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Determination of Growth Performance of Intergeneric Hybridization of Heterobranchus Longifilis and Clarias Anguillaris

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Abstract: *Experiment on intergeneric hybridization of Heterobranchus longifilis (H. l) and Clarias anguillaris (C. a.) was carried out at the Toxicology unit, Fish Farm, Federal University of Technology (F.U.T.), Minna to determine growth performance and survival of the bred hatchlings. Pure crossing of H. l. (T_1), C. a. (T_2), intergeneric crosses of male H. l. with female C. a. (T_3) and male C. a with female H. l (T_4) serve as treatments. Each treatment was replicated three times. Percentage fertilization for T_1, T_2, T_3 and T_4 were 16.66 %, 40.00 %, 16.66 % and 40.00 % respectively, Percentage hatchability was 86.00 %, 22.22 %, 80.77 % and 1.64 % for T_1, T_2, T_3 and T_4 respectively. The bred hatchlings were maintained for 8 weeks and result shows that T_2 had the highest percentage survival (85.80 ± 12.90^a) and differed significantly P (< 0.05) from other treatments while T_4 (100.00 ± 00.00^a) recorded no survivor and differed significantly P(<0.05) to other treatments in term of percentage mortality. Length-weight relationship shows negative allometric. Weight gain in T_2 was (11.22 ± 1.50^a) and differed significantly P (<0.05) from other treatments. Heteroclarias (male H.l. crossed with female C. a.) (T_3) bred specie had the highest specific growth rate (SGR) 2.85 ± 1.2^a and it is therefore recommended for farmers to culture.*

Keywords: *Hybridization, Catfish, Hormone (Ovupin-L) and Induced breeding.*

I. Introduction

With the teeming world population, the demand for high quality protein on the aquatic resources particularly fish is rising dramatically. Increased aquaculture production is clearly needed to meet this demand because capture fisheries decline on daily basis due to climate change, over fishing, exploitation, habitat destruction and increasing fishers' population among others. The role play by aquaculture in socio economic development of any society cannot be over emphasized. It is geared towards diversifying fish production to meet local consumption, generate employment and to increase opportunities of foreign exchange earnings (Adikwu, 2003).

The genus Heterobranchus is similar in many respects to Clarias but can readily be differentiated from the Clarias by their rayed dorsal fin followed by an adipose fin. Like Clarias, Heterobranchus species have four pairs of barbell; on flattened large size strong depressed head. The flesh is less oily than that of Clarias gariepinus (Olaseobikan and Raji, 2003). Catfish exhibits many qualities that make it suitable as aquaculture candidate. These include ability to withstand stress, disease resistant, fast growth rate, high yield potentials, high fecundity and good taste among others. They can also withstand low dissolved oxygen (D.O) and pH level and grow on turbid water (Hecht et al., 1982; Nwadukwe, 2003). Due to its growth potentials Clariid catfish for aquaculture production needs improvement in terms of better growth and improved genetic trait in order to meet global demand (Salami et al., 1993). Fast growth results in shorter grow-out cycle and greater production capacity are advantageous for fish farmers. Success has been achieved with artificial hybridization of Clarias and Heterobranchus catfish at inter-specific and inter-generic levels to exchange character traits and improve production (Moses and Olufeagba). They defined hybridization as "the union or combination of gamates from two different species or strains to produce new organism". Hybridization method helps the fish farmer to select desirable fish characteristics of commercial importance such as fast growth, high percentage survival, resistance against unfavorable environmental and disease condition which can increase the profitability of the farmer (Moses and Olufeagba 2005). The easiest method to do this is to genetically improve on aquaculture stock or initiate a genetic improvement program to evaluate performance of strains to utilize the best available ones to replace the old stock (Legendre et al., 1992). Other advantages of hybridization include better food conversion ratio, increased vigour and phenotypic uniformity in cross bred progeny. It is on the basis of these derivable advantages that pure train and cross of H.l. and C.a. was carried out to determine the survival and growth rate of the bred hybrid.

II. Materials And Methods

Experimental site and Source of Brood stock

The research was carried out at the Toxicology unit, Fish farm, (F.U.T.), Minna. Matured brood stocks of Heterobranchus longifilis and Clarias anguillaris measuring about 800-1000 g were sourced from the Biotechnology unit of National Institute of Fresh water Fisheries Research (NIFFR), New-Bussa. They were acclimatized for four days prior to selection and treatment.

Feeding of Brood stock, Selection and Hormonal Injection

The brood stocks were fed with commercial diet (6 mm coppens) and thereafter selected based on certain criteria. Males were examined for rigid and reddish infusion of the genital orifice particularly at the tip and for females, genital orifice for reddish infusion, distension of the belly and release of eggs when gentle pressure was applied on the abdomen. The selected samples were properly maintained separately by ensuring good water quality management and adequate feeding before being used for breeding. The matured brood stocks were treated with a single dose of hormone (Ovupin-L) according to the method of De Leeuwi et al. (1985) and Goudie et al. (1992). Injection was given intraperitoneally.

Milt and Eggs Collection and Incubation

Dry fertilization method was used for fertilization. Eggs were stripped from female brood stock into a clean plastic bowl by applying gentle pressure on both sides of the abdomen towards the genital opening after a minimum latency period of about 10 and 12 hours respectively for C. a. and H. l. with water temperature of about 27-29 ^{0} C. The male brood stocks were sacrificed to remove testes to extract milt to fertilize eggs. The milt and eggs were then mixed together gently with a plastic spoon for 2-3 minutes. Small quantity of saline solution was then poured onto the eggs to avoid sticking together. The fertilized eggs were then rinsed with distilled water and introduced into the incubation chamber for incubation. Mosquito net placed inside plastic bowls that contain clean water was used for the purpose.

Experimental Crosses of the Parent Brood stocks

Male		**Female**	
Pure Strain			
Heterobranchus longifllis	X	Heterobranchus longifilis	(T_1)
Clarias anguillaris	X	Clarias anguillaris	(T_2)
Intergeneric Crosses			
Heterobranchus longifllis	X	Clarias anguillaris	(T_3)
Clarias anguillaris	X	Heterobranchus longifilis	(T_4)

Fertilized eggs were spread in a monolayer on the mosquito net in the incubator. Aeration was maintained by flow through system. The dead eggs on the net were removed and those that fell into the container were siphoned. When hatching was completed, 150 fry were stocked per plastic bowl and reared for 8 weeks. The hatchlings were fed with hatched artemia cysts after yolk absorption thereafter the fry were fed with floating feeds (0.2 mm Coppens) of 40 % crude protein at 4 hours interval. Water quality parameters such as temperature, Dissolved Oxygen, pH and Conductivity were monitored and maintained at optimum levels. The morphometric measurements of the hatchlings were determined using sensitive electronic scale (P.E. Balance mx Rady 300 g max). The percentage fertilization, hatchability, survival, mortality and specific growth rate were determined using the following formulae:

$$\% \text{ Fertilization} = \frac{\text{Total number of fertilized eggs}}{\text{Total number of eggs stripped}} \times 100 \quad \text{(equation 1)}$$

$$\% \text{ Hatchability} = \frac{\text{Total number of hatched eggs}}{\text{Total number of eggs fertilized}} \times 100 \quad \text{(equation 2)}$$

$$\% \text{ Survival} = \frac{\text{Cumulative number of survival}}{\text{Total number of fish stocked}} \times 100 \quad \text{(equation 3)}$$

$$\% \text{ Mortality} = \frac{\text{Cumulative number of mortality}}{\text{Total number of fish stocked}} \times 100 \quad \text{(equation 4)}$$

$$\text{Specific Growth Rate} = \frac{\text{Log final weight- Log initial weight}}{T_2-T_1} \times 100 \quad \text{(equation 5)}$$

Log = Natural logarithm, T_2 = Time two and T_1 = Time one.

Experimental Design and Statistical Analysis

Completely Randomized Design (CRD) was used for the experiment. The data obtained were subjected to one way analysis of variance (ANOVA) and all differences in mean values of parameters were determined at P = 0.05 level of significance. The coefficient regression equation was used to determine the length/weight relationships. Also Duncan Multiple range Test was used for mean separation.

III. Results

The result in Table 1 shows that T_2 had the highest percentage fertilization (40.00 %) while T_1 recorded highest percentage hatchability (86.00 %) as T_4 had the least percentage hatching of 1.64 %. The result in Table 2 indicates that T_2 had the highest percentage survival of 85.80 ± 12.90^a and differed significantly ($P< 0.05$) among other treatments as T_4 recorded no survivor. Also, the result in Table 3 shows cumulative mean initial and final weight, weight gain and specific growth rate. T_2 had the highest weight gain of 11.22 ± 1.50^a and differed significantly ($P<0.05$) to other treatments. The table also shows that T_2 and T_3 had the highest specific growth rate of 2.84 ± 0.80^a and 2.85 ± 1.20^a respectively. Meanwhile the result in Table 4 shows the cumulative mean values of water quality parameters of pure strains and hybrids of Heterobranchus longifilis and Clarias anguillaris bred and reared in plastic bowls and monitored for 8 weeks. Values of all the water quality parameters measured were within the tolerance range of warm water fishes. The results in Figure I, II and III shows the regression and coefficient of the relationship between length and weight of bred and reared pure strains and hybrids of Heterobranchus longifilis and Clarias anguillaris hatchlings for 8 weeks.

IV. Discussion

The highest percentage fertilization in T_2 and hatching in T_1 and T_3 was attributed to egg and milt quality and viability. This corroborates the work of (Moses and Olufeagba (2005) on karyomorphology of African catfish, Heterobranchus longifilis where low hatchability of (22.50 % and 1.64 %) were recorded due to egg colour (white). The highest survival in T_2 and T_3 was similar to the result obtained by (Madu et al., 1992) when the authors conducted a research on intergeneric hybridization of Clarias gariepinus and Heterobranchus bidorsalis and obtained percentage survival (85.00 %) in indoor management. High survival rate was attributed to egg viability and milt quality that resulted in vigour hatchlings which increases chances of high survival rate. The 100 % mortality observed in T_4 might be due to a number of factors: poor quality of eggs and milt, only small quantity of eggs was stripped; transition from yolk sac feeding to exogenous feeding as observed by Nlewadin and Madu (2004). The values obtained for the water quality parameters measured corroborates the report of Pandey (2004) and Adekoya et al. (2004).The relationship between length and body weight of bred and reared pure strains and hybrids of Heterobranchus longifilis and Clarias anguillaris hatchlings show strong relationship as all the values obtained indicates negative allometric since an increase in y- value (length) led to increase in x- value (body weight). This observation was made by Gupta and Gupta (2013) that good response to feed by fish made it robust, plumpy and healthier.

V. Conclusion

From the research conducted, it was revealed that the intergeneric cross between male Heterobranchus longifilis and female Clarias anguillaris (T_3) had highest specific growth rate (SGR).

VI. Recommendation

Base on the aforementioned it is recommended that hybrid of male Heterobranchus longifilis and female Clarias anguillaris (Heteroclarias) should be culture by fish farmers due to its fast growth rate.

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Table 1: Percentage Fertilization and Hatchability for Intergeneric Hybridization of Heterobranchus longifilis and Clarias anguillaris reared in Plastic Bowls for 8 Weeks.

PARAMETERS		TREATMENTS		
	I	II	III	IV
% Fertilization	16.66	40.00	16.66	40.00
% Hatchability	86.00	22.22	80.77	1.64

Table 2: Cumulative Mean Percentage Survival and Mortality of Pure Strains and Hybrids Heterobranchus longifilis and Clarias anguillaris Reared in Plastic Bowls for 8 Weeks

PARAMETERS		TREATMENTS		
	I	II	III	IV
% Survival	63.10 ± 12.8^{b}	85.8 ± 12.9^{a}	78.60 ± 21.2^{ab}	0.00^{c}
% Mortality	36.30 ± 12.8^{a}	14.18 ± 12.9^{b}	21.39 ± 21.2^{ab}	100.0^{a}

All values on the same column carrying different superscript differed significantly ($p<0.05$) from each other.

Table 3: Cumulative Mean Initial and Final Weight, Weight Gain and Specific Growth Rate of Pure Strains and Hybrids Heterobranchus longifilis and Clarias anguillaris reared in plastic bowls for 8 weeks

PARAMETERS		TREATMENTS		
	I	II	III	IV
Initial weight	4.65 ± 1.5^{a}	4.89 ± 2.7^{a}	3.69 ± 2.3^{a}	0.80
Final weight	8.77 ± 1.8^{c}	16.11 ± 4.1^{a}	11.22 ± 3.2^{b}	-
Weight gain	4.12 ± 0.8^{b}	11.22 ± 1.5^{a}	8.52 ± 1.3^{b}	-
SGR	1.55 ± 0.7^{b}	2.84 ± 0.8^{a}	2.85 ± 1.2^{a}	-

All values on the same column carrying different superscript differed significantly ($p<0.05$) from each other. SGR= specific growth rate.

Table 4: Cumulative Mean Water Quality Parameters of Pure Strains and Hybrids Heterobranchus longifilis and Clarias anguillaris Reared in Plastic Bowls for 8 weeks

PARAMETERS		TREATMENTS	
	I	II	III
Temperature (^{o}C)	29.0 ± 1.9^{a}	28.4 ± 1.5^{a}	29.0 ± 1.2^{a}
pH	7.5 ± 0.4^{a}	7.2 ± 0.4^{a}	7.4 ± 0.3^{a}
Dissolved Oxygen (mg/l)	5.3 ± 0.2^{a}	5.3 ± 0.2^{a}	5.2 ± 0.2^{a}
Conductivity (µs/cm)	1.9 ± 19.6^{a}	1.9 ± 7.1^{a}	1.9 ± 11.4^{a}

All values on the same column carrying the same superscript did not differed significantly ($p>0.05$) from each other.

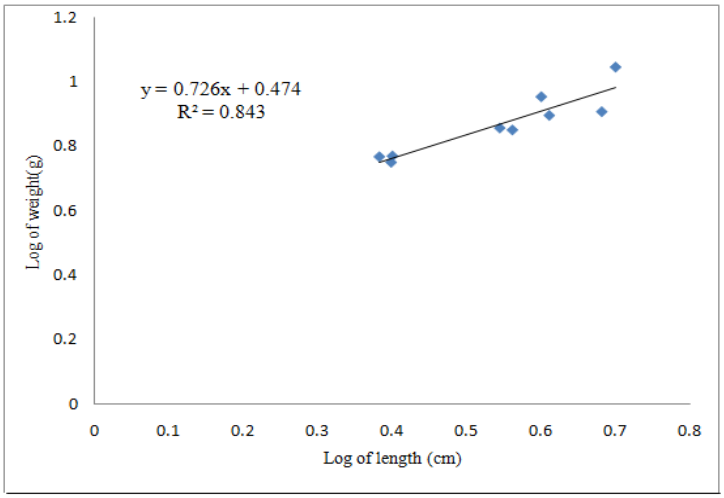

Figure I: Relationship between length and weight of pure strains Heterobranchus longifillis hatchlings bred and reared in plastic bowls for 8 weeks (T_1).

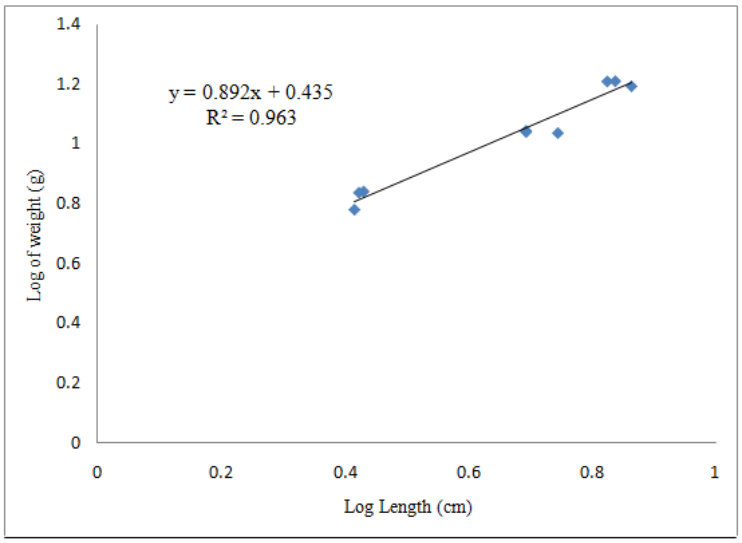

Figure II: Relationship between length and weight of pure strains Clarias anguillaris hatchlings bred and reared in plastic bowls for 8 weeks (T_2).

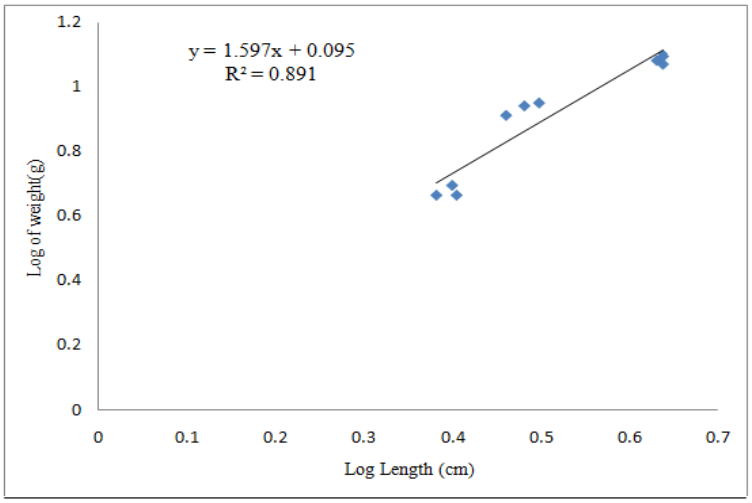

Figure III: Relationship between length and weight hybrids of Heterobranchus longifilis and Clarias anguillaris hatchlings bred and reared in plastic bowls for 8 weeks (T_3).