

Effect of Tank Colour on Physicochemical Parameters, A Growth Performance of *Clarias Gariepinus* (African Catfish) in Coloured Tank Culture

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Abstract

Aquaculture has become an important means of meeting the rising demand for protein-rich food in Nigeria, with *Clarias gariepinus* (African catfish) being one of the most widely cultured species. However, water quality management remains a major challenge in tank-based culture systems. Recent studies suggest that tank color may influence fish performance and water quality, yet limited data exist in the Nigerian context. This study investigated the effect of tank color on the physicochemical parameters of water and the growth performance of *Clarias gariepinus* juveniles under controlled culture conditions in Abuja, Nigeria. Three tank colors black, Red, and white were evaluated in a completely randomized design with treatments. Key water quality parameters (temperature, pH, dissolved oxygen, ammonia, nitrate, turbidity, and total dissolved solids) were monitored, alongside fish growth indicators (weight gain, specific growth rate, feed conversion ratio, and survival rate). Results revealed that Red tanks provided the most stable and favorable water conditions, with higher dissolved oxygen (5.5 mg/L), lower ammonia (0.18 mg/L), and reduced turbidity (11.5 NTU). Fish reared in red tanks exhibited superior growth performance (final mean weight 118.7 g; SGR = 2.98 %/day; FCR = 1.45) and the highest survival rate (96.7%). White tanks performed least favorably, associated with lower dissolved oxygen and higher ammonia concentrations, which negatively affected growth and survival. The study concludes that red tank coloration is most suitable for *Clarias gariepinus* culture, followed by black, while white tanks should be avoided. It recommends the adoption of red or black tanks by fish farmers, regular water quality monitoring, and further research on the long-term physiological and economic impacts of tank coloration.

1. Introduction

In sub-Saharan Africa, the increasing demand for protein-rich food has spurred rapid expansion in fish farming, particularly the culture of *Clarias gariepinus* (African catfish), due to its hardiness, high growth rate, tolerance to poor water quality, and ability to be cultured in various systems including tanks, ponds, and cages [1,2]. In intensive aquaculture systems, particularly tank-based culture, water quality management becomes paramount. The physicochemical parameters of the rearing environment—such as temperature, pH, dissolved oxygen, ammonia, nitrite, turbidity, and total hardness—play a crucial role in fish health, growth performance, feed utilization, and overall production success [3]. Unfavorable water conditions can lead to stress, disease outbreaks, and high mortality rates in cultured fish species. Recent innovations in aquaculture have explored unconventional methods to optimize water quality and fish performance. One such innovation involves the use of colored tank systems. The concept is derived from the influence of color on fish behavior, physiology, and growth, which has been widely reported in aquaculture research. Colors affect light penetration, algae proliferation, feeding patterns, and fish stress levels, all of which influence the physicochemical

conditions of the tank environment [4,5]. The *Clarias* species, known for their nocturnal and bottom-feeding behavior, are particularly sensitive to environmental stimuli including light and tank color. Studies have shown that tank background color can affect growth performance, stress hormone levels, and behavioral responses of cultured fish [6]. However, limited data exist on how tank color indirectly or directly modifies the physicochemical characteristics of the culture water over time, particularly in tropical aquaculture settings such as Nigeria. Given the increasing adoption of tank-based systems in small- and medium-scale aquaculture enterprises in Nigeria, understanding how tank color influences water quality parameters is vital. This study, therefore, investigates the physicochemical properties of water in colored tank systems used for culturing *Clarias gariepinus*, with a view to determining the most favorable tank color for maintaining optimal water quality.

2. Materials and Methods

Study Area the research was conducted at an aquaculture research facility or fish hatchery located within a controlled environment in Abuja, Nigeria. This location was selected based on its accessibility, availability of

standard water sources, and facilities for tank-based fish culture. Environmental factors such as temperature, relative humidity, and photoperiod was noted and kept as uniform as possible across treatments.

2.1. Experimental Design

The study adopted a completely randomized design (CRD) consisting of three different colored tanks: black, red, and white. Each treatment (color) was replicated three times to ensure statistical validity, giving a total of nine (9) tanks. All tanks had identical dimensions and volumes, holding approximately 200 liters of water each. Source and Acclimatization of Experimental Fish Juvenile *Clarias gariepinus* (African catfish) was procured from a certified hatchery. All fish were of uniform size (weighing approximately 20–25 grams) and similar age to reduce variability. Upon arrival, the fish was acclimatized for a period of 7 days in a neutral tank under standard water conditions. During this period, they were fed with commercial fish feed and monitored for signs of stress, disease, or mortality.

2.2. Stocking and Feeding Regimen

After acclimatization, 10 healthy fish was randomly selected and stocked into each of the 9 tanks, maintaining a uniform stocking density. The fish were fed with commercial floating pellets containing 35% crude protein. Feeding was done twice daily (morning and evening) at 3% of their body weight, and feed ration was adjusted weekly based on weight gain. All tanks were cleaned daily to remove uneaten feed and fecal matter.

2.3. Tank Color Preparation and Maintenance

Each tank was internally painted with non-toxic, waterproof, and fish-safe paint of the designated color: black, red, or white. The colors were chosen based on common recommendations in aquaculture literature and their reported effects on fish behavior and water quality. Paint were allowed to cure for at least 72 hours before water and fish were introduced. The tanks were placed under a roofed but open-sided shed to minimize the effect of direct sunlight while allowing for natural ventilation.

2.4. Water Source and Quality Management

All tanks were filled with borehole water to ensure a consistent water source. Water was aerated using electric air pumps to maintain dissolved oxygen levels. Water exchange was performed every three days at a rate of 30% to control the accumulation of metabolic waste. All fluctuations in water quality were recorded and addressed accordingly. Parameters to be Measured The study involved regular monitoring of both physicochemical water parameters and fish performance indicators.

2.5. Physicochemical Parameters

The following water quality parameters were measured:

- Temperature (°C): Using a mercury or digital thermometer.
- pH: Using a digital pH meter.
- Dissolved Oxygen (mg/L): Using a portable DO meter.
- Ammonia (mg/L): Using a colorimetric test kit or spectrophotometer
- Nitrite and Nitrate (mg/L): Measured using a water testing kit.
- Turbidity (NTU): Measured using a turbidity meter.
- Total Dissolved Solids (mg/L): Measured using a digital TDS meter.

These measurements were taken every 3 days between 8:00 a.m. and 10:00 a.m. to maintain consistency.

2.6. Fish Growth and Performance Metrics

Fish performance was evaluated using the following indicators:

- Weight Gain (g): Fish was sampled weekly and weighed using a digital scale. Specific Growth Rate (SGR/)
- Feed Conversion Ratio (FCR)
- Survival Rate (%)

2.7. Data Collection and Recording

All data were recorded in structured datasheets and digital spreadsheets. Daily observations were made to note fish behavior, water appearance, and any mortality events. Water samples was preserved temporarily for laboratory confirmation if necessary.

3. Results

Parameters	Black Tank	Red Tank	White Tank	Optimal Range
Temperature (°C)	27.4 ± 0.5	27.0 ± 0.4	28.1 ± 0.7	25 - 30
pH	7.4 ± 0.2	7.3 ± 0.3	7.6 ± 0.3	6.5 - 8.5
Dissolved Oxygen (mg/L)	5.5 ± 0.3	5.1 ± 0.4	4.6 ± 0.3	> 5.0
Ammonia (mg/L)	0.20 ± 0.03	0.18 ± 0.04	0.30 ± 0.06	< 0.50
Nitrate (mg/L)	5.6 ± 0.8	5.2 ± 0.7	6.8 ± 1.0	< 10
Turbidity (NTU)	12.3 ± 1.5	11.5 ± 1.2	16.4 ± 2.0	< 20
Total Dissolved Solids (mg/L)	280 ± 15	270 ± 12	310 ± 20	< 500

Mean Physicochemical Parameters of Water in Colored Tanks (±SD)

Performance Indicator	Black Tank	Red Tank	White Tank
Initial mean weight (g)	22.1 ± 0.5	22.0 ± 0.4	22.1 ± 0.5
Final mean weight (g)	112.5 ± 3.2	118.7 ± 3.8	98.6 ± 2.8
Weight gain (g)	90.4 ± 3.0	96.7 ± 3.4	76.5 ± 2.6
Specific Growth Rate (%/day)	2.85 ± 0.10	2.98 ± 0.12	2.56 ± 0.08
Feed Conversion Ratio (FCR)	1.52 ± 0.04	1.45 ± 0.05	1.75 ± 0.07
Survival rate (%)	93.3 ± 2.1	96.7 ± 1.8	83.3 ± 2.2

Growth and Performance Indicators of *Clarias gariepinus* in Colored Tanks (±SD)

Parameters/ Indicator	Best Value (Optimal)	Black Tank	Red Tank	White Tank
Temperature (°C)	25 - 30	27.4	27.0	28.1
pH	6.5 - 8.5	7.4	7.3	7.6
Dissolved Oxygen (mg/L)	>5.0	5.1	5.5	4.6
Ammonia (mg/L)	< 0.50	0.20	0.18	0.30
Nitrate (mg/L)	< 10	5.6	5.2	6.8
Turbidity (NTU)	< 20	12.3	11.5	16.4
Total Dissolved Solids (mg/L)	< 500	280	270	310
Final mean weight (g)	Higher is better	112.5	118.7	98.6
Specific Growth Rate (%/day)	Higher is better	2.85	2.98	2.56
Feed Conversion Ratio (FCR)	Lower is better	1.52	1.45	1.75
Survival rate (%)	Higher is better	93.3	96.7	88.3

Comparative Summary of Tank Color Effects on Water Quality and Fish Performance

4. Discussions

This study investigated the influence of tank color on the physicochemical parameters of water and the growth performance of *Clarias gariepinus* juveniles cultured under controlled conditions in Abuja, Nigeria. Three tank colors—black, Red, and white—were evaluated using a completely randomized design, with water quality parameters and fish performance monitored throughout the culture period. The results demonstrated that tank color exerted a significant effect on the stability of water quality parameters. Red tanks consistently provided optimal conditions, with higher dissolved oxygen levels (5.5 mg/L), lower ammonia concentrations (0.18 mg/L), and reduced turbidity (11.5 NTU), all within recommended ranges for catfish culture [2,7]. Black tanks also maintained favorable conditions, while white tanks exhibited the least suitable environment with higher ammonia (0.30 mg/L) and lower dissolved oxygen (4.6 mg/L). Fish growth performance followed a similar trend. Juveniles reared in Red tanks achieved the highest final mean weight (118.7 g), specific growth rate (2.98 %/day), and survival rate (96.7%), supported by efficient feed utilization (FCR = 1.45). Black tanks supported the second-best growth outcomes. These findings confirm that tank color not only influences the physicochemical dynamics of water but also directly impacts the physiological performance and survival of cultured fish. The overall findings are consistent with reports that Red and black tanks tend to promote better growth and survival in aquaculture species due to reduced stress and enhanced water stability [4,8]. In contrast, high

light reflection in white tanks may increase stress levels and disrupt feeding efficiency, contributing to poorer performance [9,10].

5. Conclusion

This study concludes that tank color plays a critical role in aquaculture management by influencing water quality and fish performance. Among the colors tested, Red tanks provided the most stable water quality conditions and supported the best growth, feed conversion efficiency, and survival of *Clarias gariepinus*. Black tanks were also suitable. White tanks proved least favorable, associated with suboptimal dissolved oxygen and relatively high ammonia levels, which negatively affected fish growth and survival. Therefore, the study establishes that Red tank coloration is most recommended for small- and medium-scale aquaculture enterprises in Nigeria, as it optimizes both physicochemical water conditions and fish productivity.

References

- Adewolu, M. A., Ogunsanmi, A. O., & Yunusa, A. (2008). Studies on growth performance and feed utilization of two Clariid catfish and their hybrid reared under different culture systems. *European Journal of Scientific Research*, 23(2), 252-260.
- Oyetunji, G. O., Olagunju, E. A., Ajayi, O. O., & Adesina, G. O. (2024). Herbicide use in Nigeria: a review of its effects on human, animal and environmental health. *Journal of Applied Life Sciences & Environment*, 57(4), 545.

3. Boyd, C. E., & Tucker, C. S. (2012). *Pond aquaculture water quality management*. Springer Science & Business Media.
4. Papoutsoglou, S. E., Mylonakis, G., Miliou, H., Karakatsouli, N. P., & Chadio, S. J. A. E. (2000). Effects of background color on growth performances and physiological responses of scaled carp (*Cyprinus carpio* L.) reared in a closed circulated system. *Aquacultural Engineering*, 22(4), 309-318.
5. Yu, Y., Xiao, M., Chen, L., & Yang, G. (2009). Isolation and characterization of microsatellite loci in the longsnout catfish (*Leiocassis longirostris*). *Aquaculture Research*, 40(2), 246.
6. Lushchak, V. I., Bagnyukova, T. V., Storey, J. M., & Storey, K. B. (2001). Influence of exercise on the activity and the distribution between free and bound forms of glycolytic and associated enzymes in tissues of horse mackerel. *Brazilian Journal of Medical and Biological Research*, 34(8), 1055-1064.
7. Boyd, C. E., & Tucker, C. S. (2012). *Pond aquaculture water quality management*. Springer Science & Business Media.
8. Schulz, R. W., & Henk, J. (1999). Puberty in male fish: concepts and recent developments with special reference to the African catfish (*Clarias gariepinus*). *Aquaculture*, 177(1-4), 5-12.
9. Boeuf, G., & Le Bail, P. Y. (1999). Does light have an influence on fish growth? *Aquaculture*, 177(1-4), 129-152.
10. Olukunle, O. J. (2014). Effect of stocking density on growth and hematological parameters of African catfish (*Clarias gariepinus*). *Journal of Fisheries and Aquatic Science*, 9(4), 345-351.