140 Comparative Evaluation of Growth Performance of African Catfish Juvenile Reared in Solar-Powered Aquatronics and Conventional Aquaculture Systems

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Abstract

A research was conducted to compare growth performance of C. gariepinus juvenile (50.14g) reared under aquatronics system (Auto-feeding-auto-water recycling) and conventional (manual-feeding-manual-water-recycling system). The results obtained showed significant difference (P<0.05) for the two systems. The mean weight gained for the aquatronics system was significantly (P<0.05) higher (157.81g) than the conventional system (101.83g), the Specific growth rate (SGR) and feed conversion ratios (FCR) were also significantly different (P<0.05) as automated system gave a significantly high SGR and low FCR values (2.53%/Day & 2.56) than manually operated system (1.97%/day & 3.66) respectively. Furthermore, there were significant differences (P<0.05) in some of the water quality parameters monitored where alkalinity and conductivity values were significantly high (P<0.05) for the automated system. Thus, the aquatronics (automated aquaculture system) is more productive than the conventional (manually operated) aquaculture system.

Keywords: *automation, productivity, catfish*

Introduction

Overfeeding and underfeeding is an issue in aquaculture (Yeoh et al. 2010). The duo encourages feed wastage and degradation of water quality with attendant poor growth and production loss. Efficiency in feeding is essential for successful aquaculture production. However, feeding of fish can be labor-intensive and expensive (Yeoh et al. 2010). Large catfish farms with several ponds can usually be fed only once per day because of time and labor limitations, while this may be done twice per day at smaller farms. Generally, growth and feed conversion increases with feeding frequency. Riche and Garling (2003) reported that, auto-feeding saves time, labor and capital. Automatic fish feeder can increase fish production and minimize losses of feed and drudgery associated with hand feeding (Ozigboet al., 2013). This research therefore, seeks to compare the growth performance of C. *gariepinus* Juveniles reared in automated and manually operated aquaculture systems.

Materials and Methodology

The research was carried out in the Department of Water Resources, Aquaculture and Fisheries Technology, Federal University of Technology, Minna (FUTM), Niger State, Nigeria.

Aquatronics system

The aquatronics system is an auto-feeding-auto-water recycling system culturing system that was designed and constructed in FUTM. The system is operated on the principle of crank mechanism which uses pinion gear to control the opening and closing of the outlet of feed hopper that is activated to dispense feed and recycled water automatically by the micro-controller at programmed time interval of 8 hours in 24 hours (9:00am–5:00pm–1:00am and 8:00am–4:00pm and 12:00am respectively).

Conventional aquaculture system

Is a system that was based on manual feeding and mechanical water recirculatory system. This was done by hand feeding of the fishes three times daily at 9:00, 1:00pm and 4:00pm throughout the course of the trial. In this system, water was recycled twice daily using mechanical means morning (8.45am) and evening throughout the trial period (5:00pm).

Experimental Design and Feeding Procedure

Fifteen (15) pieces of *C. gariepinus* juveniles mean weight (50.61g and 50.65g) respectively were randomly distributed in the two rearing systems in replicate using complete randomized design. The fishes were stocked in a round bowl of 1000 liters capacity. The rearing tanks were filled with freshwater to ¾ of the tank. The fishes were fed 3% body weight with commercial catfish feed (Aquamax) of 40% crude protein for the two systems throughout the 56 days of the experiment. The Uneaten feeds were siphoned 45 minutes after feeding for later analysis. The fishes were bulk weighed fortnightly for growth analysis.

Water quality parameters

The water quality parameters measured included; temperature (°C) with the aid of clinical thermometer, dissolve oxygen (mg/l) was determined according to the method of Wrinker (APHA, 1980). Hydrogen ion concentration (pH) was measured with pH meter at room temperature while conductivity was monitored with conductivity meter (µs/m) table 2.

Growth parameters

Biological parameters were evaluated according to Maynard et al. (1979) and Halver (1989):
Mean weight gain = Mean final weigh–mean initial weight

Specific growth rate (SGR)= $(Log_e W_2 - Log_e W_1) / T_2 - T_1 X 100$

Where, W_2 and W_1 represent–final and initial weight, T_2 and T_1 represent–final and initial time; Feed conversion ratio–Feed fed on dry matter/fish live weight gain (Brown, 1957); Protein efficiency ratio (PER) =Mean weight gain per protein fed (Osborne et al., 1919); Protein intake (g) = Feed intake x crude protein of feed; Survival (%): no stocked/no left x 100.

Statistical Analysis

The date obtained were subjected to a T-test analysis at 5% significant levels of probability. The means were separated using Turkey's method. The statistical tool used was Minitab Release 14.

Results

The mean initial weights of the fishes in the two systems were not significantly different (P>0.05). However, the growth parameters measured showed significant differences (P<0.05) for the treatments. The mean final weight, specific growth rate, feed conversion ratio and protein efficiency ratio were significantly higher (P<0.05) for automated system; 208.41g, 2.53%/Day, 2.56 and 0.98 than the manual system; 152.46g, 1.97%/Day, 3.66 and 0.68 respectively (table 1). There were no significant differences (P>0.05) in some of the water quality parameters; total alkalinity, dissolved oxygen, temperature and pH. While, the automated system had significant high (P<0.05) total hardness and conductivity than the conventional aquaculture system (Table 2).

Table 1: Comparative growth parameters for catfish reared under automated and manually-operated aquaculture systems.

Growth parameters	Aquatronics system	Conventional aquaculture system	sd ±
Mean initial weight (g)	$50.61^a \pm 0.29$	$50.65^a \pm 0.69$	0.53
Mean final weight (g)	$208.41^a \pm 26.45$	$152.46^b \pm 5.51$	19.11
Mean weight gain (g)	$157.81^a \pm 26.16$	$101.83^b \pm 6.20$	19.01
Feed conversion ratio	$2.56^a \pm 0.15$	$3.66^b \pm 0.09$	0.13
Mean feed fed (g)	402.3279	371.715	
Specific growth rate (%/day)	$2.53^a \pm 0.22$	$1.97^b \pm 0.09$	0.17
Protein efficiency ratio	$0.98^a \pm 0.01$	$0.68^b \pm 0.01$	0.01
Survival (%)	96.70	100.00	

Mean data on the same row carrying same superscripts are not significantly different from each other (P>0.05).

Table 2: Mean water quality parameters measured for 56 days.

Water quality parameters	Aquatronics system	Conventional aquaculture system	Sd ±
Mean total hardness (mg/l)	$145.00^a \pm 2.83$	$130.50^a \pm 9.19$	6.80
Mean total alkalinity (mg/l)	$128.80^a \pm 0.71$	$122.0^b \pm 2.83$	2.06
Mean dissolved oxygen (mg/l)	$3.50^a \pm 0.71$	$3.50^a \pm 0.00$	0.50
Mean pH	$7.64^a \pm 0.16$	$7.88^a \pm 0.15$	0.16
Mean temperature (°C)	$25.98^a \pm 0.18$	$26.33^a \pm 0.46$	0.35
Mean conductivity (µm/s)	$404.65^a \pm 6.80$	$372.00^b \pm 0.71$	3.19

Mean data on the same row carrying same superscripts are not significantly different from each other (P>0.05).

Discussion

The growth parameters result indicated significant performance for the automated system. This can be attributed to high feed conversion and utilization and long feeding time spacing (Jobling, 1982; Rouhani, 1993). Long time spacing in feeding frequency enable fish to consume large enough feed as the gut will be enlarged and there will be sufficient time for its metabolism in agreement with the findings in this research where the eight hours apart proved better growth. Furthermore, when the intervals between meals are short, the food passes through the digestive tract more quickly, resulting in less effective digestion Liu (1994). Moreover, the good water quality medium in which fishes were reared also aided high feed intake in agreement with Avnimelech (2005), and Xu et al. (2006) as observed with the automated system.

Conclusion

The study discovered that, *C. gariepinus* juvenile reared in automated system (auto-feeding-auto-water-recycling) had better growth (35.47%) than those reared in the manual operated system (manual-feeding-manual-water-recycling).

Recommendation

It is recommended that, for high fish yielding aquatronics aquaculture system should be adopted.

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