longitudes $13^0$13'36" E @ altitude 312 m above the sea level. The climate of the study area is characterized by dry and hot season with mean annual temperature of 34.8 ^{0}C and an annual rainfall of 600 mm per annum.

Collection of fish sample: Two hundred and fifty (250) healthy *C. gariepinus* juveniles (6.07±0.93g) were procured from the College hatchery and they were fasted for 24 hours before the experiment. At the commencement of the study, 225 healthy fish were distributed into experimental tanks filled with borehole water from hatchery.

Experimental procedure: Nine circular plastic tank aquaria (40 litres) were supplied with dechlorinated borehole water and changed every 72 hours to ensure good water quality and prevent ammonia build-up. Twenty-five (25) fish were randomly stocked into each tank, which were covered with a net of 2 mm mesh size to protect the fish from jumping out of the tank. Prior to starting the experiment, the fish were weighed individually to obtain the initial weight. The experimental fish and treatments were randomly assigned in triplicate, and the research design was 3 x 3 Completely Randomized Design. Three aquaria for each treatment used were represented as stated below:

Treatment BLU: - Blue colour tank
Treatment GRN: - Green colour tank
Treatment OGE: - Orange colour tank

Feeding and Measurement: The fish were fed with 2mm Coppens feed @ 5% of total body weight per day, as recommended by Adewolu and Olakunle (2009), with half daily ration fed to the fish at 0700 h and the other half at 1700 h. Feeding was generally completed in 5–10 mins. Fish were reweighed weekly and feeding rate was adjusted accordingly with the use of 200g weighing scale (Scout Pro SPU202 Model). The feeding trial lasted for 12 weeks.

Water management: Water temperature, pH and dissolved oxygen concentrations in water were monitored twice a week, while ammonia and nitrate were measured weekly. Temperature was measured using a mercury in-glass thermometer. Temperature was measured using a mercury in-glass thermometer. pH and dissolved oxygen were measured with a pH meter (BICASA model B.E.104), while nitrite and nitrate were determined in the laboratory as described by APHA (1998).

Determination of growth performance: Growth and nutrient utilization parameters were assessed in terms of Mean Weight Gain (MWG), Specific Growth Rate (SGR), Food Conversion Ratio (FCR) and Survival Rate (SR), using the following formulae (Akinwole and Faturoti, 2006):

Mean Weight Gain (g): This was calculated as the difference between the initial and the final mean weight for fish in each tank.

Specific Growth Rate (SGR): This was calculated from data on changes of body weight over a given time interval,

$$\text{SGR} = \frac{100 \times (1n\ FBW - 1nIBW)}{D}$$

Where: FBW = final body weight (g) (weight at the end of the time interval studied)

IBW = initial body weight (g) (weight at the beginning of the time interval studied)

D = number of days

Food Conversion Ratio (FCR): The food conversion ratio was calculated as,

$$\frac{Weight\ of\ dry\ feed\ fed\ (g)}{Live\ weight\ gained\ (g)}$$

Survival Rate (SR): The survival rate SR was calculated as total fish number harvested/total fish number stocked expressed in percentage.

$$\text{SR} = \frac{Total\ \ fish\ number\ harvested}{Total\ \ fish\ number\ stocked} \times 100$$

Statistical analysis: Data resulting from the experiment were subjected to analysis of variance (ANOVA) and presented as Mean±Standard deviation (S.D). Fisher's LSD was employed for mean separation using SPSS software statistical program version 20.0. (SPSS Inc., Chicago, IL, USA). Descriptive statistics such as table, graph and chart were also employed.

RESULTS

The growth and nutrient utilization of African catfish juveniles raised in differently coloured tanks are shown in Table 1. The final mean weight and mean weight gain values recorded in fish raised in blue tanks were significantly higher ($P<0.05$) than in green and orange tanks. Similar trend was followed in specific growth rate, but no significant difference obtained among the treatments ($P>0.05$). blue tank recorded 1.19±0.09 $\%.day^{-1}$) while the least specific growth rate was found in green tank (1.12±0.06 $\%.day^{-1}$).

Feed intake values for the treatment groups ranged from 1038.02±321.18 g feed/fish in orange tank to 1229.55±38.14 g of feed/fish in green tank. There were no significant differences ($p>0.05$) for all values obtained in feed intake between treatments. The feed conversion ratio (FCR) was also not significantly different among treatment groups. Orange coloured tank had the best FCR (2.59±0.28 %) while the least FCR performance was obtained in orange coloured tank (2.85±0.07 %). The survival rate of fish

varied from 95.23±8.25 to 100.00±0.00 % in different treatments but there was no significant difference between experimental groups (Figure 1).

Table 1. Growth performance, and nutrient utilization of *C. gariepinus* fingerlings reared in different tank colours

	Treatment Colours		
Variable	**BLU**	**GRN**	**OGE**
Initial mean Weight (g)	6.50±0.96[a]	6.22±0.57[a]	5.50±1.20[a]
Final mean weight (g)	68.79±17.36[a]	56.44±3.79[b]	52.78±11.37[b]
Mean Weight gain (g)	62.29±16.77[a]	50.22±3.34[b]	47.28±10.25[b]
Specific growth rate (%.day^{-1})	1.19±0.09[a]	1.12±0.06[a]	1.17±0.03[a]
Feed intake (g feed fish^{-1})	1203.57±268.34[a]	1229.55±38.14[a]	1038.02±321.18[a]
Feed conversion ratio (%)	2.61±0.11[b]	2.85±0.07[a]	2.59±0.28[b]

Values are means ± SD
Means across the same row differently superscripted differ significantly (P< 0.05).
LEGEND: BLU- Blue tank; GRN- Green tank and OGE- Orange tank

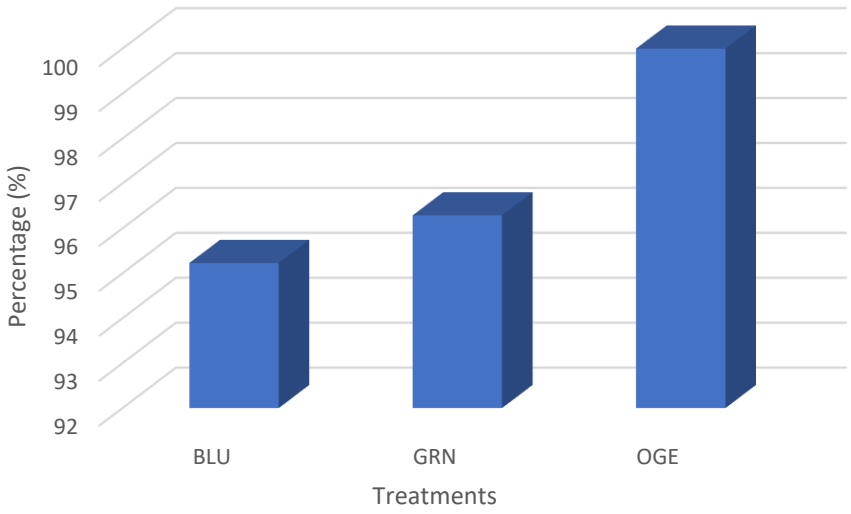

Figure 1. Survival rate of *C. gariepinus* juveniles reared in different tank colours

The results of water quality parameters as investigated in the study were presented in Table 2. Dissolved oxygen concentration was slightly (*p<0.05*) higher in green coloured tank (5.26±0.55 mgL^{-1}) than other tank colours, while orange tank shows the least (5.07±0.51 mgL^{-1}). The pH values in the studied tank colours are found to be slightly alkaline, with the lowest mean reading recorded in blue tank (7.65±0.21) while the marginally higher value was recorded in orange tank (7.74±0.25). Also, water temperature in green and orange tanks was slightly higher (28.44±0.52 ^{o}C) than the blue tank (28.11±0.78 ^{o}C). Marked variations (p<0.05) was observed in nitrate and nitrite with orange had the highest value of 2.63±2.27 mgL^{-1} and 0.46±0.60 mgL^{-1} respectively.

Table 2. Water quality parameters of *C. gariepinus* fingerlings reared in different tank background colours (Values are Mean±SD).

	Treatment Colours		
Water parameters	**BLU**	**GRN**	**OGE**
Dissolved Oxygen (mgL^{-1})	$5.24±0.38^{a}$	$5.26±0.55^{a}$	$5.07±0.51^{a}$
pH	$7.65±0.21^{a}$	$7.73±0.21^{a}$	$7.74±0.25^{a}$
Temperature (^{o}C)	$28.11±0.78^{a}$	$28.44±0.52^{a}$	$28.44±0.52^{a}$
Nitrate (mgL^{-1})	$0.54±0.12^{b}$	$1.01±0.83^{ab}$	$2.63±2.27^{a}$
Nitrite (mgL^{-1})	$0.01±0.00^{b}$	$0.08±0.12^{b}$	$0.46±0.60^{a}$

Values are means ± SD.

Means across the same row differently superscripted differ significantly ($P< 0.05$).

LEGEND: BLU- Blue tank; GRN- Green tank and OGE- Orange tank

DISCUSSION

It is evinced from the study that blue coloured tank affects growth performance in *Clarias gariepinus* juveniles. Weight gain was markedly higher in blue tank, which concur with the previous studies by Krasteva *et al*., (2019) who reported significant highest weight gain (6.98 g) in European catfish juveniles (*Silurus glanis*) raised in blue tank over white, green, and black tanks. However, Okomoda *et al*., (2017) and Dada (2009) found no significant difference in the weight gain of *C. gariepinus* fingerlings and fry raised in blue, green and white tanks. These authors instead reported considerable high weight gain in black tank which was not considered in this study. Also, this result contradicts the finding of McLean *et al*. (2008) who indicated that tank colour did not affect the growth performance of juvenile flounder or tilapia. According to these authors, fish maintained in red-light tanks showed better percent increases in body weight. Similarly, Ekokotu and Nwachi (2014) observed no specific significant disparities in the growth reaction of *C. gariepinus* fry raised in blue, green and white tank colours. Imanpoor and Abdollah (2011) suggested that the tank colour is an important parameter for fish welfare, and it must be considered for enhancing performance of cultured fish.

In the present study, fish in treatment groups exhibited a slighted variation in specific growth rate (SGR). Although, fish maintained in blue tanks showed better percent increases in SGR. In contrast to this finding, Okomoda *et al*. (2017) and Solomon and Ezigbo (2018) found significant higher specific growth rate in *C. gariepinus* and *Heterobranchus bidorsalis* juveniles reared in black tanks than in the ones with white, green, blue, yellow, and red background colour. Also, Krasteva *et al*., (2019) showed that the SGR of the European catfish fingerlings cultured in black and green tanks was significantly higher than those reared in the experimental tanks with white and blue colour. The present study found significant best Food Conversion Ratio (FCR) in fish reared in blue and orange tanks. Interestingly, most of the previous studies did not record marked disparity regarding FCR in their studies. In similar vein, Okomoda *et al*. (2017) and Krasteva *et al*. (2019) observed no significant difference in feed conversion ratio in their research on culturing African catfish juveniles in different tank colours. The same results were also reported by Imanpoor and Abdollah, (2011) who found FCR to be differed non-significantly in Caspian Kutumin juvenile raised in different tank colours.

In the present study, survival rate of *Clarias gariepinus* juveniles followed similar high trend (95.23±8.25 – 100.00±0.00 %) but highest in Orange tank (100.00±0.00 %). There was no significant

variation in survival among the treatment groups. Krasteva *et al*. (2019) reported similar findings of no significant variation in survival rate of European catfish juveniles (*Silurus glanis*) reared in blue, white, green, and black background colours. This observation is consistent with the work of a Üstündag and Rad (2014) found similar and varied survival rates (98.25% and 99.57%) in rainbow trout (*Oncorhynchus mykiss*) juveniles reared in different colour tanks. In contrast to this findings, Dada (2009) and Solomon and Ezigbo (2018) reported high survival rate in African catfish fry reared in black tanks than in the ones with blue, green, white, maroon and yellow background colour.

The mean water temperature, pH, dissolved oxygen, nitrite, and nitrate concentrations in this study were not significantly varied among treatment groups, which shows that the treatment colours did not affect culture environment. The recorded mean values of all these parameters were within the optimum range for catfish growth and health (Boyd, 1998; Omitoyin, 2007). The good water quality levels in this study may be because of constant water change of the culture system. Similarly, the close range in the average temperature recorded during the experimental period was probably because all the treatments were indoors. Also, the differences recorded in these parameters among treatments could be attributed to different metabolic rate from individual treatment (Falaye *et al*., 2011).

CONCLUSION

The present study shows that the blue tank has significant effect on growth performance of *Clarias gariepinus* juveniles, which resulted to high weight gain and best food conversion ratio. More so, fish survival was higher in orange tank, but not significantly better than the other experimental tank colours. It is however, recommended that in future research more tank colours should be explored to find more appropriate/best colour for optimum growth performance in African catfish juvenile.

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