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A comparative study on growth performance and survival rate of *Clarias gariepinus* burchell, 1822 and *Heterobranchus longifilis* valenciesnnes, 1840 under water recirculation system

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Abstract: The growth performance and survival rate of *Clarias gariepinus* burchell, 1822 and *Heterobranchus longifilis* valenciesnnes, 1840 under water recirculation system were examined. The post fingerlings of the two species were stocked at 486 fish/m^3/tank and fed coppens® feed for sixteen weeks. Fish body weights were determined bi-weekly using electronic weighing balance. Final mean weight of $170.49^a \pm 14.39$g (*C. gariepinus*) and $42.78^b \pm 1.57$g (*H. longifilis*) were obtained. *H. longifilis* had a better survival rate (86.21%) compared to *C. gariepinus* (66.94%). The performance index (PI) showed that *C. gariepinus* (PI=101.90^b) performed better than *H. longifilis* (PI=30.50^a). The water quality variables were similar in the culture tanks. The results of the present experiment showed that post fingerlings of the two species of clariid catfish have different growth performance, survival and feed utilization efficiency under water recirculation system with *C. gariepinus* having better growth performance and yield than *H. longifilis*.Therefore, the culture of *Clarias gariepinus* clariid catfish under water recirculation system is recommended for better yield and profitability.

Keywords: Growth Performance, Catfish, Intensive Culture, Survival Rate, Fingerlings

1. Introduction

Three systems are used in culturing fish namely: extensive, semi-intensive and intensive systems. Extensive system requires low capital input and is greatly influenced by environmental conditions. Earthen ponds or natural water bodies are used and low stocking densities are employed. Little or no feeding is practiced. In semi intensive system, feeding is practiced, the natural productivity of the pond harnessed, and supplemental aeration is normally done. Production level can be as high as 5 tonnes. Intensive systems usually employ circular tanks, raceways and cross ways. Intensive systems generally require high capital inputs, continuous aeration and the feed used is nutritionally complete. Cost of production is high and precise management is a pre-requisite for success [1]. Intensive culture of finfish in Water Recirculation System (WRS) is a production technique that reuses fish culture water and has been adopted for African catfish (*Clarias gariepinus)* in Europe and America [2]. Nigeria has a high potential to develop its fish farming to increase the amount of fish that is produced in the country because of its high demand and favourable scale price.

The most cultured fish species in Africa especially in Nigeria are *Clarias gariepinus* [3], *Heterobranchus* species [4] and their hybrids. Under different culture systems, the above species exhibit different feed utilization efficiencies, growth performance, and disease resistance [5].

Previous investigation on growth response and survival rate of Clariid catfish, particularly *Clarias gariepinus* and *Heterobranchus longifilis* showed that both species exhibit fast growth and ability to withstand adverse condition in earthen ponds and concrete tanks [6].

Heterobranchus species has some advantages over *Clarias* species such as higher growth rate, feed conversion [7]and remarkable yield [8] while *Clarias* species mature earlier and has higher fecundity [6, 10, 11, 12]. However, there is paucity of information on the culture of *Heterobranchus longifilis* under Water Recirculation System. Therefore, this study aimed at comparing the growth performance and survival rate of *Clarias gariepinus* and *Heterobranchus longifilis* under Water Recirculation System.

2. Materials and Methods

2.1. Study Area

The experiment was conducted in the Water Recirculation System of Nigerian Institute for Oceanography and Marine Research, Sapele Station, Nigeria.

2.2. Collection and Stocking of Experimental Fish

Post fingerlings of *Clarias gariepinus* and *Heterobranchus longifilis* were obtained from a reputable hatchery (Heritage Fish Farm, Sapele, Nigeria) and transported in plastic containers. On arrival at the experimental site, the water in the containers were replaced with fresh water and the post fingerlings were allowed to remain in the containers for three hours to allow them recover from transportation stress before been released into WRS culture tanks. The post fingerlings were stocked at 486 fish/m^3/tank.

2.3. Feeding and Measurement

Each culture treatment was fed with Coppens® (Floating diet) a completely dry catfish feed containing 45% crude protein, 12% fat, 2.2% calcium, 1.2% potassium, 0.5% Ash, 2.2% fiber, 60 ppm minerals and vitamins A (10000 IU/kg), E (200mg/kg) and C (100mg/kg). The post fingerlings were fed 5% of their body weight twice daily, morning (6 am – 8 am) and evening (4.00 pm – 6.00 pm)(GMT + 1) for 16 weeks. Fish body weight were determined and recorded to the nearest 0.01g, using electronic weighing balance (Metller PC 180). Measurement exercises were completed on each sampling day before feeding with appropriate ration.

2.4. Physiochemical Parameter

Water quality parameters, such as dissolved oxygen, pH, surface, and atmospheric water temperatures were monitored daily according to the method of [5].

2.5. Nutrient Utilization Parameters

Nutrient utilization parameters were determined based on the following formulae:

$$\text{Percentage Weight Gain (\%)} = \frac{100(Y-X)}{X} \quad [13]$$

Where Y = Final Mean Body Weight (g)

X = Initial Mean Body Weight (g)

Specific Growth Rate (SGR%day) was calculated [14] and converted into percentage thus:

$$SGR = \frac{100 \text{ X } [\text{In(Final body weight)} - \text{In(Initial body weight)}]}{\text{Rearing period in days}} \quad [15]$$

Where *"in"* represents natural logarithm.

Food Conversion Efficiency (FCE)

$$FCE = \frac{\text{Final Weight by Fish X 100}}{\text{Weight of feed given}} \quad [16]$$

Survival Rate (SR) was calculated according to [14]

$$SR\ (\%) = \frac{\text{Total fish number harvested}}{\text{Total fish number stocked}} \text{ X } 100 \quad [17]$$

$$PI = \frac{\text{Survival Rate X Final Mean Weight (g)} - \text{Initial Mean body weight (g)}}{\text{Rearing duration in days}} \quad [3]$$

2.6. Statistical Analysis

Data was subjected to one-way analysis of variance (ANOVA) using SPSS software. Differences between means were analysed using Duncan's Multiple Range Test (DMRT)

3. Results and Discussions

The result on growth performance and bi-weekly weight gain of Clariid catfish *Clarias gariepinus* and *Heterobranchus longifilis* cultured under water recirculation system for 16 weeks is presented in Table 1 and Figure 1 respectively. *Clarias gariepinus* has the highest mean weight gain of 173.78^b ± 14.30g while the lower value of 42.78^a ± 1.57g was recorded for *Heterobranchus longifilis*. There was a significant difference ($P<0.05$) in weight gain between the two species.

The highest percentage weight gain and mean specific growth rate (SRG) value of 5182.07% and 3.54^a respectively was obtained for *Clarias gariepinus.* While 1278.06% and 2.24^b for percentage weight gain and specific growth rate respectively were recorded for *Heterobranchus longifilis*.

Heterobranchus longifilis showed the highest survival rate value (86.21%) against 66.94% recorded for *Clarias gariepinus*.

Final mean food conversion efficiency (FCE) was higher in *Clarias gariepinus* (17.13^b) as compared to 8.17^a obtained for *Heterobranchus longifilis.*

The performance Index (PI) data was highest in *Clarias gariepinus* (101.90^b) whereas lower value of 30.50^a was calculated for *Heterobranchus Longifiis.*

The general trend for bi-weekly growth pattern for the two species showed a stepwise pattern with *C. gariepinus* been the highest while *H. longifilis* was lower (Fig. 1).

There was no significant difference (P > 0.05) in the water quality of the culture system (data not shown)

Observation on these growth parameters disagreed with those of previous researchers [18, 11]. Reference [7] observed a drastically slower growth rate in *Clarias gariepinus* than *Heterobranchus Longifilis* in their study on growth performance, food conversion ratio (FCR) and survival rate after 254 days grow out period. In a similar work carried out by [19], the results showed that hybrid (*Heteroclarias*) had the best weight gain in all the three-culture system followed by *Clarias gariepinus* and least with *Heterobranchus longifilis*, which is in agreement with the findings in this present study.

Survival rate of *Heterobranchus longifilis* was higher compared to *Clarias gariepinus.* However, [20] among others have demonstrated that survival decrease as stocking density increases. This principle may not be the reason for the significance different in the survival rate of the two clariid catfish because both species were stocked at the same stocking density. The observed differences may be because of high rate of cannibalism in *Clarias gariepinus* compared to *Heterobranchus longiflis.* It was also observed in the present study that *Heterobranchus longifilis* grew uniformly as compared to *Clarias gariepinus*. This may also account for the high rate of cannibalism observed in *Clarias gariepinus* hence low survival rate recorded. However, despite the low survival rate observed in *C. gariepinus*, it had a better yield than *H. longifilis.*

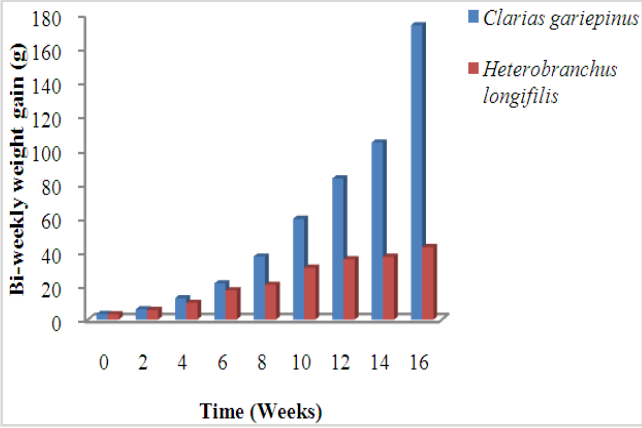

Figure 1: *Bi-weekly weight gain of C. gariepinus and H. longifilis fed Coppens® feed.*

7. Conclusion

The result of growth performance and bi-weekly weight gain in two clariid catfishes *Clarias gariepinus* and *Heterobranchus longifilis* reveals that the post fingerlings have different growth performance and feed utilization efficiency under water recirculation system examined in this study with *Clarias gariepinus* performing better than *Heterobranchus longifilis*. Therefore, the culture of *Clarias gariepinus* clariid catfish under water recirculation system is recommended for better yield and profitability.

Table 1*.Growth performance and survival of H. longifilis and C. gariepinus cultured under water recirculation system for sixteen weeks.*

Growth Parameter	Fish Species	
	Heterobranchus longifilis	*Clarias gariepinus*
Initial Mean Weight (g)	3.10 ± 0.22^a	3.29 ± 0.38^a
Final Mean Weight (g)	42.78 ± 1.57^a	173.78 ± 14.30^b
Final Mean Weight Gain (g)	39.62 ± 1.44^a	170.49 ± 14.39^a
% Weight Gain (%)	1278.06^a	5182.07^b
Final Mean Specific growth Rate (SGR % day)	2.24^a	3.54^a
Survival Rate (SR %)	86.21^a	66.94^b
Final Mean Food Conversion Efficiency (FCE)	8.17^a	17.13^b
Performance Index (PI)	30.50^a	101.90^b

a,b denote significantly different values in a row at P<0.05 level by one-way ANOVA and Duncan's Multiple Range Test.

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