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Reproductive, Growth Performance and Nutrient Utilization of *Heterobranchus bidorsalis* (Geoffroy, 1809) and its Hybrid "Clariabranchus" Induced with Synthetic Hormone and Pituitary Gland of *Heterobranchus bidorsalis*

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ABSTRACT

This study was conducted to assess the reproductive performance, growth rate and nutrient utilization capacities of pure breed *Heterobranchus bidorsalis* (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) and its hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) (Clariabranchus) induced with synthetic hormone (ovaprim) and pituitary of male and female *Heterobranchus bidorsalis*. In this study, 3 female *Heterobranchus bidorsalis*, 3 male *Heterobranchus bidorsalis* and 3 male *Clarias gariepinus* were used for the experiment. One female *H. bidorsalis* induced with ovaprim produced eggs which were divided into two equal halves. Each half was fertilized separately by milt from *H. bidorsalis and C. gariepinus* to produce pure breed and hybrid, respectively. A similar crossing was done for the female *H. bidorsalis* induced with Male Pituitary Extract (MPE) and Female Pituitary Extract (FPE). Percentage fertilization and hatching rate of pure breed induced with ovaprim were significantly ($p<0.05$) higher than the other genetic crosses. The highest values for weight gain (5.46±1.58 g), average daily growth (0.39±0.11 g) and specific growth rate (1.04±0.16%/day) occurred in pure breed induced with MPE. The lowest values for these growth parameters were obtained in the hybrid induced with FPE. Feed intake, protein intake, feed conversion ratio and protein efficiency ratio varied significantly ($p<0.05$) among the treatments. This study has shown that the pure breeds and hybrids induced with ovaprim and MPE performed better than those induced with FPE. Therefore, they are recommended for commercial aquaculture.

Key words: Catfish, induced breeding, ovaprim, pituitary extract, growth parameters, feed utilization

INTRODUCTION

There is increase global attention on aquaculture because of the need to augment fish production from the wild. This is particularly noticeable in populous countries like Nigeria because of the high protein demand. The protein requirements of most countries cannot be adequately met by poultry and livestock food. Poultry products are more expensive than fish and beef have been implicated in heart disease. Fish are generally cheap, rich in protein and high in poly unsaturated fat which gives it medical or health commendation (Balogun, 1998; Ziaeian *et al*., 2008; Widjaja *et al*., 2009). Culture of fish in Nigeria is relatively high because of the awareness of

aquaculture, availability of large and cheap water and strong interest of providing food and making profit (Adebayo and Popoola, 2008; Owodeinde and Ndimele, 2011).

The most popular culturable fish species in Nigeria and other parts of Africa are members of the catfish family called Clariidae. *Clarias gariepenus* and *Heterobranchus* sp. are the two commonly cultured clariid fish (Vanden and Bernacsek, 1990; Ojutiku, 2008). Among the Culturable food fish in Nigeria, catfish especially *Clarias gariepinus* and *Heterobranchus* sp. are the most cultured fish species. They are very popular among fish farmers and consumers alike. They are reared all-over the country especially in the south and have very good commercial value in Nigerian markets (Adewolu and Adoti, 2010; Owodeinde and Ndimele, 2011). There preference as cultured species is due to several factors. These include fast growth rate, high resistance to disease, tolerance to adverse environmental conditions, ability to feed on wide range of feed and capacity to withstand low pH and oxygen (Fagbenro *et al*., 1992). It also has high feed efficiency and utilization (Adebayo and Olanrewaju, 2000). Nigeria contributes significantly to catfish supply in Africa. Nigeria accounted for about ninety percent of the catfish supply in Sub-Saharan African in 2000 (FAO, 2004).

The profitability of the aquaculture industry has become widely known in the last decade (Ita, 1996; Huda *et al*., 2002). The private sector sees it as huge investment potential which is yet to be fully maximized. The governments of most countries on the other hand perceive it as a means of ensuring food security and creating employment. However, the numerous potentials of the aquaculture industry are threatened by inadequate fish seed needed for production. Dependence on natural propagation will leave us with a gap too wide to manage. This is because at this low level of production, aquaculturists have not been able to meet the market demand. In order to ensure the continued growth of the industry, there is the need to increase fish seed. This can be achieved by artificial propagation by induced breeding (Richter and Van Der Hurk, 1982; Naeem *et al*., 2005a).

Artificial propagation will increase the availability of quality fingerlings used to restock artificial and natural water bodies. It has made possible the supply of varieties of seeds of different fish species. Artificial propagation has also resulted in the development of strains superior to the parent stock by methods of selection breeding and hybridization. 'Heteroclarias' and 'Clariabranchus' are inter-specific hybrids of *C. gariepinus* and *H. bidorsalis* which transfer or combine desirable traits of the two species (Bartley *et al*., 2000; Kori-Siakpere *et al*., 2006).

Different fish species have been induced to spawn with different hormonal materials. Some are artificial (synthetic), others are natural. These hormones include: Human Chorionic Gonadotropin (HCG) (Eyo, 2002); clomiphene citrate (Aguigwo, 1991), pituitary extract (Haniffa *et al*., 2000) and Ovaprim (Naeem *et al*., 2005a; Owodeinde and Ndimele, 2011). Synthetic hormones have some advantages over the natural hormones in inducing spawning in fish. Absence of ovulation due to inaccurate dosage of hypophysis can be eliminated. The synthetic hormone used in the process is interspecific, so it is efficient even in the case of taxonomically very different fishes (Naeem *et al*., 2005b).

This study was therefore designed to investigate the reproductive, growth and nutrient utilization of pure breed *Heterobrancus bidorsalis* and its hybrid 'clariabranchus' when induced with synthetic hormone (ovaprim) and pituitary of *Heterobrancus bidorsalis*.

MATERIALS AND METHODS

Broodstock collection and selection: This study was carried out between March, 2010 and November, 2010 using fish hatchery facilities of the Department of Fisheries, Lagos State

University, Ojo, Lagos State, Nigeria. Hatchery raised gravid broodstocks were selected from Lagos State University hatchery. According to Ayinla *et al.* (1994), broodfish for breeding purpose should be selected by consideration of some external morphological characteristics. These features are: gravid females with distended abdomen must oozes out eggs when gently pressed and males should have reddish tip on genital papillae. Female fish were also selected on the basis of ovarian biopsy (Legendre, 1986). Three female *Heterobranchus bidorsalis*, three male *Heterobranchus bidorsalis* and three male *Clarias gariepenus* (0.85-1 kg) were used for this study. They were brought into the laboratory in the morning and kept in separate fish tanks to acclimatize for 48 h before the experiment.

Types of hormone administered and their extraction: Three hormones were used in this study; one synthetic and two natural hormones. The synthetic hormone, ovaprim (Aqualife Syndel International Inc., Vancouver, BC, Canada) was bought from Silver Brothers Pharmacy, Lagos, Nigeria. The natural hormones; female pituitary and male pituitary were obtained from female and male *Heterobranchus bidorsalis* fish, respectively. Male and female pituitary hormones were extracted according to the method described by Viveen *et al.* (1985). Each gland was then transferred into a sealed test tube containing acetone.

Administration of hormones: Three female *H. bidorsalis* were separately injected with the three hormones (ovaprim, male pituitary of *H. bidorsalis* and female pituitary of *H. bidorsalis*) used in this study. The first female broodstock was administered ovaprim intramuscularly (0.05 mL kg^{-1}) (Naeem *et al.*, 2005b). *H. bidorsalis* male and female pituitary extracts were injected separately into the second and third *H. bidorsalis* fish.

Stripping: The females *H. bidorsalis* injected with the different hormones were stripped after a latency period of about 16 hours (Adebayo, 2006). This was done by gently pressing the abdomen with the thumb at anterior-posterior direction from the pectoral fin towards the genital papilla. The eggs that oozed out were collected in dry bowls.

Artificial fertilization: Wet fertilization method was employed. The eggs from each female *H. bidorsalis* administered with the different hormones were shared into two dry bowls. That is, two bowls contained eggs from female *H. bidorsalis* injected with ovaprim. Another two bowls contained eggs from female *H. bidorsalis* induced with male pituitary of *H. bidorsalis*. The last set of two bowls contained eggs from female *H. bidorsalis* induced with female pituitary of *H. bidorsalis*. In all, there were six bowls of eggs from three female *H. bidorsalis*. Then six males (3 *H. bidorsalis* and 3 *C. gariepinus*) were sacrificed and testes removed. Milts from male *H. birdosalis* and *C. gariepinus* were collected after dissection of the testes. The milts were preserved in 0.9% sodium chloride solution as soon as they were collected. 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). The milts from one *H. bidorsalis* was used to fertilize half of the eggs (1 bowl) from female *H. bidorsalis* induced by injection of ovaprim-pure line *H. bidorsalis*. The other half of the eggs (2nd bowl in that set) was fertilized by milt from one *C. gariepinus*-crossbreed. A similar fertilization process was separately carried out for the female *H. bidorsalis* injected with male and female pituitary of *H. bidorsalis*. In all, there were six genetic crosses representing six experimental units.

The genetic crosses are as given below:

- *H. bidorsalis* ♀ x *H. bidorsalis* ♂ (injected with synthetic hormone-ovaprim)
- *H. bidorsalis* ♀ x *C. gariepinus* ♂ (injected with synthetic hormone-ovaprim)
- *H. bidorsalis* ♀ x *H. bidorsalis* ♂ (injected with pituitary gland of male *H. bidorsalis*)
- *H. bidorsalis* ♀ x *C. gariepinus* ♂ (injected with pituitary gland of male *H. bidorsalis*)
- *H. bidorsalis* ♀ x *H. bidorsalis* ♂ (injected with pituitary gland of female *H. bidorsalis*)
- *H. bidorsalis* ♀ x *C. gariepinus* ♂ (injected with pituitary gland of female *H. bidorsalis*)

Incubation and hatching: Fertilized eggs from each mating combination were incubated separately in six aerated water tanks with continuous flow through system. Hatching nets were used as egg collectors. The eggs hatched after 24-26 h and the larvae were allowed to absorb their yolks for three days while still in the incubation tanks. Dead eggs and net were siphoned after hatching to prevent fouling of the water. Fry were fed *ad-libitum* with *Artemia* (shell-free) for 14 days. Aeration was done continually throughout this period. Water temperature, pH and dissolved oxygen were 28±1°C, 6.89 and 4.8 mg L^{-1}, respectively. Water was changed regularly to prevent fry mortality caused by pollutants especially ammonia and inadequate dissolved oxygen.

Feeds and water quality: Eighteen circular flow-through tanks were used as experimental culture system. Fry were fed 0.1-0.3 mm commercial feed (coppens, 56% crude protein) (Table 1) for the first four weeks and 0.5-0.8 mm for another four weeks at 3% of their body weight (Viveen *et al.*, 1985). Feeding was done twice daily; morning (9:00 h) and evening (16:00 h). Siphoning of the uneaten food was done regularly and 60% water exchange was done on a daily basis. Some water parameters were measured and recorded every week. The parameters are water temperature measured with mercury-in-glass thermometer. Water pH measure with pH-meter (Jenway model 9060) and dissolved oxygen concentration determined by Winkler method (Boyd, 1979).

After a month, forty-five 4-weeks old fry from each genetic cross were stocked in 3 replicates in the tanks. Their growth performance and nutrient utilization ability were assessed. Length and weight of fish samples in each tank were measured and recorded every two weeks. The data were used to evaluate the growth performances.

Reproductive performance parameters: The number of eggs released was determined by the difference between the weight of the female broodstock after spawning and the weight before spawning in grams. The value obtained was then multiplied by 700, (1 g = 700 eggs) (Viveen *et al.*, 1985).

Table 1: Nutrient composition of commercial feed (Catco fish Concentrate-Coppens) fed to frys of pure and hybrid 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^{-1}

Each kg of the diet contained: 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

Fertilization rate was evaluated when the eggs attained the 4-8 celled stage of embryonic development. In order to estimate percent fertilization, a sample of egg from each replicate of each experimental unit (genetic cross) were carefully collected on a petri dish which contained water. The numbers of fertilized and unfertilized eggs were counted under a microscope (Adebayo, 2006). The fertilization rate was then estimated by the equation below (Adebayo, 2006):

$$\text{Fertilization rate} = \frac{\text{No. of fertilized eggs}}{\text{Total No. of eggs counted}} \times 100$$

The eggs were then transferred to their original experimental units/tanks for hatching. The numbers of hatchlings in each treatment unit were carefully counted and the hatching rate was determined using the equation below (Adebayo, 2006):

$$\text{Hatching rate} = \frac{\text{No. of eggs hatched}}{\text{Total No. of eggs in a batch}} \times 100$$

Survival rate was also calculated using the equation below (Adebayo, 2006):

$$\text{Survival rate} = \frac{\text{No. of hatchlings alive to larvae stage}}{\text{Total No. of hatchings}} \times 100$$

Growth performance parameters: After the evaluation of the reproductive performance of the pure breed and hybrid (Clariabranchus) which lasted about 14 days, the growth performance aspect of the study started. The growth phase of the study involved the use of 720 14-day old pure and hybrid juveniles. Forty juveniles were randomly assigned to each of the three replicates of the six experimental units (genetic crosses). The experimental units were randomly allocated into 18 different circular flow-through tanks. Rearing conditions were similar to the ones used in the reproductive performance phase of the experiment. Each 2 m diameter tank contained about 45 L fresh water with at least 60% water exchange daily. Before stocking, parasites and invertebrate predators were eliminated by the addition of quicklime to the tank bottom at the rate of 150 g m^{-2}.

Feeding trial: The fish in each treatment (flow-through tank) were gradually weaned over a five-day period unto pelleted artificial diet (56% crude protein (Table 1). Feeding was done twice daily at 3% body weight. The feed for each day was divided into two parts and administered at 0900 and 1600 h for a period of 56 days. The mean weight (g) and total length (cm) of the fish from each treatment and its replicates were measured fortnightly. The feeding rate was recalculated every fortnight to accommodate weight changes that would have occurred.

The following growth and nutrient utilization parameters were evaluated:

Growth parameters:

$$\text{Weight gain (WTG)} = W_1 - W_0$$

Where:
W_1 = Final mean weight (g)
W_0 = Initial mean weight (g)

$$\text{Percentage weight gain (\%)} = \frac{100(Y-X)}{X}$$

Where:
Y = Final mean body weight (g)
X = Initial mean body weight (g)

$$\text{Specific Growth Rate (SGR)} = \frac{\text{Log}_e\ WT - \text{Log}_e\ Wt}{T-t} \times 100$$

where, WT is final weight, Wt is initial weight, T is final time, t is initial time and Log_e is natural logarithm.

$$\text{Average Daily Growth (ADG)} = \frac{W_1-W_0}{T}$$

where, W_1 is mean final weight, W_0 is mean initial weight and T is rearing period.

Nutrient utilization parameters

Feed Intake (FI): Feed intake was determined as quantity of feed fed per day and was calculated as:

$$FI = \frac{\text{3\% body weight of fish}}{\text{days}}$$

$$\text{Protein intake (PI)} = \text{Feed intake (g)} \times \text{\% protein in the diet}$$

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Weight of dry feed fed (g)}}{\text{Live weight gained (g)}}$$

$$\text{Protein efficiency ratio (PER)} = \frac{\text{Gain in weight of test fish (g)}}{\text{Protein consumed (g)}}$$

Length-weight relationship: The relationships between length and weight of the fish in each experimental unit were estimated using the equation (Ricker, 1973):

$$W = aL^b \quad (1)$$

where, W is weight of fish (g); L is length of fish (cm); a is y-intercept or the initial growth coefficient and b is slope or the growth coefficient.

Equation 1 was linearized by logarithmic transformation to enable the estimation of the values of constants a and b using least square linear regression (Zar, 1996). After linearization, the equation became:

$$\log W = \log a + b \log L \quad (2)$$

The growth coefficient (b) was tested for significant difference from the isometric value (3) by t-test using the equation described by Sokal and Rohlf (1995):

$$t_s = (b-3) / SE,$$

where, t_s is the t-test value, b the slope or growth coefficient and SE the standard error of the slope (b).

The condition factor was calculated by the formula (Pauly, 1983):

$$\text{Condition factor (K)} = \frac{100W}{L^b}$$

Statistical analysis: The data collected were analysed for significant differences ($p<0.05$) by Analysis of Variance (ANOVA) using computer Statistical Package for Social Sciences (SPSS) for windows (v. 17.0). Determined differences were partitioned by Fisher's Least Significant Difference (LSD) at $p = 0.05$. The percentage data were transformed to arc sin values before analysis (Zar, 1996).

RESULTS

Water quality parameters: Three pysico-chemical parameters (dissolved oxygen, temperature and pH) were measured in this study. There was no significant difference ($p>0.05$) in these parameters among the treatments (genetic crosses) (Table 2). The range of values recorded for dissolved oxygen, temperature and pH were 1.96±0.23-3.91±0.94 mg L^{-1}, 28.51±0.82-28.84±1.10°C and 6.33±0.05-6.62±0.14, respectively.

The pure and cross breeding of *H. bidorsalis* carried out using Ovaprim (OVA), Male Pituitary Extract (MPE) and Female Pituitary Extract (FPE) were all successful. The various hormones used for the ovulation synchronization in the spawners resulted in different responses of the latter to some parameters. These parameters are: fertilization of the eggs, hatching of the fry, survival of the juveniles, growth performances and efficiency of feed utilization.

Table 2: Water quality parameters of the culturing medium of pure breed and hybrid of *Heterobranchus bidorsalis*

Treatment	Dissolved oxygen	Temperature	pH
Ovaprim			
(H. b ♀ x H. b ♂)	1.96±0.23	28.84±1.10	6.35±0.20
(H. b ♀ x C. g ♂)	3.43±0.66	28.84±1.11	6.62±0.14
Male pituitary extract of *Heterobranchus bidorsalis*			
(H. b ♀ x H. b ♂)	3.91±0.94	28.67±1.01	6.38±0.07
(H. b ♀ x C. g ♂)	3.70±0.29	28.67±0.94	6.45±0.03
Female pituitary extract of *Heterobranchus bidorsalis*			
(H. b ♀ x H. b ♂)	3.22±0.57	28.51±0.82	6.33±0.05
(H. b ♀ x C. g ♂)	3.71±0.20	28.63±0.94	6.37±0.04

Values are as Mean±SD

Table 3: Percentage fertilization, Hatching rate and survival rate (14 days Post-hatch) of pure breed and hybrid catfish (*Clarias gariepinus* and *Heterobranchus bidorsalis*) induced with synthetic hormone (Ovaprim) and pituitary of *Heterobranchus bidorsalis*

Treatment	% Fertilization	Hatching rate	% Survival
Ovaprim			
(H. b ♀ x H. b ♂)	70±2.887[a]	90±4.619[a]	76.67±7.22[a]
(H. b ♀ x C. g ♂)	80±4.619[a]	80±2.309[b]	50.00±4.62[c]
Male pituitary extract of *Heterobranchus bidorsalis*			
(H. b ♀ x H. b ♂)	70±6.351[a]	80±6.928[b]	81.00±2.31[a]
(H. b ♀ x C. g ♂)	70±2.309[a]	70±5.774[c]	77.33±10.11[a]
Female pituitary extract of *Heterobranchus bidorsalis*			
(H. b ♀ x H. b ♂)	30±2.309[b]	40±4.619[d]	69.00±12.70[b]
(H. b ♀ x C. g ♂)	45±3.464[b]	30±4.041[d]	66.67±10.11[b]

Values are as Mean±SD. Values in the same column and with the same superscript are not significantly different (p>0.05)

Table 4: Growth of pure breed and hybrid of catfish (*Clarias gariepinus* and *Heterobranchus bidorsalis*) induced with synthetic hormone (Ovaprim) and pituitary glands of male and female *Heterobranchus bidorsalis*

Treatment	WG (g)	PWG (%)	ADG (g)	SGR (%/day)
Ovaprim				
(H. b ♀ x H. b ♂)	2.96±1.00[ab]	099.18±25.08[a]	0.21±0.07[ab]	0.71±0.20[a]
(H. b ♀ x C. g ♂)	5.04±2.39[a]	122.63±38.40[a]	0.36±0.17[a]	0.98±0.20[a]
Male pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♂)	5.46±1.48[a]	099.29±28.82[a]	0.39±0.11[a]	1.04±0.16[a]
(H. b ♀ x C. g ♂)	4.96±1.56[a]	084.99±10.86[a]	0.36±0.11[a]	0.96±0.16[a]
Female pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♂)	0.28±0.06[b]	022.44±05.20[b]	0.02±0.01[b]	0.18±0.05[b]
(H. b ♀ x C. g ♂)	0.15±0.05[b]	013.80±03.76[b]	0.01±0.01[b]	0.08±0.04[b]

Values are as Mean±SD. WG: Mean weight gain, PWG: percentage weight gain, ADG: Average daily growth, SGR: Specific growth rate. Values in the same column and with the same superscript are not significantly different (p>0.05)

Reproductive performance parameters: The hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) induced with ovaprim had the highest percentage fertilization (80±4.62%) while the lowest (30±2.31%) was recorded in the pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with FPE (Table 3). The percentage fertilization obtained in the pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) and hybrid treatments were significantly higher than the pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) and hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) induced with FPE.

The pure line (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with ovaprim had the highest (90±4.62%) hatching rate wile the lowest value (30±4.04%) was observed in hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) induced with FPE. The highest (81±2.31%) and lowest (50±4.62%) survival rates were recorded in pure breed induced with MPE and hybrid induced with ovaprim, respectively (Table 3).

Growth parameters: The growth parameters {Weight Gain (WG), Percentage Weight Gain (PWG), Average Daily Growth (ADG), Specific Growth Rate (SGR)} investigated in this study varied significantly ($p<0.05$) among the treatments (genetic crosses) (Table 4). The highest values for WG (5.46±1.48 g), ADG (0.39±0.11 g) and SGR (1.04±0.16%/day) occurred in pure breed induced with MPE while their lowest values {WG (0.15±0.05 g), ADG (0.01±0.01 g), SGR (0.08±0.04 %/day)} were obtained in the hybrid induced with FPE. However, PWG was slightly different. While the lowest values (13.80±3.76%) still occurred in hybrid induced with FPE, the highest value (122.63±38.40%) was found in hybrid induced with the synthetic hormone, ovaprim. The WG, PWG, ADG and SGR of the pure lines (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) and hybrids

Table 5: Nutrient utilization parameters of pure breed and hybrid of catfish (*Clarias gariepinus* and *Heterobranchus bidorsalis*) induced with synthetic hormone (Ovaprim) and pituitary glands of male and female *Heterobranchus bidorsalis*

Treatment	FI (g) (Mean±SD)	PI (g) (Mean±SD)	FCR (Mean±SD)	PER (Mean±SD)
Ovaprim				
(H. b ♀ x H. b ♂)	1.61±0.78^{a}	090.16±43.73^{a}	0.55±0.17^{a}	0.04±0.01^{a}
(H. b ♀ x C. g ♂)	3.18±1.70^{b}	177.96±94.98^{b}	1.13±0.86^{ac}	0.05±0.02^{a}
Male pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♂)	3.32±1.42^{b}	185.81±79.67^{b}	0.58±0.20^{a}	0.04±0.01^{a}
(H. b ♀ x C. g ♂)	2.70±1.02^{ab}	151.12±57.21^{b}	0.52±0.06^{a}	0.04±0.01^{a}
Female pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♂)	0.53±0.06^{c}	029.40±3.39^{c}	2.45±0.87^{bc}	0.01±0.01^{b}
(H. b ♀ x C. g ♂)	0.44±0.03^{c}	024.70±1.52^{c}	3.57±0.65^{b}	0.01±0.01^{b}

Values are as Mean±SD. FI: Feed intake, PI: Protein intake, 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)

Table 6: Parameters of length-weight relationship of pure breed and hybrid of catfish (*Clarias gariepinus* and *Heterobranchus bidorsalis*) induced with synthetic hormone (Ovaprim) and pituitary glands of male and female *Heterobranchus bidorsalis*

Treatment	A	B	r^2	k
Ovaprim				
(H. b ♀ x H. b ♀)	1.50	2.50	0.84	1.53
(H. b ♀ x C. g ♀)	2.13	0.02	0.88	1.08
Male pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♀)	0.83	1.89	0.96	1.56
(H. b ♀ x C. g ♀)	0.62	1.70	0.91	1.90
Female pituitary extract of *Heterobranchus bidorsalis*				
(H. b ♀ x H. b ♀)	0.47	0.76	0.69	0.53
(H. b ♀ x C. g ♀)	0.04	0.01	0.01	1.23

A: Initial growth coefficient, B: Growth exponent, r^2: Coefficient of determination, k: Condition factor.

(*H. bidorsalis* ♀ x *C. gariepinus* ♂) induced with ovaprim and MPE were significantly (p<0.05) higher than the pure breed and hybrid induced with FPE (Table 4).

Feed utilization: Table 5 shows the results of the feed utilization parameters. These parameters are Feed Intake (FI), Protein Intake (PI), Feed Conversion Ratio (FCR) and Protein Efficiency Ration (PER). The highest values for FI (3.32±1.42 g) and PI (185.81±79.67 g) were recorded in pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with MPE while the lowest values {FI (0.44±0.03 g), PI (24.70±1.52 g)} occurred in hybrid (*H. bidorsalis*♀ x *C. gariepinus* ♂) induced with FPE. The best FCR (0.52±0.06) was obtained in hybrid induced with MPE while the least (3.57±0.65) was recorded in hybrid induced with FPE. The values observed in PER were generally low (0.01±0.01-0.05±0.02). However, the PER of the pure lines and the hybrids induced with ovaprim and MPE were significantly (p<0.05) higher than the PER of pure breed and hybrid induced with FPE. The FI and PI of pure breeds and hybrids induced with MPE were not significantly (p>0.05) different from the values of these parameters obtained in the hybrid induced with ovaprim. However, they were significantly (p<0.05) higher than the FI and PI recorded for pure breed and hybrid induced with FPE.

Length-weight relationship: The result of the length-weight relationship revealed that the growth coefficient (b) for all the treatments (genetic crosses) were negatively allometric (Table 6).

The b-value varied between 0.01 in hybrid induced with FPE to 2.50 recorded in pure line induced with ovaprim. The coefficient of determination (r^2) for length-weight relationships was strong (0.84-0.96) in the pure breeds and hybrids induced with ovaprim and MPE. However, it was low (0.01) in hybrid induced with FPE. The condition factors varied between 0.53-1.90.

DISCUSSION

Most of the fishes responded well to hormone injection and spawned within 15-17 h (latency period) at temperature of about 28°C. This is in agreement with the findings of Adebayo (2006) who reported that broodstock of *C. gariepinus* injected with ovaprim spawned within 11-18 h (latency period) at a temperature range of 23.50-23.77°C.

The fertilization and hatching rates in pure breeds and hybrids induced with the synthetic hormone, ovaprim were significantly ($p<0.05$) higher than the values obtained for the pure lines and hybrids induced with FPE. This finding is in agreement with the study by Nwokoye *et al.* (2007). They reported that female *Heterobranchus bidorsalis* injected with ovaprim had significantly higher number of fertilized eggs and higher hatching rate than their counterparts injected with pituitary extract from *Heterobranchus bidorsalis*. This effect could be due to the presence of domperidone in Ovaprim. This substance suppresses the function of Gonadotropin-releasing inhibitor, i.e., dopamine, in the fish (Popesku *et al.*, 2008).

The weight gain, average daily growth and specific growth rate of pure breed induced with MPE were the highest. However, they were not significantly ($p>0.05$) different from the values of these parameters obtained in pure line and hybrid induced with ovaprim. A similar observation was reported by Ataguba *et al.* (2009) and Owodeinde and Ndimele (2011). Both studies reported that pure breeds of fish species performed better than their hybrids. However, the results of this studies is not in agreement with the studies by Ndome *et al.* (2011) and Adewolu *et al.* (2008), who reported that hybrid (*C. gariepinus* ♀ x *H. longifilis* ♂) had a better specific growth rate than the pure breed (*C. gariepinus* ♀ x *C. gariepinus* ♂). Olarewaju and Dada (1997) also reported that the hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) also called clariabranchus performed better than either of the parents because of its improved hybrid vigor. The cause of the inconsistencies in studies might be due to reasons such as experimental design, inherent variation in species and water quality factors.

The highest FI and PI were recorded in the pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with MPE. While these values were not significantly ($p>0.05$) different from those obtained in the hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) induced with ovaprim, they varied significantly ($p<0.05$) from the pure line (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with ovaprim. The highest PER was recorded in hybrid induced with ovaprim and this was significantly ($p<0.05$) different from the values obtained in pure breed and hybrid induced with FPE. The best FCR occurred in hybrid induced with MPE. This result is similar to the report from Chow and Halver (1980). that the hybrid (*H. bidorsalis* ♀ x *C. gariepinus* ♂) called clariabranchus possess adequate enzymes needed to digest and utilize protein. Also, Ojutiku (2008) reported that hybrid in most cases were superior to the parental strains in growth, food conversion and resistance to disease.

The pure breeds and hybrids used in this study had condition factors (K) greater than 1, except pure breed (*H. bidorsalis* ♀ x *H. bidorsalis* ♂) induced with FPE. This is similar to the result reported by Kumolu-Johnson and Ndimele (2011). They examined length-weight relationships of nine fish species from Ologe Lagoon, Lagos, Nigeria.

CONCLUSION

The need for the production of increased number of quality fingerlings of catfish for the growth of catfish culture in Nigeria and other African countries cannot be overemphasized. This study has shown that pure breed *Heterobranchus bidorsalis* and its hybrid called 'Clariabranchus' can be artificially propagated using synthetic and natural hormones. However, the pure breeds and hybrids obtained from induction with the synthetic hormone (ovaprim) and male pituitary extract performed better than those induced with female pituitary extract. Therefore, ovaprim and male pituitary extract are recommended for commercial aquaculture practice.

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