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Effects of Water Level on Growth, Nutrient Utilization and Survival of African Catfish, *Clarias gariepinus*

Adebola Oluyinka Ajiboye*, Adetunji Quadri Aremu

Department of Animal Science and Fisheries Management, Bowen University, Iwo, Osun State, Nigeria

Email address
debron2005@yahoo.com (A. O. Ajiboye)

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Abstract
Water level is a critical factor that should be taken into consideration in ensuring optimum growth, nutrient utilization and survival of fish species. This study was conducted to investigate the effects of water level on nutrient utilization, growth, survival of African catfish, *Clarias gariepinus*. 225 samples of *C. gariepinus* of mean weight 198.50g were randomly stocked at 15 fish per water volume and replicated thrice. Each treatment was assigned 10, 20, 30, 40 and 50 liters of water and denoted T1, T2, T3, T4 and T5 respectively. Water quality parameters of the water medium and growth parameters such as Mean weight gain (MWG), Specific growth rate (SGR), Feed conversion ratio (FCR), Survival rate (SR) and Protein efficiency ratio (PER) were determined according to standard procedures. The data collected were analyzed using analysis of variance (ANOVA) and Duncan's Multiple Range Test was used to separate the differences among the means. pH values of all the treatments were not significantly different. The water temperature of T4 and T5 were significantly higher $p<0.05$ than other treatments. Ammonia content of T1 varied significantly $p<0.05$ than other treatments. Dissolved oxygen content of T5 was significantly higher $p<0.05$ than other treatments. The SR, MWG, SGR and PER of T5 varied significantly $p<0.05$ than other treatments. Contrary to the above trend, the FCR of T5 was significantly lower among the treatments. The findings in this study suggest that water level is a crucial factor that must be achieved for optimum growth, nutrient utilization and survival of fish.

1. Introduction

Aquaculture production is primarily determined by availability of water for culture of different aquatic organisms. Many fish farming culture systems have been jeopardized due to non availability of water for culture of fish. Aquaculture production can be boosted through good site for construction of standard pond, provision of quality feeds, quality water and management skills. Nevertheless, water level is a crucial factor that must be considered, as this determines the growth, survival, yield and the well being of the fish. Several findings had been reported by researchers on the effects of water level on survival, growth, behavior of different fish species ((Einarsdóttir & Nilssen, 1996; Thomas et. al., 1999; Flodmark et. al., 2002; Flodmark et. al., 2004; Bukat et. al. 2012). The impact of water level fluctuations on the species communities has been widely studied in rivers, lakes and reservoirs (Kahi et. al., 2004). Despite several studies had been conducted on effects of water level on fish growth, little or no information has been documented on the water level required for culture of *Clarias gariepinus*. This study was conducted to investigate the

effects of water level on nutrient utilization, growth and survival of African catfish, *C. gariepinus*.

2. Materials and Methods

The study was conducted in the department of Animal Science and Fisheries management Laboratory, Bowen University Iwo Osun state, Nigeria. A total of 225 samples of *C. gariepinus*of mean weight 198.50g were obtained from a private farm in Ibadan, Oyo State. The fish samples were transported inside 25 liters container. The fish samples were acclimatized in the laboratory for a week before the commencement of the experiment. The fish samples were stocked at 15 fish per different water volume (10, 20, 30, 40 and 50 liters of water) and were allotted T1, T2, T3, T4 and T5 respectively. Each treatment was replicated thrice. Water was changed every day in each treatment. Fish samples were fed at 5% biomass. The fish samples were weighed fortnightly and the new weights were used to adjust the quantity of feed fed to the fish.

2.1. Monitoring Of Water Quality Parameters

The water medium was aerated using an electronic aerator of model PAI. Water samples were analyzed weekly to determine water quality parameters (water temperature, dissolved oxygen, ammonia and pH). The pH of the water was determined using a digital pH meter Suntex (model TS-2). Water temperature was measured with mercury in glass thermometer. The reading was taken by dipping the thermometer in water to a depth of 0.5 m. Other water quality parameters were determined according to the procedures described by American Public Health Association (1992).

2.2. Growth Parameters of the Fish

Growth parameters such as mean weight gain (MWG), specific growth rate (SGR), feed conversion ratio (FCR), Survival rate (SR) and protein efficiency ratio (PER) were calculated as follows:

i. $MWG = W_2 - W_1$

Where:

W_2= Mean final weight of fish

W_1= Mean initial weight of fish

ii. SGR was calculated as:

$$SGR = \frac{\ln W_2 - \ln W_1}{T_2 - T_1} \times 100$$

Where:
W_2= Mean final weight
W_1= Mean initial weight
T_2=Final day of the feeding trial period
T_1= Initial day of the feeding trial period

iii. FCR= Total feed consumed by fish (g) / Weight gain by fish (g)

iv. PER = Body weight gain (g) / Protein intake (g).

v. Survival rate=Fish quantity at the end of the experimental period/Fish quantity at the beginning of the experimental period × 100.

2.3. Statistical Analysis

Data was subjected to one- way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test for the separation of means at a significance level ($p<0.05$).

3. Results and Discussion

The water quality parameters of the water medium are presented in Table 1. The physical and chemical properties of water determine the quality of the water, growth and well being of aquatic organisms. pH values recorded in this study ranged between 6.90 (T1) to 7.06 (T2). The values recorded for pH were not significantly different among the treatments. In this present study, the range reported is in agreement with the findings of Pedapoli and Ramudu (2014) and Ajiboye et. al., (2015). Normally, negative values are recorded for pH when other water quality parameters are negative. It would be expected that water medium with low water level would be acidic, but in this study, the pH was within the tolerable level recommended for tropical fishes. Water temperature is one of the most important physical factors affecting fish growth and production (Gaber et. al., 2012). The water temperature of the water medium during the study ranged between 21.67^0C (T1) and 24.33^0C (T5). The water temperature of T4 and T5 were significantly higher $p<0.05$ than other treatments. These values are not in agreement with the findings of Santhosh and Singh (2007), who reported 24^0C to 30^0C for the culture of carp. Water levels determine the rate of metabolic activities in fish. Fish subjected to low water level are prone to experience low metabolism, while high water level increases metabolic activities in fish. In this study, there was a significant increase in water temperature with increasing water level. The ammonia content of the water in T1 varied significantly $p<0.05$ compared to other treatments. Moogouel et. al., (2010), investigated the effects of the selected physico-chemical parameters on growth of rainbow trout (*Oncorhynchus mykiss*) and reported higher values (1.25mg/l-4.63mg/l). It was evident in this study that, the highest water level contained the lowest concentration of ammonia. Ammonia becomes toxic to fish when there is reduction in the level of dissolved oxygen. This explains the reason for significant increase recorded in the concentration of ammonia in T1. The dissolved oxygen content recorded in this study ranged between 3.43mg/l (T1) and 6.50mg/l (T5). Statistics showed that T5 was significantly higher than other treatments. Physico-chemical analysis of fish pond water in freshwater areas of Bayelsa State, Nigeria, was determined by Keremah et. al. (2014). These authors reported a range of 2.8mg/l to 6.6mg/l. Apparently, in this study, the highest water level contained the highest

concentration of dissolved oxygen. It is worthy of note that high water level with quality water has more dissolved oxygen than low water level. The parameters calculated during the feeding trial are shown in Table 2. The MWG recorded during this study ranged between 7.41g (T2) and 14.02g (T5). The highest MWG value recorded in T5 was significantly higher $p<0.05$ than other treatments. Apparently, the SGR further indicated that T5 varied significantly $p<0.05$ compared to other treatments. It was very obvious in this study that MWG and SGR increased significantly with increasing water levels from 10 liters to 50 liters. This may be attributed to the level of dissolved oxygen that also increased with increasing water levels and ammonia level that decreased with increasing water level. Dahlberg et. al., (1968), investigated the influence of oxygen and carbon dioxide on swimming performance of largemouth bass and coho salmon and reported that fish growth and feed intake were adversely affected by low dissolved oxygen. FCR determines the amount of feed that is converted to flesh. FCR values recorded indicated that T1 (0.91) and T2 (0.92) were significantly higher than other treatments. The PER values ranged between 3.11 (T2) and 4.50 (T5). The value recorded for T5 was significantly higher than other treatments. The values of FCR and PER recorded in this study were efficiently achieved with increasing water level. This report was in line with the findings of Flodmark et. al., (2004), who reported that juvenile brown trout exposed to high stable water level showed higher feed intake and growth rate than those exposed to fluctuating or low water level. The percentage survival calculated revealed that the lowest (60%) and highest (100%) values were recorded in T1 and T5 respectively. Analysis further confirmed that T5 was significantly higher $p<0.05$ than other treatments. The highest survival rate in this study was obtained at increasing water level, dissolved oxygen, feed conversion ratio and protein efficiency ratio. The lowest survival rate recorded in this study was as a result of stress caused by low dissolved oxygen, feed conversion ratio and protein efficiency ratio.

Table 1. *Effects of Water Level on Water Quality Parameters.*

No	Parameters	T1	T2	T3	T4	T5
1	pH	6.90	7.06	7.00	7.00	7.00
2	Temperature	21.67^{b}	22.67^{b}	23.67^{ab}	24.0^{a}	24.33^{a}
3	Ammonia	0.70^{a}	0.50^{b}	0.34^{c}	0.30^{d}	0.22^{e}
4	Dissolved Oxygen	3.43^{a}	3.83^{a}	4.20^{b}	4.93^{b}	6.50^{c}

Mean with the same superscript are not significantly different.

Table 2. *Growth Parameters of Clarias gariepinus subjected to Different Water volumes Level.*

PARAMETERS	T1	T2	T3	T4	T5
MIW	13.24^{a}	13.24^{a}	13.23^{a}	13.22^{a}	13.22^{a}
MFW	54.16^{b}	51.14^{cb}	48.31^{c}	49.22^{c}	59.78^{a}
MWG	7.80^{c}	7.41^{c}	7.70^{c}	9.41^{b}	14.02^{a}
SGR	2.30^{b}	2.16^{ba}	2.11^{a}	2.11^{a}	2.42^{c}
FCR	0.91^{c}	0.92^{c}	0.88^{c}	0.87^{b}	0.70^{a}
PER	3.20^{dc}	3.11^{d}	3.24^{c}	3.81^{b}	4.50^{a}
SR	60.00^{d}	62.22^{d}	68.91^{c}	86.71^{b}	100.00^{a}

Mean with the same superscript are not significantly different.

4. Conclusion

The findings in this study have practically shown that water quality parameters that determine the well being of the fish were affected by water level. In this study, *Clarias gariepinus* achieved the best growth and survival at highest water level. There is need for future research to be carried out on water level required for culture of different fish species.

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