

Effects of Catfish (*Clarias gariepinus*) Brood-stocks Egg Combination on Hatchability and Survival of Fish Larvae

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Abstract

Fish seed production of catfish and tilapia has been successfully carried out in Nigeria. Despite the success, there still exist a wide gap between fish seed demand and supply, this therefore necessitate increased research for development. This project is aimed to study the effects of *Clarias gariepinus* brood-stocks' egg combination on hatchability and survival of fish larvae.

2 females gravid *Clarias gariepinus* brood stock size (800-900 g) were injected with pituitary gland hormone at 3 mg kg⁻¹ of body weight. Milt gotten from the selected male was mixed with collected eggs of injected females after the expiration of latency period. 1/3 of the eggs collected from T1 (first female brood stock) and T2 (second female brood stock) were combined and recorded as T3 (mixture of 1/3 of T1 and T2). Each of T1, T2 and T3 were replicated as T11, T12, T13, T21, T22, T23, T31, T32, T33. Each of the replicated fertilized egg was spread in a monolayer pattern on a 1 mm diameter net in nine 0.8 m × 0.8 m × 0.8 m aquarium tank under a recirculatory system. Water quality, fecundity, fertilization rate and survivability of fish were determined. The data collected were analyzed using analysis of variance (ANOVA) at p < 0.05 significant level.

The percentage fertilization was 62.34^a, 61.98^a and 62.75^a for T1, T2 and T3 respectively. The percentage hatchability was 52.11^a, 50.32^a and 51.51^a for T1, T2 and T3 respectively. The survivability result shows relatively high survival rate in treatment T1 and T2, while the rate of survival in T3 was very low.

Egg combination does not have effect on fertilization rate and hatchability of eggs; however, it reduces the survival of larvae. In order to increase survival of catfish fry, it is important to avoid mixture of eggs from multiple brood fish.

Keywords: Aquaculture; Fish breeding; Artificial insemination; Catfish

Introduction

World aquaculture has grown tremendously during the past two decades to becoming an economically important industry [1]. According to [2], aquaculture continues to grow more rapidly than all other animal food-producing sectors, with an average global annual growth rate of 8.8% per year since 1970, compared to only 1.2% for capture fisheries. Globally, aquaculture is expanding into two new directions, intensifying and diversifying. Intensive fish culture has the capacity to produce large quantity of fish per unit space but seldom exists without an efficient fish seed production [3]. Fish seed production is an important aspect of aquaculture that has witnessed continuous research and innovation for increased fish production. Artificial propagation methods constitute the major practicable means of providing enough quality seed for rearing in confined fish enclosure waters such as fish ponds, reservoirs and lakes [4]. Catfish fish seed production is not left out as it represents a valuable fish species most especially in Africa. This fish exhibit a seasonal gonadal maturation which is frequently triggered by rainy season. The maturation processes of *C. gariepinus* in nature are generally influenced by annual changes in water temperature and photoperiodicity and the final triggering of spawning is usually caused by rise in water level due to rainfall [5]. In captivity, catfish does not spawn by itself, except the environment is simulated to mimic its natural habitat which is a cumbersome process and un-economical. Meanwhile, in its natural environment, several studies have reported poor hatchling and survival performance; [5] reported an average rate of 59.1% in the rainy season for *C. gariepinus* in the Republic of Congo, while [6] reported a rate as low as 4% for *C. gariepinus* eggs incubated on a nylon substrate. As a result of this, several research has been conducted to improve hatchability and

survival of catfish larvae in captivity, among the research are the work of [7] on reproduction growth, health control and aquaculture potential of African catfish *Clarias gariepinus*; [8] on the effect of various doses of ovaprim on reproductive performance of African Catfish *Clarias gariepinus* (Bruchell) and *Heterobranchus longifilis* (Valenciennes); [9] on recent advances in fish hatchery management; [10] on homestead artificial propagation, growth and morphometric characteristics of the African catfish (*Clarias gariepinus*). Despite all these researches, there still exist a wide gap between fish seed demand and supply. However, the insufficiency of supply and relatively high cost of fingerlings of *Clarias gariepinus* [11], resulting from low output per breeding attempt, indicates the need to widen the scope of factors affecting the low output. As a result of this backdrop, this project is aimed to study the effects of catfish (*Clarias gariepinus*) brood-stocks' egg combination on hatchability and survival of fish larvae.

Materials and Methods

Brood-stock selection and management

Eight samples, (4 males and 4 females) gravid *Clarias gariepinus*

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brood stock size ranging from 800-900 g total body weight (TBW) were gotten from the brood-stock tank of the Universite Africaine De Technologie Et De Management, UATM, Benin Republic. This is done after examination for gonad development according to the method of [12]. Male brood-stocks were examined for rigid and reddish infusio of the genital papillae and female genital orifice were examined for reddish infusio, distension of the belly and release of eggs when gentle pressure was applied on the abdomen. Before stocking, the brood fish was disinfected with 0.5 % salt bath 5 g NaCl/1 litre water temperature of 25°C to 28°C according to the method of [13]. Bathing was done by dipping the fish into the solution for fifteen minutes. They were later acclimatized for 2 weeks in holding indoor fibre glass of 1000 L water holding capacity and maintained under optimum temperature.

Hypophysation of brood-stock

Two brood-stocks were selected from the pre-selected sample. They were weighed individually and intramuscular injection with pituitary gland hormone earlier extracted from catfish was applied at dosage of 3 mg kg⁻¹ of body weight [14]. During injection, fish receives finger rubs to prevent back flow of fluid. Once they were injected, each treatment fish were labelled T1 and T2 and was kept in different water holding tanks for 14-16 hours in the hatchery.

Fertilization and spreading of eggs on hapa

The male was sacrificed to obtain the gonads which house the milt. At the expiration of the latency period, the females were carefully removed, moped with towel and hand stripped manually for eggs. Slight pressure was applied on the abdomen of the female brooder, and this led to the ovulated eggs to ooze out easily from the genital opening which was collected in plastic bowl. A sample of 20 unfertilized eggs from each female size class was taken to determine egg sizes. The eggs obtained from stripping each brood-stock were weighed, followed by several drop of creamy milt squeezed over the eggs with dry hands. The bowl is then gently swirled to mix the eggs and milt, feather is also used to mixed egg and milt together so as to ensure that the milt mix properly. 0.9% (NaCl) saline solution [15] was added to facilitate fertilization. After 45 seconds to one minute, no further fertilization can take place as the sperms are no longer motile. 1/3 of the eggs collected from T1 and T2 were combined and recorded as T3. Each of T1, T2 and T3 where then divided into three equal part as replicate for the three treatment. This was labelled T11, T12, T13, T21, T22, T23, T31, T32, T33. Each of the replicated fertilised egg was spread in a monolayer pattern on a 1 mm diameter net in nine 0.8 m × 0.8 m × 0.8 m aquarium tank under a recirculatory system (Table 1).

Fertility rate and hatchability rate

After a certain period of incubation before hatching sub samples of eggs (1gm) kept on separate net were examined to assess the fertility rate (%) and hatchability rate (%) as determined from counting the number of active larvae. Prior to hatching, three sample plots were determined on the screen, and the number of fertilized and unfertilized eggs was counted physically for each treatments. The fertilized eggs were green, transparent and flattened whereas the unfertilized ones were whitish in color and thick. The FR% was computed based on the formula [16].

T1	T2	T3
T11	T21	T31
T12	T22	T32
T13	T23	T33

Table 1: Treatment T1, T2 and T3 with their replicate.

Chemical and physical features	Desired Level
Dissolved Oxygen (DO)	6mgL ⁻¹
Water pH	7-7.5
Temperature	27°C-30°C
Ammonium (NH ₄)	0.5mg/L

Table 2: Water quality requirements of african catfish hatchery.

Water Quality Parameters	Values		
	T1	T2	T3
Temperature (°C)	28.35 ± 0.10	28.21 ± 0.07	28.11 ± 0.06
Dissolved Oxygen (mg/L)	5.29 ± 0.08	5.28 ± 0.09	5.28 ± 0.05
pH	7.34 ± 0.17	7.44 ± 0.19	7.34 ± 0.09
Ammonia (mg/L)	0.4 ± 0.04	0.4 ± 0.06	0.3 ± 0.10

Table 3: Measured water quality parameters.

$$FR\% = \frac{\text{No. of fertilized eggs} \times 100}{\text{Total No. of ova collected}}$$

The hatchability rate was calculated as described [8]

$$HR\% = \frac{\text{No. of hatched eggs} \times 100}{\text{Total No. of eggs incubated}}$$

Survival rate

Survivability evaluation was observed for a period of about 1-5 weeks. The post-hatching survivability was evaluated as described by [17] as adopted by [18].

$$\% \text{ Survival} = \frac{(\text{Total no. of larvae} - \text{No. of dead larvae}) \times 100}{\text{Total no. of larvae}}$$

Water quality determination

The water quality of the system of culture was monitored daily, parameters like pH, Dissolved Oxygen (DO), Nitrite and temperature was measured during the trials using HATCH analysis water testing kit model FF-1A following method described by [19], the analysis were done immediately after water samples collection [20] (Table 2).

Data analysis

The data collected was subjected to standard statistical analysis. The data collected were analyzed using analysis of variance (ANOVA) to find a level of significance at p < 0.05. Standard deviation and standard error of mean was calculated per treatment. Also Duncan Multiple Range Test was used for mean separation.

Results and Discussion

Water quality parameters

During the study period water qualities parameters were measured and the result is presented in the Table 3 below:

Temperature

The average temperature taken shows that there is no significant difference between the values recorded for the different treatment. The temperature for the treatment are T1 (28.35 ± 0.10); T2 (28.21 ± 0.07) and T3 (28.11 ± 0.06). The mean temperature recorded falls within the ranges recorded by [21] and ranges earlier documented by [19] for optimum performance of freshwaters fish (Figure 1).

Dissolved oxygen

The dissolved oxygen (DO) concentration measured was with

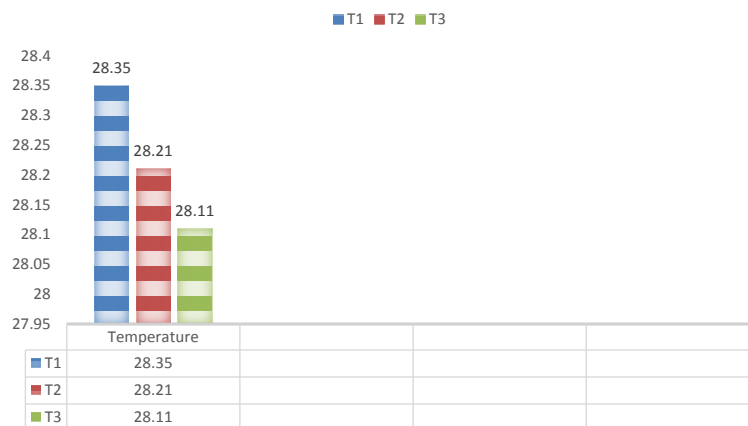


Figure 1: Average temperature

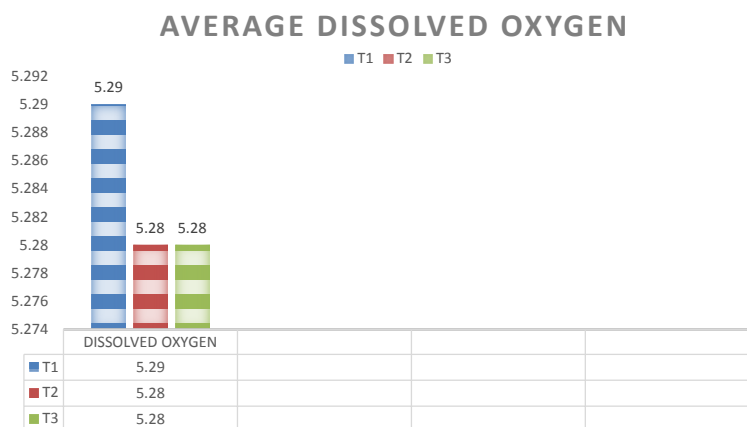


Figure 2: Average dissolved oxygen.

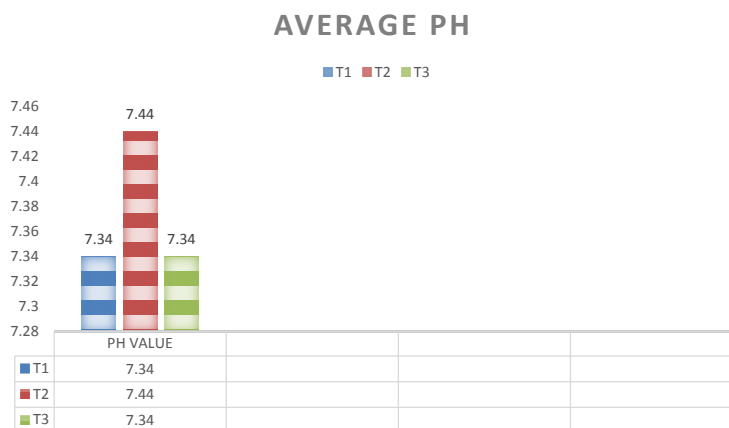


Figure 3: Average pH.

mean value of 5.29 ± 0.08 ; 5.28 ± 0.09 and 5.28 ± 0.05 for T1, T2 and T3 respectively. There was no significant difference ($p > 0.05$) in dissolved oxygen concentration among all treatments during the study periods. The range oxygen recorded in this study slightly varies but fell within the recommended values. These values agree with those of [22], they also pointed out that the minimum dissolved oxygen should be 5 mg/l for tropical fish (Figure 2).

pH value

The pH concentration measured was with mean value of 7.34 ± 0.17 ; 7.44 ± 0.19 and 7.34 ± 0.09 for T1, T2 and T3 respectively. There was no significant difference ($p > 0.05$) in pH concentration among all treatments during the study periods. The range pH recorded in this study was slightly varies but fell within the recommended values. The

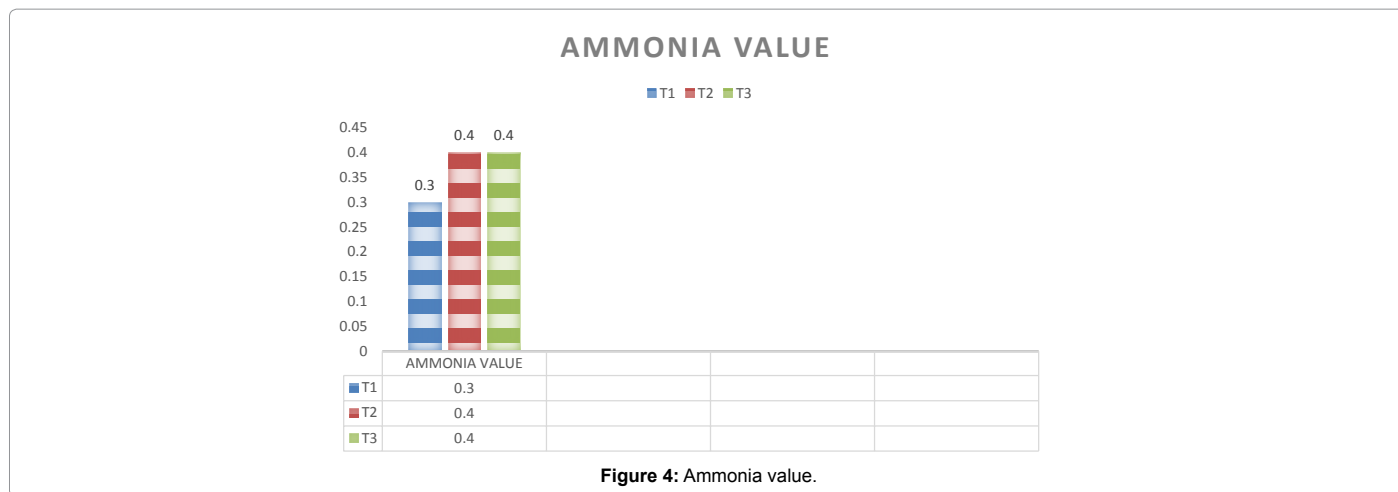


Figure 4: Ammonia value.

Parameters	T1	T2	T3	S.E
Fecundity	235,345 ^a	222,549 ^a		5436
% Fertilization	62.34 ^a	61.98 ^a	62.75 ^a	1.76
% Hatchability	52.11 ^a	50.32 ^a	51.51 ^a	1.55

Values carrying different superscript on the same row differed significantly from each other.

Table 4: Mean fecundity, percentage fertilization and percentage hatchability.

Period	Initial Stock per Tank is 300											
	Mortality			% C.M			Survival			%C.S		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
1	5	6	27	1.6	2	9	295	294	273	98.3	98	91
2	17	14	87	5.6	4.7	29	283	286	213	94.3	95.3	71
3	25	20	154	8.3	6.7	51.3	275	280	146	91.7	93.3	49.7
4	32	28	201	10.7	9.3	67	268	272	91	89.3	90.7	30.3
5	44	38	289	14.6	12.7	96.3	256	262	11	85.3	87.3	2.7

% C.M = Percentage Cumulative Mortality.
% C.S= Percentage Cumulative Survival.

Table 5: Survivability of hatchlings.

desirable range for pond pH is 6.5-9.5 and acceptable range is 5.5-10.0 [23]. The range of the pH obtained from this study was (6.89-7.10), this agreed with [23] (Figure 3).

Ammonia

The Un-ionized ammonia concentration measured was with mean value of 0.4 ± 0.04 ; 0.4 ± 0.06 and 0.3 ± 0.10 for T1, T2 and T3 respectively. There was no significant difference ($p > 0.05$) in Un-ionized ammonia concentration among all treatments during the study periods. The range Un-ionized ammonia recorded in this study was slightly varies but fell within the recommended values. The ammonia concentration recorded falls within desirable limit 0-0.05 mg/l and acceptable limit less than 0.5 mg/l [24] (Figure 4).

Fecundity

The fecundity of brood stock used during the experiment shows that no significant difference between the two treatments as T1 has fecundity of 235,345^a while T2 has 222,549^a as presented in Table 3. This must have been as a result of close weight range of the brood stock used in the experiment or probably a coincidence. As several results have shown variation in fecundity of brood stock, although variation in fecundity within a common trail of similar-sized fish species could be

attributed to hormone administration rate, breeding history, maturity stage, and other external environmental factors [25].

Percentage fertilization

The results of the experiment show no significant difference in the percentage fertilization recorded as presented in Table 3. The percentage fertilization was 62.34^a, 61.98^a, and 62.75^a for T1, T2 and T3 respectively.

Percentage hatchability

The results of the experiment show no significant difference in the percentage hatchability recorded as presented in Table 3. The percentage hatchability was 52.11^a, 50.32^a and 51.51^a for T1, T2 and T3 respectively.

Survivability

The survivability result presented in Table 4 shows relatively high survival rate in treatment T1 and T2, while the rate of survival in T3 was very low. At the end of the 5th week the survival percentage were 85.3%, 87.3% and 2.7 % for T1, T2 and T3 respectively. The lower survival of T3 as observed in the experiment was due to the development of some fast growing population in the stock. The fast growing population was observed to cannibalize on the slower growing population thereby suppressing their population (Table 5).

Conclusion and Recommendations

Physical observation during the study confirm two developmental stage of fish after the 3rd day, some population were actively and vigorously seeking to feed, while some population have not fully absorbed their yolk. This could be linked with the combination of eggs from different brood-stock; this made some population or strain to develop faster than the other. Possibility will arise that the difference in developmental stages increases with the increase in the number of female brood fish used. From day 7 to 14 cannibalism surfaced: attacks between different sizes of fish occurred, where the weaker and the slow growing one were seriously affected. The mostly attacked parts are tails, mostly broken with body wounds, eventually dead. Combination of eggs from different female brood fish could hamper the chances of survival. It is however important to strip female eggs separately to have a good survival result.

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