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Influence of Culture Water Draw-off on Growth of the African Catfish *(Clarias gariepinus, Burchell 1822)* cultured under Integrated System

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Abstract

An experiment was carried out over a period of 10 weeks to investigate the influence of culture water draw-off on growth and feed utilization of the African catfish. Two similar fish culture tanks (designated A and B) were stocked with juveniles of African catfish at 43 fish per m^3. The fish were fed twice daily at 3 % body weight. 0.06 $m^3$of culture water was removed at 3-day intervals from tank B to irrigate Okra plot and the tank was replenished with an equal amount of freshwater. Culture water was not removed from tank A till both tanks were replenished with freshwater at 14-day intervals. Selected water quality, growth and feed utilization parameters were measured just before replenishing. The selected water quality parameters were within the recommended range for fish culture except for nitrite and dissolved oxygen. The water quality, growth performance and feed utilization parameters were better in tank B, with periodic culture water removal than in tank A, without water draw-off. Average final weight, weight gain, daily weight gain, specific growth rate, percentage survival and feed conversion ratio were; 165.06 g, 95.07 g, 1.36 g/day, 0.01 %/day, 95.30 % and 2.40 in tank A and 238.22 g, 171.62 g, 2.45 g/day, 0.02 %/day, 94.87 % and 1.82 in tank B respectively. Periodic draw-off of culture water had positive effect on the cultured fish as evident in better performance indices recorded in this study.

Keywords: Integrated aquaculture, Wastewater, African catfish, Growth performance, Feed Utilization

Introduction

The achievement of sustainability goals of food production and reducing negative environmental impact has been difficult because of the existence of trade-offs between them (Naylor, 2008). Thus, there is a need for a suitable agricultural system to meet the increasing demand for food, and also maximize the utilization of the available limited resources without much wastage (Gabriel *et al*., 2007). Integrated aquaculture has been identified as one of such ecosystem friendly agricultural systems. Integrated farming involves the use of waste product from one activity for production of another product. For instance the wastewater from fish culture systems can be used to increase the fertility of the soil to improve plant growth. Farms using integrated system have the tendency of relatively cheaper production than farms where activities are done separately. Water scarcity is emerging as an international challenge and its most efficient management is in recycling of water used for integration (FSD, 2009).

The multiple use of farm water resources for aquaculture can result in many environmental benefits. Aquaculture practice can be integrated into a farming system before the water is used for its primary purpose, such as irrigating crops or pastures (Oribhabor and Ansa, 2006). In this way, nutrients are also added in organic form to the water before irrigation, which may subsequently reduce the need for additional inorganic fertiliser application.

Fish culture can be integrated with several systems for efficient resource utilization. Integrated fish farming is one of the best examples of mixed farming. On farm waste recycling, an important component of integrated fish farming is highly advantageous to farmers as it improves the economy of production and decrease the adverse environmental impact of fish farming (Charyulu and Biswas, 2010). The integration of aquaculture with crop farming ensures resource utilisation, recycling of farm waste, employment generation and economic development. Integrated fish farming promote the optimal utilization of waste material in order to produce protein for human consumption. It is important to developing countries especially Nigeria that is interested in food security, economic development and finding a lasting solution to unemployment problems in rural areas (Eyo et *al.*, 2003). Integrated agriculture is expected to be mutually beneficial to all products involved in the system. While the benefits (soil fertility improvement from nutrients rich fish culture wastewater) derived by crops in an integrated aquaculture cum crop agriculture system is obvious, the benefits to fish in the system are relatively unknown or undocumented. Therefore this study was carried out to investigate the effect of periodic fish culture water removal (or wastewater draw-off) on growth performance and feed utilization of the African catfish cultured under integration system.

Materials and Methods

A 10-week fish culture experiment was carried out using facilities at the Oyo State Fisheries Department, Agodi, Ibadan, Oyo state Nigeria. Two similar concrete tanks with water volume of $5.5m^3$ each (maintained throughout the study) were used for the experiment. Post juveniles of *Clarias gariepinus* (Burchell 1822) were stocked at 43 fish per m^3 in each tank. The fish were fed twice daily with 2 mm floating feed for the first four weeks and 3-5 mm pelletized sinking feed for the remaining six weeks of culture at 3 % body weight. Culture water of 0.06 m^3 was drawn-off from one tank, experimental tank B, every three days to irrigate okra plots established adjacent to the tanks and the water was replenished with fresh water. The culture water in tank A was not removed until both tanks were refreshed with fresh water every two weeks.

Water quality parameters namely pH, temperature, potassium, dissolved oxygen (DO), phosphates, nitrate, nitrites and ammonia were monitored regularly in the two tanks every 14 days just before refreshing with fresh water. The water samples were collected between 7.30 to 9.30 am and determination of the selected parameters done in line with the procedures of AOAC (2005). Fish in each tank were sampled every two weeks for growth parameters including average weight gain, average daily weight gain, specific growth rate, percentage survival and feed conversion ratio (FCR), in line with the procedures of

Ridha and Cruz (2001).The mean and standard deviation of the fish growth and water quality parameters were determined using descriptive statistics, while the differences in water quality parameters between the two tanks were tested using t-test.

Results and Discussion

Water quality parameters

The mean values of selected water quality parameters for the two experimental tanks are as shown in Table 1. The mean pH obtained in the tank A and tank B during the study were 7.33±0.41 and 7.08±0.66 respectively. pH values in the two tanks did not show any significant difference ($P>0.05$). The mean pH values recorded fell within the acceptable range for fish culture, growth and survival as reported by Omitoyin (2007). Mean temperature value obtained in tank A was 27.75±0.76 °C and tank B was 27.68±0.72 °C. Generally, the water temperature recorded in this study agreed with the report of Gabriel *et al*. (2007).

The mean phosphate values obtained during the study were 7.82±8.93 mg/l and 6.57±7.02 mg/l in tanks A and B respectively. Phosphate values recorded during the course of the experiment showed no significant difference ($P>0.05$). The mean potassium value obtained in tank A was 6.47±6.35 mg/l while that of tank B was 4.91±5.34 mg/l. The potassium values obtained in the tanks showed wide variations during the study. Potassium values in the two tanks as obtained in this study showed no significant difference ($P>0.05$).The mean value of potassium recorded in this study fell within the acceptable range of fish culture 0-75 mg/l (Viveen *et al*., 1986).

The mean ammonia value obtained in tank A was 0.34±0.23 mg/l and that of tank B was 0.36±0.10 mg/l. The ammonia values obtained for the tanks did not show wide variation during the study though the difference was significant ($P<0.05$). This result agrees with the report of Viveen *et al.* (1986). The mean dissolved oxygen (DO) in tanks A and B during the study were 3.27 ± 0.61 mg/l and 3.37±0.66 mg/l respectively. DO recorded among the two tanks throughout the period of the experiment showed no significant difference ($P>0.05$).

Tank B with culture and wastewater draw-off for irrigation purpose showed better water quality especially in terms of the parameters that are indicative of metabolic wastes; phosphate, potassium, ammonia, nitrite and nitrate. The mean concentrations of these parameters were comparatively lower in tank B with periodic water removal than the values recorded in tank A. The mean dissolved oxygen content in tank B, 3.37±0.66 mg/l, was higher than the mean value of 3.27±0.66 mg/l recorded in tank A. Though the two culture tanks had DO below the 5 mg/l commonly recommended as optimum level for warm water fish culture, the values were still within the range that can be tolerated by *Clarias gariepinus*. Aside the dissolved oxygen and nitrite, all the water quality parameters were within the levels recommended for fish culture by Omitogun (2007). The significant difference observed in protein metabolites (ammonia, nitrate and nitrite) between the two culture systems can be associated with frequent removal of wastewater and replenishing with freshwater in tank B, which may have effect on the performance of the fish cultured in the tanks.

Table 1: Mean values of selected water quality parameters in the experimental fish culture tanks

Parameters	Tank A (without water removal)	Tank B (with periodic water removal)
pH	7.33±0.41	7.08±0.66
Temperature (^{0}C)	27.75±0.76	27.68±0.72
Phosphate (mg/l)	7.82±8.93	6.57±7.02
Potassium (mg/l)	6.47±6.35	4.91±5.34
Dissolved Oxygen (mg/l)	3.27 ± 0.61	3.37±0.66
Ammonia (mg/l)	$0.38±0.23^a$	$0.36±0.10^b$
Nitrite (mg/l)	$1.04±0.22^c$	$1.03±0.35^d$
Nitrate (mg/l)	$16.33±4.94^e$	$11.92±2.25^f$

Different superscripts along the row indicate significant differences ($P<0.05$)

The growth performance and feed utilization parameters recorded during the period of the experiment are shown in Table 2. Average final weight was 165.06±0.45 g in tank A and 238.22±0.26 g in tank B. Mean weight gain was 95.07±0.51 g in tank A and 171.62±0.54 g in tank B while mean daily weight gain was 1.36±0.04 g/day in tank A and 2.45±0.21 g/day in tank B. The differences in these values were statistically significant ($P<0.05$). Specific growth rate was 0.01 %/day in tank A and 0.02 %/day in tank B. Percentage survival was 95.30 % in tank A and 94.87 % in tank B. FCR was 2.40 in tank A and 1.82 in tank B. All the growth parameters were better in tank B where wastewater was periodically drawn for irrigation than in tank A, without wastewater draw-off. The better growth performance in tank B may be associated with better water quality experienced by fish cultured in tank B. The nutrient utilization was also better in tank B than in A. These results are in line with the submission of Akinwole and Adeola (2012), who reported that water quality parameters affected respiration, feeding, metabolism, reproduction and hence the optimum growth of the cultured organisms. Generally, the growth of *Clarias gariepinus* in the two culture systems could be regarded as good. The specific growth rate, FCR and survival rate were better than the values of 0.058 %/day, 2.45 and 91.20 % respectively, reported in a study with *C.gariepinus* fingerlings by Jamabo and Keremah (2009).

Table 2: Growth and feed utilization parameters of the African catfish cultured in experimental tanks without (A) and with (B) periodic water drawoff.

Parameters	Tank A (without water removal)	Tank B (with periodic water removal)
Stocking density (fish/m3)	42.5	42.5
Duration (days)	70	70
Average initial weight (g)	69.99±0.82 [a]	66.66±0.67 [a]
Average final weight (g)	165.06±0.45 [b]	238.22±0.26 [c]
Average weight gain (g)	95.07±0.51 [d]	171.62±0.54 [e]
Average daily weight gain (g/day)	1.36±0.04 [f]	2.45±0.21 [g]
Specific growth rate (%/day)	0.01 [h]	0.02 [h]
Percentage survival	95.30 [g]	94.87 [g]
Feed conversion ratio	2.40	1.82

Different superscripts along the row indicate significant differences ($P<0.05$)

Conclusion

The results of this study showed that wastewater draw-off from fish culture system had positive effect on the growth and feed utilization of the cultured organism. It has thus encouraged integrated culture systems because water, an important resource, can put to effective use by dual purpose of fish culture and crop irrigation.

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References

Akinwole, A.O. and Adeola I.O. (2012). Interrelationship of Temperature, pH, Dissolved Oxygen and Nitrogenous waste in Fish culture systems. *Nigerian Journal of Rural Extension and Development. 6: 38-42.*

Association of Official Analytical Chemists (2005). Official Methods of Analysis. 18th ed. AOAC International, Gaithersburg, MD pp 49.

Charyulu, D.K. and Biswas, S. (2010). Organic Input Production and Marketing in India – Efficiency, Issues and Policies. CMA Publication No –239. 258pp

Eyo, A. A., Ayanda, B. A, and Adelowo, E. O. (2003). Economic Prospect of Investment in Integrated Fish cum Livestock Farming .NIFFR. *Annual Report* pp 92-97.

Farming Systems Design (FSD) 2(009). Methodologies for Integrated Analysis of Farm Production Systems. *Proceedings of an International symposium held August 23-26 2009 - Monterey, CA.*

Gabriel, U. U., Akinrotimi, O. A., Bekibele D. O., Anyanwu, P. E. and Onunkwo D. N. (2007). Economic Benefit and Ecological Efficiency of Integrated Fish Farming in Nigeria. *Scientific Research and Essay*. 2 (8): 302-308.

Jamabo, N. A. and Keremah, R. I. 2(009). Effects of Stocking Density on the Growth and Survival of the Fingerlings of *Clarias gariepinus* (Burchell, 1822). *Journal of FisheriesInternational 4 (4): 55-57.*

Naylor, R. L. (2008). Managing food production systems for resilience. In: Chapin F.S., Kofinas G.P., Folke C. (eds) Principles of Natural Resource Stewardship: Resilience-based Management in a Changing World. Springer, New York, pp 259–280.

Omitoyin, B. O. 2007. Introduction to Fish Farming in Nigeria. Ibadan University Press, Ibadan, Nigeria, pp 89.

Oribhabor, B. J and Ansa, E. J. (2006). Organic waste reclamation, recycling and re-use in integrated fish farming in the Niger Delta. *J. Appl. Sci. Environ. Mgt.* 10 (3): 47 – 53.

Ridha, M. T. and Cruz, E. M. (2001). Effect of Biofilter Media on Water Quality and Biological Performance of the Nile Tilapia *Oreochromis niloticus* L. reared in a simple Recirculating System. *Aquacult. Eng.*24 (2): 157 – 166.

Viveen,W. J., Richter, J. J., and Vanoordt, P. G. (1986). Practical Manual for the culture of African catfish, *Clarias gariepinus.* Section for Research and Technology, Agriculture University of Wageningen. The Hague, Netherlands pp 94.