Comparative Study of Ovaprim and African Catfish Pituitary Extract to Induce Breeding in the Hatchery Complex of University of Calabar, Nigeria

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Abstract

Fish is a vital source of food for people. It is the most important single source of high-quality protein providing about 16% of animal protein produced by the world population. This study examined the Hatchability, growth performance and survival rate of *Clarias gariepinus* hatched with ovaprim and catfish pituitary hormone. Artificial breeding (ovaprim) and natural hormones (pituitary gland) technique were adopted for this experiment. Six pairs of brood stock (catfish) with three pairs, each for artificial and natural hormones were selected from both male and female and were subjected to different treatment with ovaprim and natural hormones. At a mean temperature of 25.7±0.81 latency period for ova prim and pituitary gland extract were 660 and 696 minutes, respectively. Workers fecundity was significantly higher ($P<0.05$) for brooders treated ovaprim than pituitary hormone induced spawners. Hatching rates also followed the same trend, in which significantly higher hatching success was recorded for ovaprim ovulated eggs (60%) than the pituitary hormone induced eggs (20%). Fry survival rate was (70%) for ovaprim induced fish while pituitary hormone induced fish fry had (40%), percentage mortality was significantly minimal for ovaprim treated fish. Production cost analysis revealed that, the use of pituitary produced a statistically significant gross profit and a higher profit index of ₦19,000.00 over ovaprim ₦24,000.00 although ovaprim was more productive with a good yield for the cost amount. From the study, it was concluded that ovaprim is superior hence was recommended for use by catfish breeders.

Keywords: Hatchability performance, survival rate, catfish pituitary hormone and ovaprim.

Introduction

The study on techniques in catfish breeding and larval rearing management is important because it is capable of informing fish rearers or farmers on the best approach for optimal yield in fish production. The demand for fish production is about 2.7 million metric tonne per annum with local production accounting for 800,000 metric tonne only leaving a large deficit of 1.9 metric tonne being met by importation (Daily Trust, 2014).Catfish (*Clarias gariepinus*) is one of the most cultured fish species in Nigeria. Eliot (1995) reported that the culture of catfish (*Clarias gariepinus*) through hypophysation was initiated in Western Nigeria in 1973 with the trial in Clariaslazera collected from Ogbese River. Olauneya (1986), in a fish demand survey asserted that in Nigeria the catfish was the most preferred (about 60% of total fish demand), it out classed tilapia, carp and

other fresh water species by a wide margin. Fish is a vital source of food for people. It is the most important single source of high quality protein providing about 16% of animal protein produced by the world population (FAO 1997). It is an important protein source in regions where livestock is relatively scarce. FAO (2000) states that fish supplied more than 10% of animal protein consumed in North America and Europe, 20% in Asia, 22% in China and 17%in Africa while in Nigeria it is estimated to be 40% (Adewumi, 1994).It is important to know how to produce catfish fingerlings. Producing fingerlings with diverse techniques reduces cost of production and provides assurance of getting better output. Fingerlings can be raised up to juvenile stage before stocking is done. One can also serve as a good source of quality and healthy catfish seeds supplier for other catfish farmers from his or her own hatching.

"The quality of output you will get depends on the quality of breeder catfish, breeding materials and of course the method used". The importance attached to culture of catfish in Nigeria is not only because it commands high market value but it can also tolerate low dissolve oxygen level and other adverse conditions where most other species cannot survive (Omitoyin, 1989). In order to bridge fingerlings demand-supply gap, hatchery techniques have been developed for seed production of some culturable fish species. These are either through natural breeding in captivity or by induced breeding using exogenous ovulating agents, which trigger the ripening of matured eggs (Ajah, 2007). In Africa, various hormonal substances (Ovaprim, carp pituitary, human chorionic gonadotropin, frog pituitary extracts etc) have been used to induce breeding in fish with varying magnitudes of success (Okoro *et al.,*2007). There is therefore the need to carryout comparative studies on the effectiveness of these induction agents in order to obtain the viable options.The hormones promote reproduction in fish which is controlled by several factors such as sex steroids in the regulation of reproductive processes. These reproductive processes are controlled through the brain-pituitary gonadal axis. The brain is stimulated by environmental cues (water rise, temperature, feeding, rainfall and photoperiod) to release gonadotropin releasing hormones. Then the ovulation and spermiation are affected as a result of the sex steroids that have been produced (Zarski *et al.,* 2015).

Administration of these hormones to induce ovulation and spawning in fish is achieved through artificial propagation with either natural or synthetic hormones. The study therefore compares the use of pituitary gland extracts and ovaprim hormones to induced breeding and fry quality of *Clarias gariepinus*.

Materials and methods

Description of the study area

This study was carried out in the Faculty of Oceanography Hatchery, University of Calabar, Calabar. It is located on the Western Bank of the staff quarters and University of Cross River State. This area covered a greater portion of western bank of the Great Kwa River. It lies between latitude 04.56^0, 020'N and longitude 08.20^0, 456'E in Cross River State, Nigeria. (Fig.1). The climate of the area is humid-tropical, although wet occurs between March and September while the dry season occurs between October and February.

There is a short harmattan season usually December and January.It experiences a moderately high temperature which ranges from 27^0C–35^0C (Okpa, 2020).The predominant vegetation type is the mangrove which consists of trees and shrubs of few generalvarying species. It is harvested for wood, firewood, fibres and the mangrove environment is important for inland fisheries serving as highly productivehabitat for shell fish and find fish.

Broad Stock Procurement and Transportation

A total of six gravid females and six matured males of *Clarias gariepinus* weight ranging from 1000 g – 1500 g were procured from a reputable farm (Evason's Fish Farm) located at No. 19 Mayne Avenue Street Calabar, Cross River State. Fish transport was done carefully in order to reduce stress and successfully transport them to their experimental site. Ajah (2019), reported that, selection of broad stock in hatchery operation is essential for the following reasons:To obtain the right brood fish that will yield the desired quality and quantity of fish fingerlings.To obtain the right brood stock that will be economically viable and early maturity.

Acclimatization

Temperature of the transporting water and the water where the fish were to be stocked were equal before stocking the fish. After transportation and acclimatization, they were fed 5% of total biomass with Coppens pelleted fish feed (48% crude protein) twice daily. Feeding was suspended a day prior to the hormonal treatments.

Hormone and Procurement

The following hormones were used to induce the brood stock

1. Synthetic hormone (ovaprim)
2. Biological hormone also known as pituitary hormone

Pituitary gland was extracted from some of the male brood fish; they were weighed so as to get a corresponding weight to that of recipient fish. The head of the male donor was cut off after stunning the fish and subsequently the lower jaw was cut off, the virtual side of the brain was opened to expose the pituitary gland, the glands were collected with a pair of tweezers and placed in a beaker containing 2 ml of 0.9% normal saline solution. Each of the gland was crushed in a mortar using a pestle. Two millimeters of 0.9% normal saline solution was added and the suspension decanted and collected into a 2ml syringes. The freshly collected pituitaries were immediately injected into the female spawners.

The hormone ovaprim was purchased commercially at an Agro-Allied outlet located in Calabar metropolis. Clear distilled water was added and then a dose of 0.5 ml ovaprim was administered to the female brood fish at 0.5ml ovaprim/kg of body weight. The Fish was injected in between the lateral line and dorsal fin. The male fish was killed, the abdomen dissected carefully and their milt sac obtained. The weight of each male was obtained and recorded alongside the weight of each of the gonad. A small incision was made on the lobes with a sharp razor blade and the milt was squeezed into a dry Petridish. Milt was waded into a Petridish with 0.9% normal saline solution.

Latency period was recorded for each of the fish in each group and stripping was done within 10 and 12 hours after injection

with slight pressure at the ventral part of the abdomen, the ovulated eggs were allowed to ooze out freely and then collected into a dry Petridish of known weight. A sample of 1g of the stripped eggs from each female were collected and fertilized by pouring the prepared milt into the eggs. The mixture of 1g incubated separately on the spawning substrate, placed in water in each of the holding plastic containers. Post hatching, dead eggs were removed by siphoning, (the spawning, substrate was named and percentage hatchability determined by recording the number of dead eggs in each container.

Water Quality Management

Basic water quality parameters were determined; temperature was measured with a mercury in-glass thermometer. Dissolved oxygen and pH were measured using a dissolved oxygen and pH meter respectively.

Experimental Design

Completely randomized design was employed. The experiment consists of two treatments; treatment one was *C. gariepinus* brood fish treated with the pituitary gland extract while treatment two was *C. gariepinus* treated with ovaprim. Each treatment was replicated three times using plastics containers measuring 2.0m in diameter and 0.84m in height which were labeled, T1R1, T1R2, T1R3 and T2R1, T2R2, T2R3 for the *C. gariepinus* broodstock treated with pituitary and ovaprim respectively. Each tank was provided with aeration facilities through a network of air pumps connecting tubules and diffuses. The brood stock was stripped and after fertilization the hatched larvae were placed in plastic containers.Latency period is the time taken from injection of female brood fish to time of stripping. Workers fecundity was estimated by counting the number of eggs stripped from each female brood fish as follows.

F= Total weight of eggs x No of eggs per gram

Relative Workers (Fecundity) was estimated by dividing the number of eggs stripped fecundity by the length per fish.

Percentage Hatchability was determined by estimating the number of unhatched egg:

$$\%\text{Hatchability} = \frac{\text{Total no. egg incubates}}{\text{No. of unhatched egg}} \times 100\%$$

The survival rate per rearing tank was determined at the end of the experimental period with the formula:

$$\%\ \text{Survival} = \frac{\text{No of survival fry}}{\text{Total no fry stocked}} \times 100\%$$

The mortality rate was determined as follows.

$$\%\ \text{Mortality} = \frac{\text{Initial no of hatchlings- final no of hatchlings fry}}{\text{Initial no of hatchlings}} \times 100\%$$

Measure of profitability indicates the amount of money return to the investor on every naira invested, this was used to determine the profitability for each of the treatment. A modified Return per Capital Invested (RPCI) applied is specified as:

$$\text{RPCI} = \frac{\text{income Realized}}{\text{Total Revenue}}$$

Feeding Regime

Feeding rates and frequencies depend on fish size. Two to three days after hatching and restoration of the yolk sac, feeding of the small larval fish and fry commenced, using a high protein rich diet (Artemia). Feeding was frequent and in excess because at this stage they have a high energy demand and must eat nearly continuously and be fed almost hourly.

The data collected were subjected to analysis of variance (ANOVA) and the means were compared with least significant difference (LSD) using SAS statistical package.

Results and discussion

The result of the mean value of physico-chemical properties of water used in incubation and rearing tanks is presented in Table 1. The mean dissolved oxygen of the treatments was between 6.44- 6.80 mg/L, temperature ranged between 25.00 - 26.40°C and the pH mean values 8.00. Weatherly (1990) described fish growth as the product and an integrator of the reactions involving the intrinsic and extrinsic factors (including the aquatic medium) in which the fish finds itself. It has been established that specific features of the catfish environment are of primary importance in determining the growth and survival of the fish species. The dissolved oxygen of the treatments was between 6.44 - 6.80mg/L; temperature, 25.00 -26.40 °C and pH, 8.00. These values fall within the range (3.0- 9.0 mg/L for dissolved oxygen), (24.00 – 32.00°C for temperature) and (6.50 -9.00 for pH) reported by Boyd (1997) as the best for tropical fishes.

Table 2 showed that ovaprim has the highest hatchability rate (60%) compared with pituitary extract having 20%. This result is in line with Olaniyi and Akinbola (2013) who reported that both African catfish pituitary extract and Ovaprim aided spawning in African catfish although they were statistically different (P>0.05). This is in line with Nwokoye *et al.* (2007) who reported that ovaprim performed better than pituitary in the hatchability of *Clarias gariepinus*. Nwokoye *et al.* (2007) reported that gravid female of H. bidorsals injected with Ovaprim recorded the best result in all the reproductive parameters investigated. Similarly, the survival rate was higher in ovaprim which has 70% while pituitary has 40% survival rate, respectively. This is similar with that of Nayak *et al.* (2001) who reported higher hatching rate of 96% using Ovaprim. Whereas this is different from Belal Hossain *et al.* (2012) who reported that hatching rate of 76.9% in eggs spawned from Ovaprim induced individual fish compared to 72.7% in African catfish pituitary extract (ACPE) induced fish. Also similar with that of Adebayo and Popoola (2008) who reported high hatching rate ranging from 51.1-73% in the different treatment (Clarias pituitary extract (CPE), Frog pituitary extract (FPE) and ovaprim). This is also different with the finding of Olaniyi and Akinbola (2013) who reported higher survival rate from pituitary gland extract. The variation could be as a result of seasonal temperature variation between Katsina and Ogbomoso or the ovaprimused was adulterated. This was higher than the range of 30.00 - 66.00% reported by Adebayo and Popoola (2008) and that of Olaniyi and Akinbola (2013) who observed survival rate of 50.14% in ovaprimand 82.98% in Claria pituitary gland extract in their study.

In terms of growth, fish induced with ovaprimgained more weight than those of pituitary. This was in line with Ndimele and Owodeinde (2012) who reported higher growth rate in fish induced with ovaprimthan those induced with pituitary hormone. Faster growth rate was also observed in fish produced fromOvaprim induced group than those of pituitary extract after feeding commenced (Olaniyi and Akinbola, 2013). De Graaf *et al.* (1995)

reported similar results for *C. gariepinus* raised with artificial propagation techniques where fish fingerlings from Ovaprim induced performed better than those of pituitary. Findings also revealed that the percentage weight gain of the fish induced with ovaprim hormone was more than those induced with pituitary hormone and this also differed significantly Odedeyi (2007). Similarly, specific growth rate was slightly higher ($p>0.05$) in fish induced with ovaprim hormone than those induced with pituitary. These findings were in line with Ndimele and Owodeinde (2012) who reported higher growth performance among the fish induced with ovaprim hormone compared to those induced with pituitary hormone. Similar findings were observed by Nwokoye *et al.*(2007). The results of water parameters were within the standard range and comparable with Boyd (1979) standard water quality for tropical aquaculture.

The cost of production revealed that ovaprim has the highest cost of ₦24, 000 while least was pituitary extract having a cost of ₦19,000. This follows the same pattern as reported by Adebayo and Popoola (2008) but not in agreement with Olaniyi and Akinbola (2013) who reported higher cost of production using pituitary gland extract compared to using ovaprim.

Conclusion

The study observed the hatchability, survival and mortality rates of fries treated with African Catfish Pituitary Extract and ovaprim. It also study the cost involved in fish hypophysation in *C. gariepinus* using the two treatments. Based on the result, ovaprim induced treatment has the highest hatchability rate of 60%,highest survival rate of 70% and lower mortality rate of 8.5%, but has the highest cost of production while pituitary gland extract has the lowest hatchability rate (20.0%), lowest survival rate (40%)and highest mortality rate of 30.0%, but it has lowest cost of production.

Recommendation

Based on the findings, it is recommended that, if the farmer is financially buoyant, He/she should go for ovaprim, due to the fact that, there was higher success rate recorded, which means that, the financial gain will be more. However, if the farmer cannot afford the use of ovaprim, the farmer can also go for pituitary, though the financial returns will not be as high as in ovaprim.

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Table 1: Mean values of physico-chemical parameters of water

Parameters	Incubation Tank	Rearing Tank
Dissolved Oxygen (mg/l)	6.80 mg/L	6.44mg/L
Temperature(^{o}C)	26.40°C	25.00 °C
pH	8.00	8.00

Table 2: Hatchability, Survival, mortality rates and economic performance of fish treated with Ovaprim and pituitary extract (ACPE)

Parameter	Hormone	Mean (%)	Value
Hatchability rate	Pituitary	20	NA
	Ovaprim	60	NA
Survival rate	Pituitary	40	NA
	Ovaprim	70	NA
Mortality	Pituitary	30.0	NA
	Ovaprim	8.5	
Cost of production	Pituitary	19,000	NA
	Ovaprim	24,000	NA

NA = Not Applicable

Plate 1: Stripping of eggs from gravid female

Plate 2: Utilized eggs after hatching

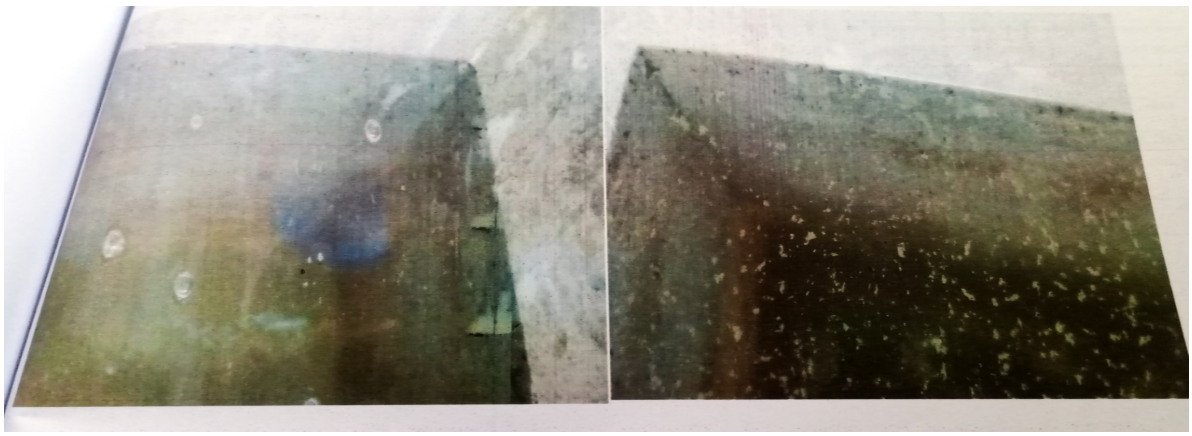

Plate 3: Survived frys in each tank

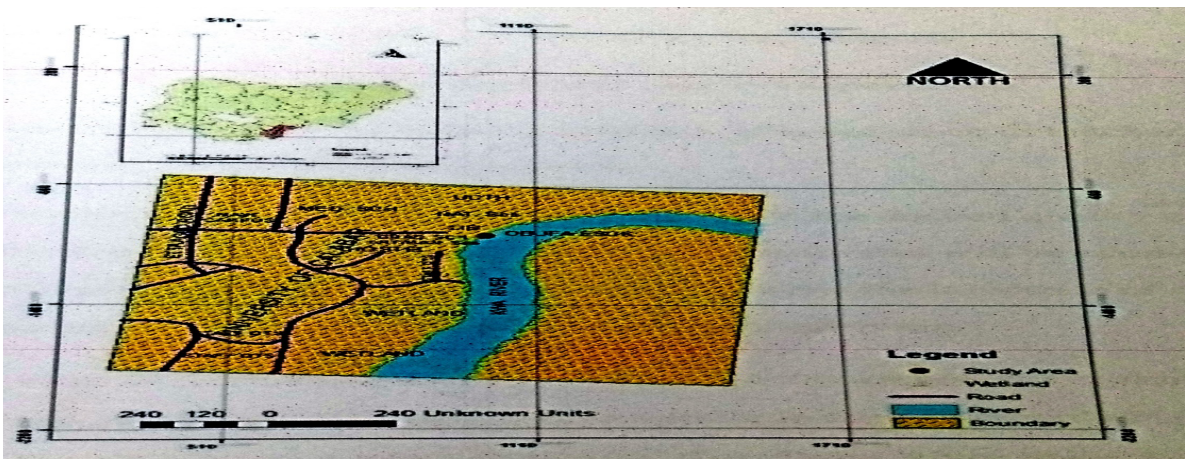

Fig. 1: Map of University of Calabar Fish Farm
(Source: https://wwww.unical.edu.ng/handbook)