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# Growth Performance of the Reciprocal Hybrids of *Clarias gariepinus* (Burchell, 1822) and *Heterobranchus bidorsalis* (Valenciennes, 1840)

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**Abstract:** An experiment was conducted to determine the survival rate, fertilization rate, growth performance and feed utilization of the reciprocal hybrids of *Clarias gariepinus* and *Heterobranchus, bidorsalis*. Two genetic crosses were made: *C. gariepinus*♀ x *H. bidorsalis*♂ (clariabranchus) and *H. bidorsalis*♀ x *C. gariepinus*♂(heteroclarias). The experiment was divided into two phases; artificial propagation of the fish species using synthetic hormone and rearing the fry for 14 days; and rearing the 14 days old fry for 35 days. In the first phase of the experiment, survival of frys were estimated in each experimental unit (genetic cross) while in the second phase, growth and nutrient utilization were investigated. The result revealed that the highest %fertilization, hatching rate and %survival occurred in *H. bidorsalis*♀ x *C. gariepinus*♂(heteroclarias) and the differences were significant ($p<0.05$). Percentage weight gain and specific growth rate were significantly ($p<0.05$) higher in clariabranchus than heteroclarias. Based on the result of this study, reciprocal hybrids of *Clarias gariepinus* and *Heterobranchus, bidorsalis* is recommended for commercial aquacultural practices.

**Key words:** Clariabranchus, *Clarias gariepinus*, feed utilization, growth performance, *Heterobranchus bidorsalis*, heteroclarias, reciprocal hybrid, survival rate

## INTRODUCTION

Fish is an important and the cheapest source of animal protein and account for about 37% of Nigeria's total protein requirement (FDF, 2002). Fish production in Nigeria is mainly from the captured sector, especially artisanal coastal and artisanal inland fisheries. This sector contributes over 80% of total domestic production of about 510,000 tonnes per annum (FDF, 2004). Over-exploitation of the marine fishery resources has resulted in gradual depletion of the stock. FAO (2003) reported that Nigeria is one of the largest importers of fish in the developing world, importing about 600,000 metric tones annually. To solve this short-fall in fish supply, Nigeria must encourage investments in aquaculture.

Genetic technologies have been used in different areas of biology to develop species that possess desirable characteristics for culture. Bartley *et al*. (1997) reported that the hybridization of the African catfish (*Clarias gariepinus*) with the Thai catfish (*Clarias macrocephalus)* produced offspring that was preferred to the parental species because they had the desired flesh quality of the Thai catfish and the fast growth of the African catfish. Legendre *et al*. (1992) reported that *Heterobranchus* sp. had a growth rate twice as fast as that of *Clarias gariepinus* while *Clarias gariepinus* survives in poorly oxygenated water (Teugels, 1996). Hybridization between these two clariid catfishes may produce offspring that possess a combination of these desirable qualities.

The continuous growth of aquaculture is hinged on the production of fish seeds with high fertilization and survival rates, high feed conversion efficiency, and high growth rate among other factors (Adebayo and Popoola, 2008). This kind of seed can be obtained through genetic technology. This study investigates the fertilization, hatching and survival rates of larvae of reciprocal hybrids of two African clariid catfish (*Clarias gariepinus* and *Heterobranchus bidorsalis*) and also studies their growth performance and feed utilization.

## MATERIALS AND METHODS

**Experimental fish:** This study was conducted in 2007. Sexually matured brood fish (500-600 g) were obtained from Lagos State University, Nigeria. The brood fish consist of two male each of *Clarias gariepinus* and *Heterobranchus bidorsalis* and two female each of this same fish species. The broodstocks were selected based on their external morphological features as described by Viveen *et al*. (1985).

**Experimental procedure:** The experiment was divided into two broad stages:

- Artificial propagation of fish species, using synthetic hormone and raising the fry for 14 days
- Rearing of 14days old fry for another 35days

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**Artificial propagation:** The broodstocks used for the experiment were conditioned for two weeks in holding tanks in the hatchery of Lagos State University and were fed 40% crude protein pelleted feed at 3% body weight twice daily at 09:00 and 16:00 h.

The female broodstocks were induced by injecting Ovaprim, a synthetic hormone (Aqualife Syndel International Inc. Vancouver, B.C. Canada) at the rate of 0.5 mL / 1000 g body weight. Ovulation occurred 15-18 h after injection and gentle pressure was applied to the anterior-posterior direction on the abdomen of the two female brood fish (1 *C. gariepinus* and 1 *H. bidorsalis)* to strip them of eggs. Two male brood fish (1 *C. gariepinus* and 1 *H. bidorsalis*) were anaesthetized, sacrificed and their testes removed. Milt was collected after dissection of the testes and immediately preserved in 0.9% NaCl solution. Stripped eggs were later fertilized with milt after sperm activation was initiated by the addition of 5 mL fresh water and checked for motility by microscopic examination (Viveen *et al*., 1985). These are the two (2) crosses:

- *Clarias gariepinus*♀ × *Heterobranchus bidorsalis*♂ (Clariabranchus)
- *Heterobranchus bidorsalis*♀ × *Clarias gariepinus*♂ (Heteroclarias)

After about 1min of gentle stirring, fertilized eggs were rinsed in fresh water to remove excess milt and treated with talcum powder for 15-30 min to inhibit adhesiveness of the egg jelly coat and to prevent clumping and suffocation of eggs during incubation. Eggs were incubated in glass tank (70 x 45 x 35 $cm^3$). The incubation jars was aerated continually and temperature was 27±1ºC. Hatching occurred 23-26 h later. The larvae were left for three days in the incubation jars to absorb their yolk.

After yolk absorption, the post-larvae were fed Artemia naupli for a period of 14days. Aeration was done continually and the water temperature, pH and dissolved oxygen were 27±1ºC, 6.5 and 4.5 mg/L, respectively. Water was changed regularly to avoid mortality resulting from polluted water.

**Growth experiment:** A total of 180 14 days old hybrid catfish (Heteroclarias and Clariabranchus) juveniles were used. Thirty specimens of each hybrid were randomly chosen and allocated to 6 circular flow-through tanks {each experimental unit (that is genetic cross) had three replicates}. Rearing conditions were the same as described above. The diameter of each tank was 2 m and there was at least 50% water exchange daily. Each tank contained about 45l of fresh water.

Prior to stocking, quicklime was applied to the tank bottom at 150 $g/m^2$ to eliminate parasites and invertebrate predators.

Table 1: Nutrient composition of commercial feed (CATCO FISH CONCENTRATE - COPPENS) fed to frys of reciprocal hybrids (Clariabranchus and Heteroclarias) of clariid catfish

| Nutrient | Composition (%) |
|---|---|
| Crude protein | 56.0 |
| Crude fibre | 10.9 |
| Crude fat | 15.0 |
| Ash | 10.9 |
| Phosphorus | 8.0 |
| Energy | 3400 Kcal/Kg |

*: Each kg of the diet contains 300 mg vit C, 200 mg vit E, 22,500 IU vit A, 2,500 IU vit $D_3$, 5 mg Cu, E280 Preservatives and E324 Anti-oxidants

**Feeding trials:** The fish in each of the culture treatments was fed on commercial pelleted diet (56% crude protein) (Table 1) at 3% of their body weight according to the recommendation of Viveen *et al*. (1985). The daily ration was divided into two; one part was fed at 09:00 h and the other part at 18:00 h. Feed were dispensed evenly on the water surface in each tank to allow equal opportunity for feeding. Feeding in all tanks was generally completed in about 10-15 min. Weighing of fish was carried out weekly throughout the period of the experiment. On weighing days, fish were not fed until the whole exercise was completed. Feeding rate was recalculated to accommodate for the weight changes. The feeding trials lasted for five weeks.

**Determination of water quality parameter:** Temperature of water in all tanks was measured daily using mercury-in-glass thermometer. pH was measured by a pH meter (Jenway model 9060). Dissolved oxygen concentration in water was determined weekly using the methods of APHA (1989).

**Reproductive performance parameter:** The number of eggs released in each treatment unit was determined by subtracting the weight of the brood stock after stripping ($W_b$) in grams from the weight of the brood stock before stripping ($W_a$) in grams and multiplying the difference by 700 (1 g = 700 eggs) (Viveen *et al*., 1985).

Fertilization rate was determined when eggs generally reached the 4-8 celled stage of embryonic development. For calculating percentage fertilization, a sample of about 50 eggs from each replicate of each treatment were carefully taken on Petri dish containing water and counted under a microscope (40 times magnification) (Adebayo, 2006). The fertilization rate was then calculated based on the total number of eggs counted.

After hatching, the numbers of larvae within each experimental unit were carefully counted and the hatching rate was calculated.

Similarly, the survival rate was calculated at the end of the rearing period (49 days after hatching) based on the initial number of larvae used in the experiment.

**Growth and nutrient utilization:** Growth and nutrient utilization were analyzed by calculating the Weight Gain (WG) over the test period, Percent Weight Gain (PWG), Specific Growth Rate (SGR), Food Conversion Ratio (FCR) and Protein Efficiency Ratio (PER).

Specific growth rate (SGR)

$$= \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{T_2 - T_1} \times \frac{100}{1}$$

where,

$W_2$ = Weight of fish at time $T_2$ in days
$W_1$ = Weight of fish at time $T_1$ in days
$\text{Log}_e$ = Natural Logarithm.

Food Conversion Ratio (FCR) as determined by Weight of dry feed fed (g) divided by live weight gain (g); and Protein Efficiency Ratio (PER) defined as gain in weight of test fish (g) divided by the amount of Protein consumed (g).

**Statistical analysis:** Statistical analysis was performed using the SPSS V. 15.0 package for Windows. Analysis of variance (ANOVA) was used and where significant difference was indicated, means were tested using Fishers Least Significant Difference (LSD) test at p = 0.05 significance level.

## RESULTS AND DISCUSSION

The fertilization, hatching and survival rates of catfish hybrids (Clariabranchus and Heteroclarias) investigated in this study are generally high (Table 2) except the hatching rate of *C. gariepinus*♀ x *H. bidorsalis*♂(Clariabranchus) (52.57±0.88)}. This may be due to the tolerable physico-chemical qualities of the culture water (Aliu and Obasogie, 2006). The hybrid (*H. bidorsalis*♀ x *C. gariepinus*♂, Heteroclarias) had the best fertilization, hatching and survival rates.

Although, the fertilization, hatching and survival rates of *H. bidorsalis*♀ x *C. gariepinus*♂(heteroclarias) was significantly ($p<0.05$) higher than *C. gariepinus*♀ x *H. bidorsalis*♂ (clariabranchus), the values obtained in this study are lower than those reported in previous studies (Adebayo, 2006; Ataguba *et al*., 2009). The relatively lower fertilization, hatching and survival rates recorded in this study might be due to differences arising from breeding history, age, water quality and season (De Graaf *et al*., 1995 and Ataguba *et al*., 2009).

Percentage weight gain and specific growth rate of clariabranchus were significantly ($p<0.05$) higher than that of heteroclarias (Table 3). However, these results could not be confirmed with the result of the Mean Weight Gain (MWG), Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) because the difference in these parameters were not significant ($p>0.05$).

Table 2: Percentage fertilization, hatching rate and survival rate (14 days post hatching) of reciprocal hybrids (Clariabranchus and Heteroclarias) of *Clarias gariepinus* and *Heterobranchus bidorsalis*

| | Fertilization (%) (Mean±SE) | Hatching rate (Mean±SE) | Survival (%) (Mean±SE) |
|---|---|---|---|
| *C. g* ♀ x *H. b*♂ (n = 175) | 65.87±2.49[a] | 52.57±0.88[a] | 65.22±1.30[a] |
| *H. b* ♀ x *C. g* ♂ (n = 350) | 79.44±5.39[b] | 70.57±1.04[b] | 76.11±1.59[b] |

Values in the same column and with the same superscript are not significantly different ($p>0.05$)

Table 3: Growth of reciprocal hybrids of *Clarias gariepinus* and *Heterobranchus bidorsalis* between 14th and 49th day after hatching

| Parameter | *C. g* ♀ x *H. b* ♂ (Clariabranchus) | *H. b* ♀ x *C. g* ♂ (Heteroclarias) |
|---|---|---|
| Initial weight | 0.52±0.07 | 0.67±0.11 |
| Mean weight gain (g) | 1.31±0.06[a] | 1.19±0.05[a] |
| Average daily weight gain (g) | 0.04± 0.01[a] | 0.03±0.01[a] |
| Percentage weight Gain (%) | 2525.00±109.67[a] | 1362.07±101.95[b] |
| SGR (%/day) | 9.34± 0.77[a] | 7.66±0.79[b] |
| FCR | 0.23± 0.18[a] | 0.35±0.26[a] |
| PER | 11.92± 4.76[a] | 9.69±3.45[a] |

SGR = Specific Growth Rate; FCR = Food Conversion Ratio; PER = Protein Efficiency Ratio; Values in the same column and with the same superscript are not significantly different ($p>0.05$)

## CONCLUSION

This study have confirmed earlier studies that cross breeding of African clariid catfish can be done successfully and the products of the cross breed can also be reared to adults.

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