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Effects of water exchange on water quality parameters, nutrient utilization and growth of African catfish (*Clarias gariepinus*)

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This experiment investigated the effects of water exchange on water quality parameters and growth of *Clarias gariepinus*. 225 *C. gariepinus* of mean weight 2.60 ± 0.01 g were stocked at 15 fish per treatment in three replicates. Water quality and growth parameters such as mean weight gain (MWG), specific growth rate (SGR), food conversion ratio (FCR) and protein efficiency ratio (PER) were calculated using standard procedures. pH of T3 (9.15) was significantly higher p<0.05 than other treatments. Dissolved oxygen indicated that T5 (3.45 mg/l) was significantly lower than other treatments. The ammonia values revealed that T5 (0.08 mg/l) was significantly higher p < 0.05 than other treatments. MWG of T1 (29.43 g) and T2 (27.77 g) were significantly higher p < 0.05 than T3, T4 and T5. SGR and PER of T1 (2.26%), (5.74) and T2 (2.22%) (5.31) increased significantly p < 0.05 than other treatments. The FCR of T1 (0.40) and T2 (0.42) were significantly lower than other treatments. It was evident in this study that exchange of water has an increase or decrease in the state of water quality parameters and growth of a fish.

Key words: Water exchange, water quality parameters, fish carcass, growth parameters, *Clarias gariepinus*.

INTRODUCTION

The present trend of global food security in aquaculture which is focused on increasing the protein intake of every individual can only be attained through proper water management. In ensuring optimum nutrient utilization of diets and growth of tropical freshwater fishes, fish culturists must endeavour to monitor water quality parameters. The optimum production in fisheries sector is majorly dependent on the physical, chemical and biological qualities of water (Bhatnagar and Devi, 2013). It is very apparent that the health and subsequent growth of fish are directly related to the quality of water in which the fish are raised (Viadero, 2005). Fish metabolites produced as a result of biological activities and decomposition of uneaten feeds have adverse effects on the quality of water, health status and growth of the fish. Water quality parameters like dissolved oxygen, pH, turbidity, alkalinity, ammonia, temperature and other factors such as biological oxygen demand and chemical oxygen demand indicate the pollution level of given water body (Ehiagbonare and Ogundiran, 2010). It is therefore very important to note that, successful pond management requires an understanding of water quality (Bhatnagar and Devi, 2013). Water is the home of the fish and its quality has been overlooked in fish management

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Table 1. Water quality parameters' values.

Parameter	T1	T2	T3	T4	T5
pH	6.60 ± 0.62[c]	8.05 ± 1.83[ba]	9.15 ± 1.00[a]	7.58 ± 1.38[b]	8.76 ± 1.07[ba]
Dissolved oxygen	4.33 ± 1.49	5.32 ± 2.50	4.57 ± 1.05	4.03 ± 1.28	3.47 ± 0.50
Ammonia	0.01 ± 0.01[a]	0.03 ± 0.02[a]	0.05 ± 0.01[a]	0.06 ± 0.02[b]	0.08 ± 0.02[b]

Means ± S.E. with same superscript were not significantly different ($p > 0.05$).

(Keremah et al., 2014). The role of water quality parameters cannot be overlooked for maintaining a healthy aquatic environment and for the production of sufficient food organisms in ponds for increasing fish production (Bhatnagar and Devi, 2013). Aquaculture productivity is determined by physic-chemical characteristics of water body (Huct, 1986). The determination of physicochemical parameters of waters in the effluents discharged from fish farms and their environmental impacts will go a long way to help fish farmers to manage and develop their waste water systems (Pulatsu et al., 2004). The production of aquatic organisms in water bodies has faced many challenges because knowledge of water quality parameters has been neglected by fish culturists.

The objective of this study was to investigate the effects of water exchange on water quality parameters (such as pH, water temperature, dissolved oxygen, ammonia) nutrients utilization and growth of *Clarias gariepinus.*

MATERIALS AND METHODS

A total number of 225 *C. gariepinus* of mean weight 2.60 ± 0.01 g were purchased from a reputable farm in Ibadan, Oyo State, Nigeria. The fish samples were transported inside 50 L container. The fish samples were acclimatized before the commencement of the experiment for a period of two weeks in the laboratory. The fish samples were randomly assigned to five treatments and stocked at 15 fish per treatment in three replicates inside 50 L experimental bowls. The allotted fish samples were daily fed for a period of 12 weeks at 5% biomass.

The fish samples were fed three times daily (7.00 am, 12.00 noon and 6.00 pm) with 2 mm Duratee pelleted feeds. Fish feeding rates were adjusted every week after measuring the total biomass of each treatment. Water was changed every day in T1 and was allotted as control while in other treatments water was changed every 2, 3, 4 and 5 days and the treatments were allotted T2, T3, 4 T4 and T5, respectively. Water samples were collected fortnightly to determine water quality parameters. The pH of the water was determined using a digital pH meter Suntex (model TS-2). Dissolved oxygen was determined using dissolved oxygen meter (model Jenway DO 9071). The dissolved oxygen meter was standardized by using saturated potassium chloride and zero solutions. The analytical determination of ammonia was determined according to the standard methods of American Public Health Association APHA (1992).

After the feeding trial experiment, the following nutrient utilization and growth parameters were determined: Mean weight gain was calculated according to Ishwata (1969), by subtracting mean final weight (g) from mean initial weight (g). SGR = (LnW2 – LnW1) / T2−T1 × 100 (Brown, 1957). Where LnW2 and LnW1 are mean final weight and mean initial weight. T2 and T0 are final day of the experiment and initial day of the experiment, respectively. FCR was determined as described by Hepher (1988). FCR = Total feed consumed (g)/Weight gain by fish (g). PER was calculated according to the method of Zeiotoun et al. (1973). PER = Weight gain (g)/Protein intake

Statistical analysis

The data collected were analyzed using Statistical Package for Social Sciences (SPSS), Version 11, 2001 and Statistical Analysis Software (SAS), Version 8, 2001. Duncan's Multiple Range Test was used to compare the differences among the means. The significant level was set at 5%.

RESULTS

The water quality parameters results are presented in Table 1. The pH values ranged between 6.60 and 9.15. The pH value of T1 (6.60) was significantly lower compared to other treatments, while T3 (9.15) was significantly higher $p < 0.05$ than other treatments. The values recorded for dissolved oxygen indicated that T5 (3.47 mg/l) was significantly lower than other treatments. The ammonia values in this study revealed that T5 (0.08 mg/l) was significantly higher $p < 0.05$ and T1 was significantly lower than other treatments. The effects of water exchange on nutrient utilization and growth of *C. gariepinus* are shown in Table 2. The MWG values ranged between 21.30 g and 29.43 g. The MWG of T1 (29.43 g) and T2 (27.77 g) were significantly higher ($p < 0.05$) compared to other values recorded in T3 (21.30 g), T4 (21.67 g) and T5 (21.80 g). The SGR ranged between 1.99 and 2.26%. The values recorded for SGR in T1 (2.26%) and T2 (2. 22%) increased significantly $p < 0.05$ compared to other treatments. The FCR recorded in this experiment ranged between 0.40 and 0.52. The FCR of T3 (0.52), T4 (0.51) and T5 (0.51) increased significantly $p < 0.05$ than T1 (0.40) and T2 (0.42). The PER values ranged between 4.36 and 5.74. The PER of T1 (5.74) and T2 (5.31) were significantly higher $p < 0.05$ than other treatments.

DISCUSSION

pH is an indicator that determines the quality of water

Table 2. Nutrient utilization and growth of *Clarias gariepinus*.

Parameter	T1	T2	T3	T4	T5
Mean initial weight	2.60 ± 0.01	2.60 ± 0.01	2.60 ± 0.01	2.60 ± 0.01	2.60 ± 0.01
Mean final weight	3 2.03 ± 6.25	30.37 ± 4.71	23.90 ± 4.55	24.27 ± 4.28	24.40 ± 6.16
Mean weight gain	29.43 ± 6.25^{a}	27.77 ± 4.71^{a}	21.67 ± 4.28^{b}	21.30 ± 4.55^{b}	21.80 ± 6.16^{b}
Specific growth rate	2.26 ± 1.16^{a}	2.22 ± 0.13^{a}	2.01 ± 0.16^{ab}	1.99 ± 0.18^{b}	2.04 ± 0.24^{ab}
Feed conversion ratio	0.40 ± 0.08^{b}	0.42 ± 0.06^{b}	0.51 ± 0.10^{a}	0.52 ± 0.13^{a}	0.51 ± 0.16^{a}
Protein efficiency ratio	5.74 ± 0.05^{a}	5.31 ± 0.03^{a}	4.36 ± 0.06^{b}	4.37 ± 0.08^{b}	4.57 ± 0.07^{b}

Means ± S.E. with same superscripts were not significantly different ($p > 0.05$).

required for aquaculture production. The range of pH values obtained in this study agreed with studies of Wurts and Durborow (1992) and Bhatnagar and Devi (2004). They recommended that optimum pH level in ponds should be between 6.5 and 9. The significant value recorded in T1 could be attributed to regular change of water which ensures optimum level of hydrogen ions and hydroxyl anions in the culture media. Similarly, the dissolved oxygen values are within the range (3.30 to 12 mgl^{-1}) reported by Moogouel et al., (2010). The lowest value of dissolved oxygen reported in T5 could be attributed to the fact that, there was no regular exchange of water in the culture media. The available dissolved oxygen had been utilized by the fish. Dissolved oxygen required by aquatic organisms in any culture media could be determined by constant water exchange in the culture media at optimal levels. The ammonia values in this experiment were extremely low compared to the values (1.25 to 4.63 mgl^{-1}) recorded by Moogouel et al. (2010). This report could be traced to drastic reduction of dissolved oxygen in T5 which might have culminated to stress in the fish.

In this experiment, the specific growth rate did not agreed with the range recorded by Kasi et al. (2011) and Jalili et al. (2013) who recorded a range of 1.42 and 6.59 for Cobia (*Rachycentron canadum*). In any experiment, the specific growth rate of any fish is subjected to various factors like weight gain, average feed intake, condition factor and water quality parameters of the culture media. The FCR recorded in this experiment did not corroborate with the findings of Kasi et al. (2011) and Nadir et al. (2007) who reported values that ranged between 1.00 and 1.35 and 1.45 and 1.77, respectively. The major aim of an experiment could affect the FCR value of the fish. Since water exchange was the main objective of this experiment, water exchange and water quality parameters are critical factors that determines how much of the diets are converted to fish flesh. It is evident that problems encountered as a result of poor water quality parameters may result to low appetite which eventually affects conversion of the feeds into flesh. The PER values (0.4 to 0.8) reported by Gaber et al. (2012) in Tiger shrimp (*Penaeus semisulcatus*) was considerably lower than values recorded in this study.

The culture media of any experiment determines the quality of the water which also affects how efficient the protein in the diet is adequately utilized by the fish. Whenever there is poor water quality parameters, the fish species are stressed and this affect the utilization of the protein in the diet. The disparity of these values could be attributed to the fact that the controlled water exchange rate in the laboratory in this experiment gave a higher PER values than the water exchange for the Tiger shrimps carried out in the earthen ponds.

The results recorded in this study indicate that water exchange is a critical factor that should be considered in ensuring good water quality parameters, nutrient utilization of diets and growth of fish.

REFERENCES

APHA (1992). Standard Methods for the examination of waste water, 18 th Edn. American Public Health Association, Washington D.C. pp.874.

Bhatnagar A, Devi P (2013). Water quality guidelines for the management of pond fish culture. Int. J. Environ. Sci. 3(6): 1980-2009.

Brown ME (1957). Experimental studies on growth. The physiology of Fishes. 1: 360-400.

Ehiagbonare JE, Ogundiran YO (2010). Physico-chemical analysis of fish pond waters in Okada and its environs, Nigeria. Afr. J. Biotechnol. 9(36): 5922-5928.

Gaber MM, Omar EA, Abdel-Rahim M, Nour AM, Zaki MA, Srour TM (2012). Effects of stocking density and water exchange rates on growth performance of Tiger Shrimp, *Penaeus semisulcatus* cultured in earthen ponds. J. Aquacul. Res. Dev. 3(6): 1-5.

Hepher B (1988). Nutrition of pond fishes. Cambridge University Press. UK., pp 388.

Huct M (1986). Textbook of fish culture 2 nd Edn. Fish News Book Ltd., England. Vide Study on the Physicochemical properties of water of Mouri River, Khulna Bangladesh, Pak. J. Biol. Sci., 10(5): 710-717.

Ishwata N (1969). Ecological studies on the feeding of fishes. Frequency of feeding and growth. Bulletin Jan. Soc. Sci. Fish. 35: 985-989.

Jalili R, Tukmechi A, Agh N, Noori F, Ghasemi A (2013). Replacement of dietary fish meal with plant sources in rainbow trout *(Oncorhynchus mykiss*); effect on growth performance, immune responses, blood indices and disease resistance. Iranian J. Fisheries Sci. 12(3): 577-591.

Kasi M, Ramachandram U, Sundararaman M, Rathinam X, Sathasivam K (2011). Effect of different feed application rate on growth, survival and cannibalism of African catfish, *Clarias gariepinus* fingerlings. Emir. J. Food Agric. 23(4): 330-337.

Keremah RI, Davies OA, Abezi ID (2014). Physico-Chemical Analysis of

Fish Pond Water in Freshwater Areas of Bayelsa State, Nigeria. Greener J. Biol. Sci. 4(2): 33-38.
Moogouel R, Karbassi AR, Monavari SM, Rabani M1, Taheri MA (2010). Effect of the selected physico-chemical parameters on growth of rainbow trout (*Oncorhynchus mykiss*) in raceway system in Iran. Iranian J. Fisheries Sci. 9(2): 245-254.
Nadir B, Eyüp Ç, Yahya Ç, Nilgün A (2007). The Effect of Feeding Frequency on Growth Performance and Feed Conversion Rate of Black Sea Trout (Salmon trutta labrax Pallas, 1811). Turk. J. Fisheries Aquat Sci. 7: 13-17.
Pulatsu S, Rad F, Aksal G, Aydin F, Benil AC, Topcu A (2004). The Impact of Rainbow Trout Farm Effluents on Water Quality of Karasu. Turk. J. Fish. Aquat. Sci. 4: 09-15.
Viadero RC (2005). Factors Affecting Fish Growth and Production. Water Encyclopedia. 3:129–133.
Wurts WA, Durborow RM (1992). Interactions of pH, Carbon Dioxide, Alkalinity and Hardness in Fish Ponds Southern Regional Aquaculture Center, SRAC Publication No. 464.
Zeiotoun IH, Jack I, Halver JF Ulray DF (1973). Influence of salinity on protein requirements. J. Fish Res. Board. Can. 30: 1867-1873.