Asian Journal of Research in Animal and Veterinary Sciences

4(3): 1-7, 2019; Article no.AJRAVS.51319

Breeding Response of *Clarias gariepinus* Induced with Pituitary Gland and Synthetic Hormone (Ovulin) and the Effect on Growth Performance of Its Hybrid in New Bussa, Nigeria

J. Z. Ibrahim[1*], S. O. Ovie[1], H. F. Maradun[1], F. P. Asuwaju[1], Y. S. Mohammed[1], A. M. Sahabi[2] and F. Umar[3]

[1]Aquaculture and Biotechnology Programme, National Institute for Freshwater Fisheries Research, New Bussa, Nigeria.
[2]Department of Agricultural Technology, College of Agriculture and Animal Science Wurno, Nigeria.
[3]Department of Fisheries and Aquaculture, Usmanu Danfodiyo University, Sokoto, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors JZI and SOO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HFM and FPA managed the analyses of the study. Authors YSM, AMS and FU managed the literature searches. All authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Hager Tarek Hassan Ismail, Assistant Professor, Department of Clinical Pathology, Faculty of Veterinary Medicine, Zagazig University, Egypt.
Reviewers:
(1) Paria Akbary, Maritime University, Iran.
(2) Byron Baron, University of Malta, Malta.
Complete Peer review History: https://sdiarticle4.com/review-history/51319

Original Research Article

Received 27 June 2019
Accepted 10 September 2019
Published 19 September 2019

ABSTRACT

A study on the effect of using different hormones (Dry pituitary, Fresh pituitary and Synthetic hormone) on the breeding performance of *Clarias gariepinus* and growth response of the resultant hybrid was carried out. The experiment was conducted in a Completely Randomized Design at the Hatchery Complex of National Institute for Freshwater Fisheries Research, New Bussa, Nigeria. The treatments were T1 (Inducement with Dry pituitary gland), T2 (Inducement with Fresh pituitary gland) and T3 (Inducement with Ovulin synthetic hormone). The result of the study showed that there were significant differences ($P<0.05$) in all the treatment means in terms of fertilization and

**Corresponding author: E-mail: zarauj@gmail.com*

hatching rate. However, all the growth performance parameters tested (final weight, mean weight gain, specific growth rate, survival rate and condition factor), showed no significant difference (P>0.05). The Pituitary extract treatments were observed to have fish of higher growth than those of synthetic hormone (Ovulin). However, dried pituitary extract (T1) was observed to have better growth performance than fresh pituitary extract (T2) and synthetic hormone (ovulin). Based on the findings of this study therefore, dried pituitary extract is recommended for induced breeding of African catfish.

Keywords: African catfish; Clarias gariepinus; pituitary gland; synthetic hormone.

1. INTRODUCTION

Aquaculture in Nigeria is in the developing stage, because it has not been able to meet the demand and supply of the ever increasing population [1]. On a global perspective, it is one of the fastest growing food producing sectors and fish is among the most traded food commodities accounting for 17 percent of world-wide intake of animal protein [2]. Catfish is very important to the sustainability of the aquaculture industry in the country. Clariid catfish is the most sought after fish species among fish farmers and consumers because it commands a very good commercial value in Nigerian markets [3]. According to [4] *Clarias* and *Heterobranchus* are the two species most readily acceptable in Nigeria, because they grow to large sizes. African catfish hardly reproduces in captivity but with the popular induced breeding technique (artificial method of spawning, incubation and hatching of eggs under controlled environmental conditions), it has been made possible to produce fish seed all year round [5]. Aquaculturists have been able to harness the qualities of these two species by cross-breeding them to produce a hybrid (*Heteroclarias*) which is hardy and grows to a large size [6,7]. In Africa, especially in Nigeria, the species mostly cultured are *Clarias gariepinus, Heterobranhcus species* and their hybrids. The reasons for their culture are based on their fast growth rate, disease resistance, high stocking density, aerial respiration and high feed conversion efficiency among others. Improving growth rate will decrease the time it takes to grow a fish to marketable size which is advantageous for fish farmers. This will increase production efficiency, fish production and farmer's income. Pan and Zheng [7] mentioned that intra specific hybridization of fish has been considered to combine valuable traits from two or more species to obtain hybrids that exceed both parents' species. Fast growing species obtained from these crosses are often cherished by many farmers.

However, in spite of the breakthrough reported for its artificial propagation [8,9,10], the demand for fish seed still outstrips supply. Pan and Zheng [7] reported that the problem of inadequate supply of fish seed can only be solved through induced breeding by the application of various inducement materials. Various types of fishes have been induced to spawn using various hormonal materials [11,12]. Hypophysation has been used to achieve mass production of African Catfish. Hormone substances used in hypophysation include acetone dried carp pituitary at 4 mg/kg for *C. gariepinus* [13,10] or fresh pituitary gland by matching weight to weight in a recipient/donor fish. Other substances used are mammalian hormones like Human Chorionic gonadotropin (HCG) [14]. Production has also been achieved by using other substances like; Luteinizing Hormone (LH) or Follicle stimulating hormone (FSH), and deoxycorticosterone acetate (DOCA) which only induces pre-ovulation [7]. Some of these spawning agents are either difficult to quantity, ineffective or of short shelf life, and for that, many breeders are reluctant to use them in field conditions. However, the commercially available synthetic inducing hormones in ready-made form containing GnRHa and dopamine (Ovaprim, Ovopel, Ovulin, Ovatide, Dagin and Aquaspawn) are becoming very popular and found to be efficient in successful spawning of fishes [15,16,17].

Some of these hormonal materials (natural and synthetic) include HCG [18]; Clomiphene citrate [19], pituitary extract [20,21] and Ovaprim [22] [23]. Therefore, there is a need to compare the effectiveness of these hormones and establish their cost benefits.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The study was conducted at the hatchery complex of the National Institute for Freshwater

Fisheries Research (NIFFR), New Bussa, Niger State, Nigeria. Broodstock of *Clarias gariepinus* and *Heterobranchus bidorsalis* were sourced locally. The mature females were selected based on their swollen, reddish vent, well distended soft abdomen and extraction of few eggs on gentle running of finger on the abdomen. Ripe males were selected based on their reddish urino-genital papilla.

The experimental fish consisted of 18 broodstocks (9 female *C. gariepinus* as breeders, 6 male *C. gariepinus* as pituitary donors and 3 male *H. bidorsalis* as sperm donors; each male fertilizing 1 treatment. The broodstocks were divided into three treatments, thus; T1 (3 females were induced with 3 dried pituitary glands of male *C. gariepinus*), T2 (3 females were induced with 3 fresh pituitary gland of male *C. gariepinus*) and T3 (3 females were induced with synthetic hormone ovulin). The pituitary glands of *C. gariepinus* were extracted according to the ventral method as described by [8]. The dried pituitary glands were preserved in Moko Methylated spirit which contains 95% isopropyl alcohol for one month. The females were stripped of eggs following a gentle pressing of finger on the abdomen after 12 hours latency period. The eggs were collected into a clean, dry petri-dish and kept with labels. The testes of the male *Heterobranchus* were cut open using razor blade and the milt was squeezed out into petri dish containing the eggs to fertilize them.

The genetic mating combination was as follows:

♂ *Heterobranchus bidorsalis* x♀ *Clarias gariepinus*

The fertilized eggs were spread on the kakaban (spawning mat/tray) in indoor concrete tanks for hatching. At the fourth day of hatching, the fry were fed with artemia for the first two weeks. Hybrid fry were later randomly distributed into triplicate tanks of the same dimension (2 m x 2 m) at the outdoor section of the hatchery complex. The experiment was carried out for a period of eight (8) weeks. Weights of the fish were measured every week to assess the productivity in order to ascertain which of the hormones gives optimal production.

Fertilization rate was calculated by the following equation according to [24].

The Fertilization Rate = (Number of fertilized eggs / Total number of eggs counted) x 100

The eggs were then transferred to their original lot for hatching.

After hatching, the numbers of hatchlings within each batch were carefully counted and the hatching rate was calculated using the following equation according to [25].

Hatching Rate = (Number of eggs hatched / Total number of eggs in a batch) x 100.

2.2 Growth Performance

Mean weight gain (MWG) was determined from the difference between final weight gain and mean initial weight.

Specific Growth Rate (SGR) was determined from $In(W_2-W_1)/t$. Where W_2 and W_1 are final weight and initial weight respectively. And t is the duration (time period of the experiment).

Condition factor (K) =100 x Weight of fish (g)/Length of fish $(cm)^3$

Survival rate (%) = Final number of fish/Initial number of fish x 100

2.3 Water Quality Analysis

The water quality parameters were monitored throughout the culture period. Dissolved oxygen (DO) was analyzed using a digital dissolved oxygen meter; pH and temperature were measured using a hand held portable dual pH meter while conductivity was measured using a conductivity meter.

3. RESULTS AND DISCUSSION

Artificial breeding of hybrids *C. gariepinus* ♀ x *H. bidorsalis* ♂ was successfully carried out through the use of synthetic hormone (ovulin), dried and fresh pituitary gland extracts of male *C. gariepinus.*

The percentage fertilization and hatching rate of the eggs showed significant difference ($P<0.05$) in each of the treatments (Table 1). The highest percentage fertilization (80.47±4.72%) and percentage hatching rate (75.46±4.32%) was observed in T1 compared to T2 with fertilization rate of 51.27±3.57%; hatching rate of 46.03±3.72% and T3 with fertilization rate (34.00±6.57%) and hatching rate (36.03±3.61%) respectively. This result did not agree with the studies by [18] who reported in their study that the fertilization and hatching rate for pure *C.*

gariepinus induced with synthetic hormone (ovaprim) had the highest percentage (88.44±5.74%) and (71.76±0.18%) while the lowest performance was (31.92±0.07%) and (28.45±0.48%) of hybrid *Heteroclarias* induced with female pituitary extract of *C. gariepinus* respectively. The difference in percentage obtained in this study and previous ones might be due to difference in species and experimental design. All the growth parameters tested, survival rate and condition factor however showed no significant difference (P>0.05). T2 (8.33±0.64%) had the highest value of specific growth rate, compared to T3 (8.17±0.40%) and T1 (7.50±0.10%). The highest mean final weight of 7.17±4.45 g and mean weight gain of 5.35±1.40 g was observed in T1 and this agrees with the result obtained by [19] who reported that *H. bidorsalis* induced with male pituitary gland had the highest value for mean weight gain (5.46±1.48 g). T2 in this experiment had the highest value for survival rate (58.20±12.56%) compared to T1 (50.00±11.10%) and T3 (37.67±14.09%). The study also revealed that the fish generally had a condition factor (K) of less than 1. This result should however not portray the fishes as being in bad state. This is due to their allometric growth pattern, where the length increased more than the weight. This view is supported by the study of [20] on growth patterns of four dominant fish species in Ona Lake. They opined that fishes with allometric growth patterns often have K values of less than 1.

The result of water quality parameters for fish under culture is presented in Table 2. The mean dissolved oxygen of the treatments were between 8-9 mg/l, water temperature was about 29°C, atmospheric temperature ranged between 27.5-27.8°C, pH mean values ranged between 7.0-7.6 and conductivity ranged between 80-85. These values fall within the range for warm water fish culture [26]. The weekly weight gain of the hybrid at 8 week culture period is presented in Fig. 1.

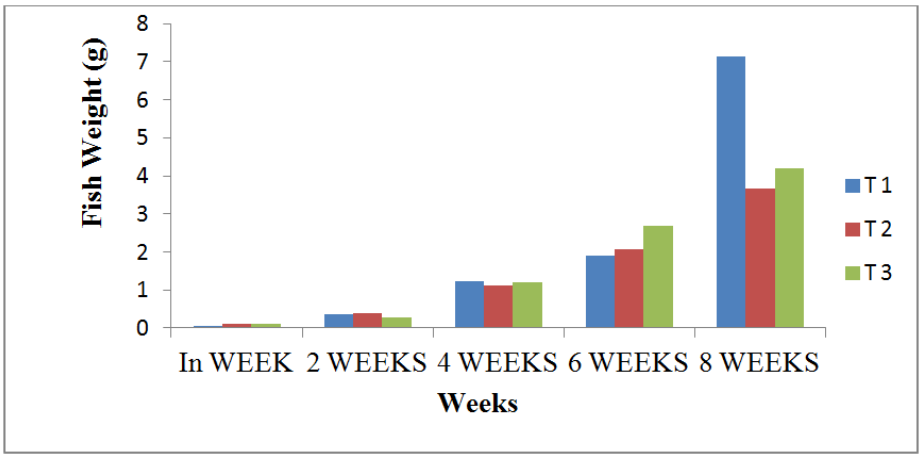

Fig. 1. Weekly weight gains of hybrid catfish

Table 1. Fertilization, hatching, survival rate, growth parameters and condition factor of hybrid induced with pituitary and synthetic hormone

Parameters	Hormone		
	Dried Pituitary (T1)	Fresh Pituitary (T2)	Synthetic Hormone (T3)
Fertilization rate (%)	80.47±4.72^{c}	51.27±3.57^{b}	34.00±6.57^{a}
Hatching (%)	75.46±4.32^{c}	46.03±3.72^{b}	36.03±3.61^{a}
Final weight (g)	7.17±4.45^{a}	3.70±0.56^{a}	4.23±0.58^{a}
MWG (g)	5.35±1.40^{a}	3.60±0.55^{a}	5.16±1.58^{a}
SGR (%)	7.50±0.10^{a}	8.33±0.64^{a}	8.17±0.40^{a}
Survival rate (%)	50.00±11.10^{a}	58.20±12.56^{a}	37.67±14.09^{a}
Condition factor (K)	0.75±0.30^{a}	0.48±0.05^{a}	0.49±0.21^{a}

Means with the same superscripts on the same row are not significantly different (P>0.05)

Table 2. Ranges of water quality parameters recorded during the experiment

Treatments	DO	PH	Conductivity	Water Temp	Atmospheric Temp
T1	8.2-9	6.5-7.0	75-80	28.2-29.0	26.5-27.5
T2	7.6-8	6.8-7.6	71-80	27.0-29.0	23.4-27.6
T3	7.1-8	6.8-7.4	77-85	28.1-29.0	24.9-27.8

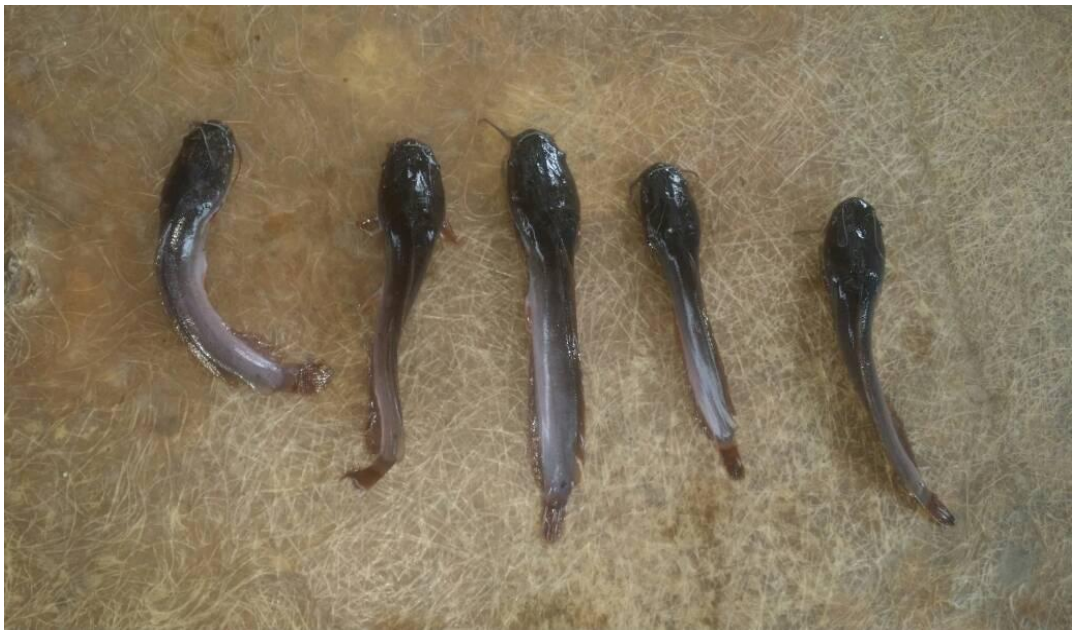

Fig. 2. *Heteroclarias* fingerlings resultant from inducement with dry pituitary

Fig. 3. *Heteroclarias* fingerlings resultant from inducement with fresh pituitary

Fig 4. *Heteroclarias* fingerlings resultant from inducement with synthetic hormone (ovulin)

4. CONCLUSION

The result of this study showed that there were significant differences ($P<0.05$) in all the treatment means in terms of fertilization and hatching rate. And all the growth performance parameters tested (final weight, mean weight gain, specific growth rate, survival rate and condition factor), however, showed no significant difference ($P>0.05$). The Pituitary extract treatments were observed to have fish of higher growth than those of synthetic hormone (Ovulin). However, dried pituitary extract (T1) was observed to have better growth performance than fresh pituitary extract (T2) and synthetic hormone (ovulin) which has the least growth performance. Based on the findings of this study therefore, dried pituitary extract is recommended for induced breeding of African catfish.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Solomon JR, Ezigbo MN. Polyculture of Heteroclarias tilapia under different feeding regimes. New York Science Journal. 2010;3(10):42-57.
2. FAO. The state of world fish aquaculture opportunities and challenges. Food and Agricultural Organization of the United Nations, Rome. 2014;22.
3. Oladosu GA, Ayinla OA, Adeyemon AA, Yakubu AF, Ajani AA. Comparative study of reproductive capacity of the African Catfish species *Heterobranchus bidorsalis, Clarias gariepinus* and their hybrid. Port Harcourt: African Regional Aquaculture Centre Tech. Paper 92; 1993.
4. Benedict OO, Yemi AS, Isaac TO. Aspects of ecology of *Clarias anguillaris* (Teleostei: *Clariidae*) in the Cross River, Nigeria. Turkish Journal of Fisheries and Aquatic Sciences. 2010;10:101-110.
5. Ekelemu JK, Zelibe SAA. Growth pattern and condition factors of four dominant fish species in Ona Lake, Southern Nigeria. Journal of Fisheries International. 2006;1(2):157-162.
6. Richter CJJ, Van der Hurk AJ. Effect of II-deoxycorticosterone acetate and carp pituitary suspension in follicle maturation of ovaries of African catfish *Clarias lazera* (C and V). Aquacul. 1982;29:53-66.
7. Pan IH, Zheng WB. Study on the artificial crossing of *Tilapia fuscus* with *Clarias parera* and the culture effect of the hybrids. Hydrobiology. 1986;10(1):96.
8. Madu CT, Omorinkoba WS, Pandogari A. Production of *Clarias anguilaris* (Mudfish) fry and fingerlings under indoor and outdoor hatchery management conditions. NIFFR Ann. Rep. 1987;36–40.
9. Madu CT, Ita EO, Omorinkoba WS, Pandogari A. Induced spawning technique of mud fish *Clarias anguillaris* (L). NIFFR Tech. Pap. Ser. 1989;17:2-8.

10. Nwadukwe FO. Inducing oocyte maturation, ovulation and spawning in the African catfish *Heterobranchus longifilis* (Valenciens Pisces: Clariidae) using Frog pituitary extract. Aquacul. Fish. Man. 1993;24:625-630.
11. Nwuba LA, Aguigwo JN. Studies on the effects of different food items on the survival of *Clarias anguillaris*. J. Aqua. Sci. 2002;17(2):121-124.
12. Eyo JE. The influence of human chorionic gonadotropin (HCG) on female *Clarias gariepinus* ovarian development. T. Zool. 2001;1:35-40.
13. Hogendoorn H, Visman MM. Controlled propagation of the African catfish *Clarias lazera* 2: Artificial reproduction. Aquaculture. 1980;21:39-53.
14. Olubiyi OA, Ayinla OA, Adeyemo AA. The effects of various doses of ovaprim on reproductive performance of the African catfish *Clarias gariepinus* (Burchell) and *Heterobranchus longifilis* (Valaenciennes). African Journal of Applied Zoology & Environmental Biology. 2005;7:101-105.
15. Brzuska E. Artificial spawning of European catfish *Silurus glanis* L.: Differences between propagation results after stimulation of ovulation with Carp pituitary and Ovopel. Aquacult. Res. 2001;32:11-19.
16. Cheah MS, Lee CL. Induced ovulaion of the Australian eel-tailed catfish Neosilurus ater (Perugia) with ovaprim. Asian Fisheries Science. 1980;13:87-96.
17. Nandeesha MC, Rao KG, Jayannan RN, Parker NC, Varghese TJ, Keshavanath P, et al. Induced spawning of Indian major carps through single application of Ocaprim-C. Tokyo, Japan: The Second Asian Fisheries Forum; 1990.
18. Aguigwo JN. Ovulation in *Clarias albopunctatus* and *Heterobranchus longifilis* (Curvier & Valenciences) using clomiphenecitrate. J. Aquat. Sc. 1991;7(1): 1-6.
19. Megbowon I, Fashina-Bombata HA, Akinwale MMA, Hammed AM, Okunade OA, Mojekwu TO. Breeding performance of *Clarias gariepinus* obtained from Nigerian waters. IOSR J. Agric. and Vet. Sci. 2013;6(3):6-9.
20. Adebayo OT. Reproductive performance of African Clariid Catfish *Clarias gariepinus* broodstock on varying maternal stress. Journal of Fisheries International. 2016;1(1-2):17-20.
DOI: jfish.2006.17.20
21. Janssen JAL. Elevage du poisson-chat Africain *Clarias lazera* (Cur & Val 1840). EnRepublique Centra fricaine I: Propagation artificielle. FAO Project/ CAR/007/NET Banguo CAR DDC Tech Paper 20. 1984;100.
22. Haniffa MA, Merlin RT, Francis T. Induced spawning of the stripped murrel *Channa striatus* using pituitary extracts human chorionic gonadotropin luteinizing hormone releasing hormone analogue and ovaprim. Acta Icht. Piscat. 2006;30:53-60.
23. Manosroi J, Meng-Umphan K, Manosroi A. Maturation induction of *Pangasius hypophthalamus* using gonadotropin releasing hormone analogue (GnRHa) in combination with domperidone in oil suspension dosage form. Asian Fish. Sci. 2004;17:39-49.
24. Madu CT. Introducing fish farming/ Aquaculture and the Entrepreneurial opportunities an overview. Federal Collage of Freshwater Fisheries Technology (FCFFT), New Bussa, Niger State; 2016.
25. Ndimele PE, Owodeinde FG. Comparative reproductive and growth performance of *Clarias gariepinus* (Burchell,1822) and its hybrid induced with synthetic hormone and pituitary gland of *Clarias gariepinus*. Turkish Journal of Fisheries and Aquatic Sciences. 2012;12:619-626.
26. Boyd CE. Water quality in warm water fish ponds. Auburn University Agricultural Experimental Station, Auburn, Alabama. 1979;358.

Peer-review history:
The peer review history for this paper can be accessed here:
https://sdiarticle4.com/review-history/51319