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Comparative Evaluation of Efficacy and Cost of Synthetic and Non-Synthetic Hormones for Artificial Breeding of African Catfish (*Clarias gariepinus* Burchell, 1822)

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Abstract: The efficacy and cost of utilization of the pituitary extract of African bull frog (*Rana adspersa*) (FPE) and *Clarias gariepinus* (CPE) and *Ovaprim* in the artificial breeding of the African catfish *Clarias gariepinus* was compared. The extraction and dosage are discussed along side the preliminary rearing of fries in the outdoor hatchery tanks. Three *C. gariepinus* were injected with 0.5 mL of *Ovaprim* in one dose while the remaining six were injected with the pituitary extract of frog (*Rana adspersa*) and *C. gariepinus* pituitary extract in one dose at the rate of 1 mL kg^{-1} of the glands. *C. gariepinus* injected with *Ovaprim* had the highest percentage fertilization (84.5%) which was significantly different from other treatments. Percentage hatchability was high and ranged from 51.5-73.0% in the different hormones treatments. The percentage hatchability shows similar pattern to percentage fertilization and latency period was 12 h for all the treatments. The cost of production was highest in CPE followed by *Ovaprim* and least in FPE and were significantly different ($p<0.05$) from one another. The results show that the synthetic hormone (*Ovaprim*) is more effective than the Frog Pituitary Extract (FPE) and Clarias Pituitary Extract (CPE).

Key words: African catfish, *Clarias gariepinus*, bull frog, *Rana dispersa*, artificial breeding

INTRODUCTION

Fish is the primary source of animal protein for an estimated 1/6th of the world's population and it contributes about 70% of the world total food supply. The average daily protein intake of Africans is very low (compared with the required value). This resulted to all sort of malnutrition-related diseases, especially among the young people. Consider Nigeria, fish was once the cheapest and most available source of animal protein. The highest cost of fish today is attributed to low supply caused by low productivity of large rivers and lakes that are already over-exploited because of indiscriminate fishing methods and very few numbers of fish farms some which are badly managed.

Malnutrition has long been recognized is a major factor adversely affecting the health, well being and socio-economic development of the people in the developing countries. It is a major cause of childhood morbidity and mortality, very high proportion of low birth-weight babies, poor outcome of pregnancies and maternal health. FAO as far back as 1977 has declared that at least one billion people in developing countries do not have adequate nutrition while 38% of children under the age of six years in these countries suffer from moderate to severe under nutrition.

The main cause of malnutrition is inadequate protein in the diet due to low supply of protein. Yet the potential of increasing fish (the best source of protein) supply is there only of if attention is given to fish farming.

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A dependable source of quality fish seed (fingerlings) is a fundamental pre-requisite for large scale development of fish culture. The scarcity of fish seed is a major factor that affects all attempts to culture fish.

Many of the fish farmers are presently able to produce their own fish seed because they lack both the technique and logistics to do so. As a result, farmer still depend on Federal or state fisheries department or on very few individuals that own hatcheries.

Fingerlings are obtained for stocking of ponds from three major ways: This include collection from the wild, crossing i.e., putting male and females' together and artificial breeding. In artificial breeding otherwise known as hypophysation is practiced to produce fingerlings of fishes like Carps, clariids and bagrids with the involvement of reproductive hormone. This reproductive hormone could either be artificial or natural hormone and it is hoped that this work would help farmers to decide on the type of hormone to be used in inducing breeding, so that there will be enough fingerlings and subsequently increase the supply of fish resulting in a rise in the amount of animal protein which is in form of fish, thereby leading to a reduction in malnutrition and death.

This research is done to compare the use of natural and artificial hormones in terms of their efficacies hatchability, survival rate and the overall cost expended when both hormones are used differently.

MATERIALS AND METHODS

The project was carried out at the teaching and research farm of the Federal University of Technology, Akure, Nigeria. Mature male and female *Clarias gariepinus* (Holandis) was procured from a reputable fish farm at Akure. Induced spawning trials were conducted between May and June 2006 to coincide with the peak of the rainy season; which also corresponds to its breeding period. The fishes were properly disinfected with a mild concentration of salt before being stocked into brooder ponds where they were acclimatized for 28 days prior to the induced spawning trials. The fishes to be used were selected using the method described by Viveen *et al*. (1985).

Before the fishes were selected for spawning, they were placed in the concrete tanks (1.0×2.0×1.5 m). The concrete tanks were prepared by scrubbing thoroughly and then disinfecting with concentrated salt solution after which several changes of water from the pond were flushed into the tank to remove the salt. Kakabans made from disinfected jute bags were placed inside the spawning tanks (nine in number).

The frogs were weighed live using a metler top loading balance (PB870) after which the animal were killed to remove pituitary using the method described by Fagbenro *et al*. (1991). The extracts were prepared using the method described by Viveen *et al*. (1985).

The same method used for preparation of frog pituitary was used for clarias. *Ovaprim* purchased from a reputable source were drawn into 5 mL hypodermal syringe. The quantity of *Ovaprim* used was commensurate with the weight of the fishes to be injected (0.5 mL kg^{-1} for female and 0.25 mL kg^{-1} for male).

In other to induce ovulation, together with egg fertilization and incubation. Spawning trials (3 trails/hormone treatment) were conducted. Female broodfish (average weight 535±5 g) were assigned to the treatments randomly and injected with 0.5 mL kg^{-1} of *Ovaprim* (syndel international incorporation), 1 mL kg^{-1} of clarias pituitary and 1 mL kg^{-1} of frog pituitary (Fagbenro *et al*., 1991).

All injections were administered intra muscularly at the base of the dorsal firm between 17.00 and 18.00 h. Male broodfish of the same size with female were also injected and used. Later female were held individually in aerated 75 L aquaria with water flow of 4.5l min at 27+1°C. Ovulation occurred

14-18 h after injection and gentle pressure was applied to the antero-posterior direction on their abdomen to strip them of eggs. At about the same time, male broodfish were sacrificed and their testis removed. Melt was collected after dissection of the testis and immediately preserved in 0.9% NaCl solution.

Fertilization of the stripped eggs with the mitt after sperm activation was initiated by the addition of 5 mL fresh water. After 1 min of gentle stirring, fertilized eggs were rinsed in fresh water to remove excess milt. 1/10th of the fertilized eggs (from each sample) were transferred into the laboratory for proper monitoring and determination of the percentage hatchability. Hatching occurred 24-28 h and the percentage hatching (hatch rate) was estimated 35-40 h after fertilization.

The early hatched larvae were stocked in gently aerated outdoor concrete tanks (hatchery). External feeding began 4-5 days post hatch, at which time, the yolk was depleted followed this was the introduction of Artemia salina to the larvae for two weeks. The Artemia was substituted with natural zooplankton received daily from the plankton pond. As from the fingerling stage, a 40% protein commercial feed was fed at 3% body weight (b.wt.) per day.

All percentage data obtained were transformed using arc sine transformation. The data obtained were pooled for each hormone treatment and compared by one way analysis of variance (ANOVA) test to determine significant difference ($p = 0.05$) and treatment means were subjected to Fitcher Least Significant Difference (LSD) test.

Calculation involving fertilization rate, hatching rate relative fecundity and percentage survival are calculated as below

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

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

$$\text{Survival (\%)} = \frac{\text{No. of hatching alive up to larvae stage}}{\text{Total No. of hatching}} \times 100$$

$$\text{Relative fecundity} = \frac{\text{Total No. of eggs}}{\text{Body weight}}$$

Comparison of the economic performance of the various hormones was assessed based on the following assumptions

- That the cost of producing fingerlings was calculated based on the cost of hormones, feeds, handling charges.
- That the price of fingerlings was #12.00
- All costs were based on the current prices in Ondo State Nigeria.

The following parameters were calculated

- Net production = Survival at the end of the experiment
- Gross profit = Value of fingerlings-cost of production

Profit Index (PI) and Incidence of Cost (IC) was described by Adebayo (1998)

- Profit index = Value of fingerlings/cost of hormone
- Incidence of cost = Cost of hormone/net production.

RESULTS

Table 1 shows the result of induction of *Clarias gariepinus* with frog pituitary extract, *Ovaprim* and *Clarias gariepinus* pituitary extract. Mean weight of eggs was highest in *C. gariepinus* injected with frog pituitary extract and was significantly different ($p<0.05$) from other treatments. The fecundity was significantly different among hormone treatments. The fecundity of *C. gariepinus* injected with *Ovaprim* was significantly lower ($p<0.05$) than those of other treatments. Cannulation and stripping revealed that single intramuscular injection of Clarias Pituitary Extract (CPE), Frog Pituitary Extract (FPE) and *Ovaprim* induced ovulation in all the female catfish at the specified dosage.

Fertilization rate was high (>75%). *C. gariepinus* injected with *Ovaprim* had the highest percentage fertilization which was significantly different from other treatment as indicated in Table 1. The % hatchability was high and ranged from 51.5-73.0% in the different hormone treatments. The percentage hatchability shows similar pattern to percentage fertilization and latency period was 12 h for all the treatments.

The economic evaluation (Table 2) revealed that hormones sources have a highly significant effect on net production of *C. gariepinus*. The cost of production was significantly different by *Ovaprim* and least in FPE and among the treatments ($p<0.05$) with CPE being the highest. Also the value of fish was highest in *Ovaprim* and was significantly different from that of FPE and CPE profit index followed the same trend as that of value of fish. Incidence of cost was highest in CPE and was significantly different ($p<0.05$) from CPE and *Ovaprim*.

Table 1: Summary of induced ovulation and spawning of *C. gariepinus* using synthetic and non-synthetic hormones

	Hormones		
Parameters	FPE	*Ovaprim*	CPE
Body weight (g)	539.00±14.450^{a}	533.00±7.67^{a}	530.00±44.59^{a}
Fecundity	15328.50±1180.250^{a}	12897.50±2106.16^{c}	1489.00±759.89^{b}
Relative fecundity	19.85±0.750^{a}	16.09±2.410^{a}	37.51±1.32^{b}
Egg weight (g)	26.26±1.670^{a}	18.09±3.00^{b}	21.28±1.10^{b}
Fertilization (%)	60.50±6.12^{c}	84.50±1.22^{a}	73.00±3.27^{b}
Hatchability (%)	51.50±2.04^{c}	73.00±1.63^{a}	60.50±2.86^{b}
Survival (%)	30.00±5.71^{c}	66.00±1.63^{a}	50.00±0.82^{b}
Hatching period (h)	72.00±0.00^{a}	72.00±0.47^{a}	73.00±0.47^{a}
Latency (h)	12.00±0.00^{a}	12.00±0.00	12.00±0.00^{a}

Means with differing superscripts in the same row are significantly different ($p<0.05$)

Table 2: Comparison of economic performance of synthetic and non-synthetic hormones

Parameters	*Ovaprim*	FPE	CPE
Net production (No)	8512.66^{a}	5513.55^{c}	7448.00^{b}
Cost of production (#)	2035.00^{b}	1900.00^{c}	2500.00^{a}
Value of fingerlings (#)	102151.92^{a}	6612.60^{c}	89376.00^{b}
Gross profit (#)	100116.92^{a}	64262.60^{c}	86876.00^{b}
Profit index	98.70^{a}	73.51^{b}	59.58^{c}
Incidence of cost	0.12^{c}	0.16^{b}	0.20^{a}

Means with differing superscript in the same row are significantly different ($p<0.05$)

DISCUSSION

Spawning and hatching of frying were observed in fishes treated with FPE, CPE and *Ovaprim*. Weight of breeders used in this experiment ranges from 530-540 g. Nearly all the fishes irrespective of their size and weight responded well to hormone injection and spawned within 11-12 h (latency period) at temperature range of 25-27°C. This is in accordance with Viveen *et al*. (1985) that *Clarias gariepinus* are mature enough when they weigh between 200-500 g.

The percentage fertilization of *C. gariepinus* injected with frog pituitary was 62%. This is slightly lower than the reported by Fagbenro *et al*. (1991). This may be attributed to species differences and culture systems. The percentage fertilization of this study using frog pituitary extract is nearly the same with that observed by Barua and Mollah (1987) on induced catfish. Catfish *Mystrus tengara* using frog (*Rana tigrina*) pituitary extract.

This study also shows the success of homoplastic hypophysation of clarias fishes as reported by Saidin (1986). The percentage fertilization ranged from 60-85% and there was significant difference ($p<0.05$) between the different treatments. These values are higher than those reported by Saidin (1986) who reported that artificial oviposition by stripping of *C. macrocephalus* gave low hatching rate 10-45%. The difference in values might be due to low gonadotropic activities in the test fish as a result of specie difference and physiological state of the fish. From this work, latency period of 11-12 h was recorded throughout though the temperature fluctuated between 26-27°C with latency period of 7-12 h.

Generally, values obtained for the ovulation and spawning response in the hormone treatments were not significantly different ($p<0.05$). Cannulation and stripping revealed that single intramuscular injection of CPE, FPE and *Ovaprim* induced ovulation in all the female catfish at the specified dosages.

Fertilization rate was high (>75%) and latency period at 27+1°C was 12 h for all the treatments. Hatching rate was high and ranged from 51.1-73.0% in the different hormone treatments. Yolk absorption was completed after 5 days and exogenous feeding commenced, survival rates of larvae after 30 days rearing was >60%.

The spawning responses for *Ovaprim* treatment (Table 1) are comparable with those of other clariid fishes. Differences in grams of eggs spawned per kilogram female were significant ($p<0.05$) among hormone treatment.

The administration of CPE and FPE elicited high ovulation response with an optimal latency period of 12 h at 27+1°C and indicated that each of the hormone were not as efficient as the *Ovaprim*.

The results show that the synthetic hormone *Ovaprim* is more effective than the FPE and CPE. In all trials, high spawning trials and high spawning fertilization and survival rates were observed in fishes spawned using *Ovaprim*. It is very likely that CPE is more effective than FPE which gave varied percentage spawning and hatchability.

RECOMMENDATIONS

Intramuscular administration of *Ovaprim*, frog pituitary extract and clarias pituitary extracts were effective agents in the artificial breeding of clarias gariepinus at the peak of the spawning season. Egg masses produced in all the hormone treatment appeared normal but with significant differences in the hatching rate.

The result of this trial is important in encouraging fish seed production through the use of the synthetic hormone which is more cost effective and readily available throughout the seasons unlike the FPE which is very difficult to get during the dry season so also, the pituitary of the frog might not be enough to induce ovulation in case a small frog is used. It also eliminates sacrificing the donor *C. gariepinus* when using the Clarias Pituitary Extract (CPE).

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