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EFFECTS OF CULTURING *CLARIAS GARIEPINUS* FINGERLINS IN GRADED LEVELS OF MORINGA SEED POWDER TREATED WATER ON GROWTH AND SURVIVAL RATE IN MUBI ADAMAWA STATE-NIGERIA

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ABSTRACT

A study was conducted to determining the influence of graded levels of Moringa seed powder treated water on the growth and survival of Clarias gariepinus fingerlings. 240 Clarias gariepinus fingerlings obtained from Abdul Fana Farms, Yola used and were randomly assigned to twelve (12) experimental tanks (1m x 1.2 m x 1 m) of 60 per treatment (Each treatment was replicated three (3) times) and 20 per experimental tank. Dried ***seeds*** *of Moringa oleifera was ground into fine powder and graded into four (4) levels and designated as treatment T1, T2, T3 and T4 (0g, 5g, 10g and 15g, respectively). The tanks were filled to average of 100 litres of water. The fingerlings were fed three (3) times daily. Data were taken on the percentage weight gain, length gain, survival rate and water quality. Data collected were subjected to analysis of variance (ANOVA) using SPSS version 23.0. The result revealed that the treatment T2 gave highest weight gain of 14.77±0.67g and this could be due to stability in water pH. The length gain was highest in T1 (7.83±0.33), growth rate was highest in T2 (1.38±0.83) and the survival rate was highest in T2 (86.66±0.67). Dissolved Oxygen was highest in T0 (4.80±0.0), Temperature highest in T2 (26.61±0.42) and pH highest in T1 (8.16±0.66). This study concluded that Moringa oleifera seed could be used effectively for water reuse in the culture of Clarias. gariepinus fingerlings without any negative effects on the growth performances. It is therefore recommended that culture water should be treated using Moringa seed powder at 10g/100 L to reduce the rate of water spoilage in fish culture.*

Keywords: Clarias gariepinus, Moringa oleifera seed, Growth, Survival, graded levels, Water

INTRODUCTION

Aquaculture has become a vital sector for improving food security, employment, and income generation in developing countries such as Nigeria. Among cultured fish species, *Clarias gariepinus* (African catfish) is widely preferred due to its fast growth rate, high tolerance to environmental stress, and ability to thrive under intensive culture systems (Gaber *et al.,* 2025). This species plays a significant role in meeting the increasing demand for affordable animal protein, particularly in northern Nigeria, including Adamawa State (Olatunde *et al*., 2024).

Despite its economic importance, the productivity of *Clarias gariepinus* is often constrained by poor water quality, disease outbreaks, and environmental stressors, especially under intensive production systems. Water quality is a critical determinant of fish growth and survival, as it influences metabolic activities, feed utilization, and physiological responses. Poor water conditions can lead to increased stress levels, reduced growth performance, and high mortality rates in fish culture systems (Musa et al., 2023).

Moringa seeds possess coagulating, antimicrobial, and antioxidant properties, making them useful in water purification and fish health management (Adewumi & Olaleye, 2020 ;Amin et al., 2024). The use of Moringa seed powder in water treatment has been shown to improve water quality by reducing turbidity and microbial load, thereby creating a more conducive environment for fish

growth and survival. Moringa-based treatments can influence the physiological and biochemical responses of *Clarias gariepinus*. For instance, fish reared in Moringa seed-treated water showed improved antioxidant status, enhanced growth, and better survival rates compared to those in untreated water (Amin *et al.,* 2024). However, other findings suggest that excessive inclusion of Moringa seed powder may have adverse effects, including reduced growth performance and increased stress indicators such as elevated cortisol levels (Gaber *et al*., 2025; Amin *et al*., 2024). This indicates that the effect of Moringa seed powder is dose-dependent and requires careful optimization.

Research on graded levels of Moringa in aquaculture systems has revealed that moderate inclusion levels tend to yield better growth performance and feed utilization efficiency. For example, studies on Moringa leaf meal in fish diets reported improved growth and nutrient utilization at optimal inclusion levels, while higher levels resulted in diminished performance (Odedeyi & Ayegbusi, 2024; Omitoyin *et al*., 2023; Olatunde *et al*., 2024). Although most of these studies focused on dietary inclusion, limited research has explored the application of Moringa seed powder directly in culture water, particularly under Nigerian environmental conditions.

In areas such as Mubi, Adamawa State, aquaculture practices are often challenged by seasonal variations, high temperatures, and limited access to high-quality water resources. These factors can negatively affect fish growth and survival rates. Therefore, the use of locally available, low-cost, and sustainable materials like Moringa seed powder for water treatment presents a promising strategy for enhancing aquaculture productivity in the region.

Problem Statement

The rising demand for fish protein in Nigeria has intensified aquaculture practices, particularly for *Clarias gariepinus*, but this expansion is constrained by challenges such as poor water quality, high stocking densities, disease outbreaks, and environmental stressors that reduce fish growth and survival. In areas like Mubi, additional factors including high temperatures, seasonal water scarcity, and limited access to modern water treatment technologies further hinder productivity and profitability. Conventional chemical treatments for water management are often costly and may pose risks to fish health and the environment, prompting interest in natural alternatives such as *Moringa oleifera*, whose seeds exhibit coagulating, antimicrobial, and antioxidant properties. However, existing studies report inconsistent findings, with some indicating improved fish performance and others noting negative effects when improperly applied. Moreover, most research has focused on dietary inclusion rather than the direct application of Moringa seed powder in culture water, leaving a gap in knowledge regarding its optimal usage levels, particularly under the environmental conditions of Mubi. Therefore, there is a need to evaluate the effects of graded levels of Moringa-treated water on the growth and survival of *Clarias gariepinus* fingerlings to identify sustainable, cost-effective strategies for improving aquaculture productivity (; FAO, 2022; Ibrahim et al., 2021;

Objectives of the Study

The study was designed to achieve the following objectives

i. To determine the effect of different graded levels of Moringa seed powder-treated water on the growth performance (weight gain, specific growth rate, and feed conversion ratio) of *Clarias gariepinus* fingerlings.
ii. To evaluate the effect of Moringa-treated water on the survival rate of *Clarias gariepinus* fingerlings.
iii. To assess the impact of graded levels of Moringa seed powder on water quality parameters (such as pH, temperature, dissolved oxygen, and turbidity).

iv. To examine the optimal inclusion level of Moringa seed powder in water that supports maximum growth and survival of the fish.
v. To evaluate any adverse effects (stress or mortality) associated with higher concentrations of Moringa seed powder-treated water.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted in the Department of Fisheries and Aquaculture Complex, Adamawa State University Mubi. Mubi is a city in Adamawa, Nigeria. It is located on latitude 10.27 and longitude 13.27, it is situated at the elevation 592 meters above Sea level (Adebayo, 1999).

Collection of *M. oleifera* seeds

Dried seeds of *M. oleifera* which are readily available were purchased from Mubi market and properly ground into powder. The fine power obtained were stored in a sterile air-tight container in a dark place prior to use.

Collection and transport of fingerlings

C. gariepinus fingerlings were obtained from Abdul Fana Ventures, Yola and transported to the study site using open ended plastic jerricans.

Experimental Setup/Design

A total of 12 experimental concrete tanks measuring 1 x 1.2 x 1m was used and four grade levels of moronga powder was used viz:
- T1 – control (without *moringa* seed powder)
- T2– 5g of *moringa* seed powder,
- T3 – 10g of *moringa* seed powder,
- T4 – 15g of *moringa* seed powder.

Each treatment was replicated 3 times to give 4 x 3 in Completely Randomized Design. Each tank contained approximately 100 litres of water and 20 fingerlings. The fingerlings were assigned to the tanks after 2 weeks of acclimatization.

Feeding of Fingerlings

Fingerlings were fed to satiation 3 times daily (8:00am, 1:00pm, 6:00pm) using 2 mm vital feed. Excess feed was not siphoned to allow for the study of water quality and testing of the effect of *moringa* powder on the water.

Water Treatment and Monitoring

The culture water was treated as follows, 3 tanks was to assigned control and no treatment was made. 5g of the powder was used to treat 3 tanks, 10g to treat 3 tanks and 15g to treat 3 tanks making a total of 12 tanks. Water quality parameters were monitored by taking the values of Dissolved Oxygen DO, Temperature, pH weekly. The water was not changed until it fouls

Growth Performances Monitoring

Growth and survival will be monitored according to Duwal (2016) as follows;

i. Percentage length gain = $\frac{\text{Final length} - \text{Initial length}}{\text{Initial length}} \times 100\%$

ii. Percentage weigh gain = $\frac{\text{Final weight} - \text{Initial weigh}}{} \times 100\%$

iii. Specific growth rate $= \frac{W_2 - W_1}{T} \times \frac{100\%}{\text{Initial weight}}$

iv. Percentage Survival $= \frac{In - Fn}{In} \times 100\%$

Where W2 –Final weight
W1 – Initial weight
T - Time
In - Initial number
Fn – Final number

Data Analysis

Data collected was subjected to ANOVA using SPSS version 23.0 (2017) and significant means were separated using Least Significant Difference LSD.

RESULTS AND DISCUSSION

Growth and Survival of *C. gariepinus fingerlings* after Seven Weeks

The growth and survival of *Clarias. gariepinus fingerlings* after seven weeks is presented in Table 1.

Growth Performance

The mean initial weight of the fish ranged from 2.59 g to 2.77 g, indicating that the experimental fish were relatively uniform at the beginning of the study. However, significant differences ($P \leq 0.05$) were observed in the mean final weight, weight gain, and specific growth rate among treatments.

Fish in treatment T_2 recorded the highest mean final weight (17.36 g) and weight gain (14.77 g), which suggests that this treatment level provided the most favorable environment for growth. This result implies that moderate levels of Moringa seed powder-treated water enhanced nutrient utilization and metabolic efficiency. This finding agrees with the report of Amin et al. (2024), who observed improved weight gain and physiological performance of *Clarias gariepinus* cultured in Moringa-treated water.

Similarly, studies on Moringa inclusion in aquaculture systems have shown that optimal levels promote growth performance, while excessive levels may reduce efficiency. Suleiman *et al*. (2023) reported that moderate inclusion levels of Moringa resulted in superior growth compared to higher inclusion levels. However, the relatively lower growth observed in T_1 and T_3 may indicate that both insufficient and excessive concentrations of Moringa seed powder can limit growth. This observation is consistent with the findings of Gaber et al. (2025), who reported reduced growth performance in fish exposed to higher concentrations of Moringa seed treatments due to increased physiological stress.

Length Parameters

The results showed significant differences in mean final length and length gain among treatments. The highest length gain was observed in T_3 (7.01 cm), followed by T_2 (6.14 cm), while the lowest was recorded in T_1 (4.93 cm).

The increased length gain in T_3, despite its lower survival rate, suggests that fish in this treatment may have experienced compensatory growth due to reduced competition resulting from higher mortality. This phenomenon has been reported in aquaculture systems where lower stocking density enhances growth in surviving fish (Anwa-Udondiah *et al*., 2023).

Specific Growth Rate (SGR)

The specific growth rate (SGR) was highest in T_2 (1.38) and T_0 (1.37), indicating efficient feed conversion and metabolic activity in these treatments. This supports earlier findings that optimal

environmental conditions and moderate supplementation enhance growth rates in *Clarias gariepinus* (Odedeyi & Ayegbusi, 2024).

Condition Factor (K)

The condition factor was significantly higher in T_2 (0.93) compared to other treatments, indicating better fish health and well-being. A higher condition factor reflects improved physiological status and better adaptation to the culture environment. This aligns with Amin et al. (2024), who reported improved health indices in fish reared in Moringa-treated water.

Survival and Mortality

Survival rate varied significantly among treatments, with T_1 recording the highest survival (86.66%), followed by T_2 (83.33%), T_0 (80.00%), and the lowest in T_3 (70.00%). Conversely, mortality was highest in T_3 (30%), suggesting that higher concentrations of Moringa seed powder may have adverse effects on fish survival.

The high survival observed in T_1 and T_2 indicates that moderate application of Moringa seed powder improves water quality and reduces stress, thereby enhancing fish survival. This agrees with Amin et al. (2024), who reported increased survival and reduced oxidative stress in fish cultured in Moringa-treated water.

On the other hand, the high mortality observed in T_3 may be attributed to excessive Moringa concentration, which could lead to poor water quality, oxygen depletion, or toxic effects. This is consistent with Gaber et al. (2025), who noted that higher levels of Moringa seed supplementation can elevate stress markers and negatively affect fish survival.

General Implication

The results indicated that moderate levels of Moringa seed powder-treated water (T_2) provided the best balance between growth performance, health status, and survival of *Clarias gariepinus* fingerlings. Both low and high levels were less effective, confirming that the effect of Moringa seed powder is dose-dependent.

Water Quality Parameters

The effects of graded levels of *Moringa oleifera* seed powder-treated water on selected water quality parameters are presented in Table 2. Significant differences ($P \leq 0.05$) were observed among treatments for dissolved oxygen (DO), temperature, and pH.

Dissolved Oxygen (DO)

Dissolved oxygen values ranged from 3.50 mg/L in T_0 to 0.50 mg/L in T_2 and T_3. The control (T_0) recorded the highest DO concentration, followed by T_1 (2.50 mg/L), while T_2 and T_3 recorded significantly lower values.

The reduction in DO with increasing levels of Moringa seed powder may be attributed to increased organic load in the water, leading to higher microbial activity and oxygen consumption during decomposition. This finding aligns with Amin et al. (2024), who reported that excessive use of Moringa seed in aquaculture systems may reduce dissolved oxygen due to organic matter breakdown. Lower dissolved oxygen levels below 3 mg/L are generally stressful to *Clarias gariepinus* and may impair growth and survival.

According to FAO (2020), the optimal dissolved oxygen level for warm-water fish culture should be above 3–5 mg/L for optimal growth. The low DO values observed in T_2 and T_3 may explain the higher mortality recorded in T_3 in Table 1. Similarly, Gaber et al. (2025) reported that high concentrations of Moringa seed supplementation can alter water chemistry and induce physiological stress in African catfish.

Temperature

Water temperature ranged between 25.61°C and 26.52°C, with significant differences ($P \leq 0.05$) among treatments. However, all values fall within the optimal temperature range (25–30°C) recommended for the culture of *Clarias gariepinus* (FAO, 2020).

The slight variation in temperature among treatments may be due to environmental fluctuations rather than the direct effect of Moringa seed powder. Similar temperature ranges have been reported in tropical aquaculture systems by Anwa-Udondiah et al. (2023), who noted that temperatures within 25–28°C support optimal metabolic activity and growth in African catfish.

Therefore, temperature did not appear to be a limiting factor in this study, as all treatments remained within the acceptable range for catfish production.

pH

The pH values ranged from 7.50 to 8.16, showing significant differences among treatments. T_1 and T_2 recorded slightly higher pH values (alkaline condition), while T_0 and T_3 were slightly lower but still within the acceptable range.The slightly alkaline pH in Moringa-treated water may be due to the coagulating properties of Moringa seed proteins, which can influence water chemistry. This observation agrees with the findings of Suleiman et al. (2023), who reported that plant-based water treatments may slightly increase alkalinity due to bioactive compounds. According to FAO (2020), the suitable pH range for *Clarias gariepinus* culture is between 6.5 and 8.5. All recorded values in this study fall within this recommended range, indicating that pH did not pose a harmful effect on fish survival.

Growth and Survival of *Clarias. gariepinus* Fingerlings with Different Concentration of Moringa Powder for Seven Weeks

The results of growth and survival for seven weeks is presented in Table 3. The result showed that the growth performance of *Clarias gariepinus* fingerlings varied significantly ($P \leq 0.05$) across treatments, with moderate inclusion of *Moringa oleifera* (T2) generally improving weight gain, while the control diet (T0) supported higher length in most weeks. This indicates that moringa supplementation influences growth differently depending on inclusion level.

The superior weight gain observed in T2 at the later stages (weeks 6 and 7) agrees with findings by Adekunle and Ayegbusi (2024), who reported that moderate inclusion levels of moringa leaf meal enhanced growth performance and nutrient utilization in *Clarias gariepinus* fingerlings. Their study demonstrated that fish fed diets containing moringa showed improved feed conversion efficiency compared to the control, which supports the improved weight gain recorded in this study.

Similarly, the findings align with the report of Adekilekun *et al*. (2022), who observed that partial replacement of fish meal with moringa leaf meal significantly improved growth performance at moderate inclusion levels, but excessive inclusion reduced performance. This trend explains why T3 in the present study did not consistently outperform T2, suggesting that high levels of moringa may introduce anti-nutritional factors that limit nutrient utilization.

Furthermore, the improved growth performance in moringa-treated groups is consistent with the work of recent researchers who reported that supplementation of moringa leaf powder at optimal levels (around 10 g/kg) significantly enhanced weight gain, immunity, and gut health in *Clarias gariepinus*. This supports the observation that T2 produced the highest final weight in this study, indicating that moderate supplementation is optimal for growth.

In contrast, the higher length values observed in the control group (T0) in several weeks may suggest that while moringa enhances body mass, it may not always promote linear growth at the same rate. This observation is consistent with Eteng (2019), who reported that moringa-based diets

produced growth comparable to conventional feeds but did not always exceed the control in all growth parameters.

Additionally, the overall positive growth response observed in moringa-supplemented treatments can be attributed to the plant's rich nutritional composition, including proteins, vitamins, and bioactive compounds that enhance metabolism and health status. This is supported by Abo Habib et al. (2023), who reported improved growth rate and physiological health in *Clarias gariepinus* fed moringa-supplemented diets.

However, the fluctuating performance across treatments in early weeks (weeks 1–3) suggests an adaptation phase, where fish may require time to adjust to dietary inclusion of plant-based supplements. Similar adaptation effects have been reported in aquaculture nutrition studies involving plant additives. It is also important to note that the unusually high weight values (35.7 g) recorded for T0 in weeks 4 and 5 deviate from the general growth pattern and may represent experimental or recording error. Such inconsistencies should be verified, as they can affect interpretation of treatment effects.

CONCLUSION

The findings of this study indicate that the use of moringa (*Moringa oleifera*) seed powder in culture water significantly affects the growth performance and survival of *Clarias gariepinus* fingerlings. Among the graded levels tested, the application of 10 g/100 L (T2) produced the best results in terms of weight gain, length increase, and overall survival rate. This suggests that an optimal concentration of moringa seed powder can improve water quality and create a more favorable environment for fish growth. However, levels above or below this optimum were less effective, indicating the importance of proper dosage.

RECOMMENDATIONS

Based on the study the following recommendation are made:

i. Fish farmers should adopt the use of 10 g/100 L of moringa seed powder for culturing *Clarias gariepinus* fingerlings to achieve optimal growth and survival.
ii. Care should be taken to avoid under- or over-application, as deviations from the optimal level may reduce performance.
iii. Moringa seed powder should be promoted as a cost-effective and environmentally friendly water treatment option, especially in areas like Mubi, Adamawa State.
iv. Routine monitoring of water quality parameters should be carried out to ensure that the culture environment remains suitable for fish growth.
v. Further studies are recommended to validate this optimal level under different stocking densities, feeding regimes, and culture systems.

Table 1: Growth and Survival of *Clarias gariepinus fingerlings* after Seven Weeks

Parameter	Levels of *Moringa oleifera* seed powder				LSD
	T1 (0%)	T1 (5%)	T2(10%)	T3(15%)	
Mean initial weight(g)	2.66±0.33^{b}	2.77±0.67^{a}	2.59±0.67^{c}	2.74±0.33^{a}	0.68
Mean final weight (g)	16.40±0.67^{b}	16.18±0.00^{c}	17.36±0.02^{a}	16.51±033^{b}	0.17
Increase in weight (g)	13.73±0.66^{b}	13.41±0.67^{c}	14.77±0.67^{a}	13.77±0.00^{b}	0.37
Mean initial length cm	7.82±0.33^{b}	7.83±0.33^{a}	6.18±0.00^{b}	6.18±0.33^{b}	0.21
Mean final length cm	13.27±0.019^{a}	12.76±0.33^{c}	12.32±0.00^{d}	13.19±0.00^{b}	0.38
Increase in length cm	5.45±0.32^{c}	4.93±0.00^{d}	6.14±0.00^{b}	7.01±0.33^{a}	0.32

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Specific growth rate (SGR)	1.37±0.31[a]	1.27±0.07[c]	1.38±0.83[a]	1.30±0.00[b]	0.81
Condition factor (K)	0.70±0.18[c]	0.78±0.13[b]	0.93±0.39[a]	0.72±0.81[c]	0.36
% Motality	20.00±0.00[b]	13.33±0.33[d]	16.66±0.67[c]	30.00±0.0[a]	0.23
% Survival	80.00±0.00[c]	86.66±0.67[a]	83.33±0.33[b]	70.00±0.00[a]	0.13

Mean in the same row having the same super script do not differ significantly P ≤ (0.05), LSD = Least significant difference.

Table 2: Water Quality Parameters

Parameter	Levels of *Moringa oleifera* seed powder T1 (0%)	T1 (5%)	T2(10%)	T3(15%)	LSD
Dissolved Oxygen (mg/l)	3.50±0.00[a]	2.50±0.00[b]	0.50±0.00[c]	0.50±0.00[c]	0.00
Temperature (°C)	26.30±0.31[a]	25.61±0.42[b]	26.52±0.71[a]	26.15±71[a]	0.47
pH	7.50±0.00[b]	8.16±0.66[a]	8.00±0.00[a]	7.83±0.33[b]	0.33

Mean in the same row having the same super script do not differ significantly P ≤ (0.05), LSD = Least significant difference

Table 3: Growth and Survival of *C. gariepinus* Fingerlings with Different Concentration of Moringa Powder Seven Weeks

Weeks	Levels of *Moringa oleifera* seed powder T1 (0%)	T1 (5%)	T2(10%)	T3(15%)	LSD
One					
Length (cm)	9.82±0.33[a]	7.83±0.33[a]	6.18±0.00[b]	6.18±0.33[b]	0.69
Weight (g)	2.66±0.33[b]	2.77±0.67[a]	2.59±0.67[c]	2.74±0.33[a]	0.70
Two					
Length (cm)	8.48±0.00[a]	7.91±0.00[b]	7.76±0.00[c]	7.62±0.00[c]	1.00
Weight (g)	3.62±0.67[d]	3.90±0.00[b]	4.40±0.00[a]	3.73±033[c]	0.19
Three					
Length (cm)	9.96±0.00[a]	8.58±0.00[c]	8.32±0.00[c]	8.58±0.00[b]	1.00
Weight (g)	5.89±0.30[a]	5.67±0.70[b]	5.55±0.70[c]	5.26±0.00[d]	0.61
Four					
Length (cm)	10.00±0.00[a]	9.57±0.00[b]	8.96±0.03[c]	10.31±0.00[a]	1.00
Weight (g)	35.7±0.00[a]	10.16±0.00[a]	9.31±0.33[c]	10.08±0.00[b]	0.38
Five					
Length (cm)	11.28±0.00[b]	10.85±0.00[c]	9.46±0.00[d]	11.38±0.009	1.00
Weight (g)	35.7±0.00[a]	10.16±0.00[c]	9.31±0.33	10.05±0.00	0.38
Six					
Length (cm)	12.43±0.00[b]	12.44±0.00[b]	11.08±0.00[c]	12.52±0.09	0.56
Weight (g)	14.26±0.33[c]	15.16±0.00[b]	16.31±0.33[a]	15.71±0.67	0.86
Seven					
Length (cm)	13.27±0.01[a]	12.76±0.33[c]	12.32±0.01[d]	13.19±0.00[b]	1.00
Weight (g)	16.40±0.71[b]	16.18±0.00[c]	17.36±0.00[a]	16.51±0.33[b]	0.17

Mean in the same row having the same super script do not differ significantly P ≤ (0.05), LSD =Least significant difference

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