Breeding techniques of common carp *(Cyprinus carpio)* using different approaches.

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Abstract

33 brood fish of Common Carp *(Cyprinus carpio)* obtained from Panyam Fish Farm, was used to evaluate the percentage hatchability of Carp through un induced natural spawning in Outdoor Hapa Net System, induced natural spawning in Outdoor Hapa Net System, and induced breeding by stripping in Indoor Concrete Ponds. Spawning and fertilisation was natural for treatment 1. Ovaprim hormone was used to induce brood fish in treatment 2 and 3, but unlike treatment 3, treatment 2 was not stripped manually, as the induced female brood fish shed her eggs naturally. At the end of the experiment, the mean number of eggs in one gram was found to be (733.33 ± 3.53^{a}) in treatment 3, as compared to that of treatment 2 (702.00 ± 3.21^{b}) and treatment 1 (709.33 ± 4.91^{b}), with a significant difference at ($P<0.05$). There was no significant difference ($P<0.05$) in fecundity ($\times 10^{3}$)from the three treatments. Percentage fertilization was highest in treatment 2 (94.44 ± 0.40^{a}). Percentage Hatchability was highest in treatment 3 (94.10 ± 0.85^{a}). Number of Post Fry in one liter of water at day seven after hatching was found to be highest in treatment 3 (1896.30 ± 53.40^{a}). In conclusion, the best method of Carp fish propagation for aquaculture is the synchronized propagation through stripping in indoor concrete ponds, which had 94% hatching rate.

Keywords: Brood fish, Spawning, Breeding, Physico-chemical, Stripping.

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Introduction

Annually, almost 100 million tons of fish are captured from the ocean, of which around 70 million tons are intended for direct human consumption. This amount includes hundreds of species. Some of these, especially predatory species, are actually threatened with extinction [1, 2]. This implies that, the constantly growing demand for fish and fish products for human consumption must be covered by fish farming through aquaculture practice. Hence, some form of intervention must be introduced in the rearing process to enhance production, such as regular stocking, feeding protection from predators, etc.

Worldwide, the most important fish species used in fish farming are, in order Common Carp, Salmon, Tilapia, and Catfish [3]. Hence, deliberate measures in aquaculture must be taken towards the sustenance of these important fish species.

This study is an attempt to identify the most efficient reproduction practice of this specie, to ensure optimum aquaculture practice of this fish species, thereby salvaging it from its current threatened state of extinction. Thus, this study is designed to evaluate the percentage hatchability of Carp through natural breeding using outdoor hapa, to evaluate the percentage hatchability of Carp using induced natural spawning system in outdoor hapa, and to evaluate the percentage hatchability of Carp by artificial propagation through induced breeding by stripping in indoor concrete tanks.

Carp naturally spawn in the spring and early summer depending upon the climate of the area. They separate into groups in the shallow areas to spawn [4]. Carp prefer shallow waters with dense macrophyte cover, an environment where they can comfortably shed their eggs and milk and successfully hatch their off springs. Males spill their milt and fertilize the eggs, which the females scatter over macrophytes in a very active manner. The eggs get attached to the substrates upon which they are scattered. Generally, a typical female (about 45 cm) can produce up to 300,000 eggs, with some estimates as high as 1,000,000 over a breeding season.

Released eggs stick closely to the vegetation regardless of their fertilisation status. Male and female spawn side by side. Released eggs are fertilized by males. Hence, the ripe eggs released by the female into the water are surrounded by a cloud of moving sperm released by the males. The sperm cells enter into the micropyle of the egg, which is open for about 30-60 seconds after exposure to water. Thereafter, the micropyle closes regardless of whether a sperm has entered into the egg or not. General preconditions for the development of dormant eggs cells in the ovary are Suitable water temperature, enough Dissolved Oxygen in the water, Light and enough natural food.

Naturally, the reproduction of Carp depends on three main groups of factors. These are the basic factors of Temperature (18°C–24°C), Dissolved Oxygen (5 mg/litre-10 mg/litre), and Light. Furthermore, are the stimulating factors which include favourably changing atmospheric pressure, the presence of males and a suitable vegetation to spawn on.

All propagation methods for fish culture are based on the reproductive biology of fish. These methods (varying with

specie of fish) are an imitation of favourable spawning conditions, general interference in the neurohormonal control of its reproduction. This involves controlled spawning, induced spawning, induced ovulation and their combinations, which can be distinguished accordingly. The methods for Common Carp fish propagation are summarized into three approaches which are natural propagation, semi-artificial and artificial methods.

In the natural-like propagation, only basic environmental conditions are ensured. Ponds with fleshy flooded grassy areas can be used for natural-like propagation of Carp. Mature brood fish are stocked at about 3-4 females per hectare, and 2-3 males per female, and those of them that have engaged will spawn naturally. This means that there is no artificial or manual inducement whatsoever on the brood fish as injection or stripping activities will be carried out by the farmer or hatchery operator. However, environmental conditions must be kept at favorable ranges, for successful spawning.

Semi-Artificial method of propagating Common Carp can be through the use of Synchronised Spawning in grassy ponds. This method includes 'The Dubisch Method', Synchronised spawning in Breeding Hapas or synchronized Spawning on Kakabans. The Dubisch method of Common Carp propagation is possible through ensuring of suitable essential environmental conditions. Small floodplain-like ponds (100 m^2-1000 m^2) are most suitable for this kind of propagation method, where the breeders or brood fish can be introduced after inducing them with hormone, for breeding activities to be carried out. Spawning will take place by one or two sets of breeders (2 females and 3 males per set) stocked in pond. The imitation of flooding induces spawning. After the spawning, breeders are scooped out of the pond using Scoop net to leave eggs and larvae in water, such that developing eggs and larvae can easily be observed.

First of all, brood fish are injected (3 mg of Hypophysis per kilogram of body weight), when the water temperature is >18°C. Then, brood fish are transferred to spawning ponds and are stocked into a fleshly inundated grassy pond. Thereafter, it is to expected that the brood fish will spawn on one of the following mornings usually after 24 hours. For the synchronised spawning in Breeding Hapas, hypophised brood fish are placed into Breeding Hapas (e.g dimensions 1 m × 1 m × 2 m; mesh size 1 mm), where they can now spawn. After spawning, brood fish are carefully removed, while fertilized eggs remain in the Hapa. Fourthly, larvae will hatch in the Hapa.

Hapas are cages, usually made from fine mesh that can be set up in any shallow pond, canal or ditch. They are fixed to poles pushed into the pond bottom. They are only suitable for use in shallow waters (less than 1.6 m) with low water flow rate and level fluctuation. Harvesting of fish is simple, usually by the use of a bamboo pole to confine the fish in one corner. They are easily cleaned by scrubbing with a hard brush whilst washing with pond water. However, Hapas are not suitable for growing fish to market size, reason beign that they are fouled quite quickly, and water exchange is insufficient to maintain very high stocking densities. Natural food is also available in Hapas, as phytoplankton and other small food particles can freely pass through the mesh hole, and the material itself provides a surface suitable for algal growth. This can be enhanced by using manure to fertilizer the water and to promote phytoplankton growth, a technique particularly useful with Tilapia. Hapas are available in standard sizes of 5, 6, 10, 20, 40 and 120 m^2 with 90 cm depth, but can be made to any size and shape specification as the case requires.

For the Synchronised Spawning on Kakabans, injected brood fish are stocked into small, freshly flooded ponds where spawning substrates made out of plant fibres (kakabans) are strategically placed. Thereafter, eggs stick to the substrate. Hence, the Spawning substrates with eggs are placed into a new pond or into wire-meshed boxes. Finally, larvae are stocked from the old pond into a new one.

Artificial propagation of fish in general and of Common Carp specifically is when propagation is fully programmed, and each phase is completed under controlled hatchery conditions strictly. Key steps of artificial propagation *viz*-First of all, the injection of suitable brood fish with gonadotropic hormones, which will be done twice for the female fish and once for the male fish. This is followed by stripping of its sexual products (eggs and sperm), usually done 10-12 hours after injection (depending on the temperature of the water). Thereafter, fertilized eggs should be treated against stickiness and then incubated in hatchery jars or small receptacles. Hatched larvae are placed and reared in large jars, and as soon as larvae grows and starts to feed, they can now be stocked into nursery ponds.

Comparism between artificial propagation of common carp with its natural spawning

There is need for an increased number of male spawners for natural spawning, as compared to artificial propagation. Reason being that one male cannot gratify the need for an overhaul of stimulation on the female specie, such as will facilitate shedding of eggs, talk more of releasing enough milt as to saturate the shedded eggs in water. About 3 males to one female in this case is a good recommendation. This implies that the need for male spawners will be about 4-6 times less, as compared to if spawning is natural. Also, during incubation as in the natural reproduction, eggs are at the risk of beign exposed to adverse environmental conditions that could influence hatching time and hatching success. Whereas, during incubation (as in artificial propagation), it is easy to protect the eggs against parasites and water fungi as well as against bad weather conditions and predators. This is possible since propagation is by controlled means as compared to the natural method of spawning.

Furthermore, newly hatched larvae will obviously not be protected from their enemies since they are exposed and not controlled; therefore, they will have a low percentage survival. Whereas in artificial propagation, newly hatched larvae can also be more protected from their enemies; therefore, their survival is further enhanced through their controlled first feeding.

Stocking of feeding larvae in well-prepared ponds ensures better growth and survival. However, in a natural habitat, fry feed on planktons that may be abundant or lacking, depending on how fertile the pond is. Whereas, as in the case of artificial propagation, fry feeding too must be fully controlled to avoid wastage and water pollution which is harmful to fish life.

Study area

As shown in Table 1 this experiment was conducted in Panyam Fish Farm, Panyam, Mangu Local Government Area of Plateau State, Nigeria. Panyam Fish Farm has existed since 1954, and is well known specifically for Carp fish farming in West Africa. It is situated in Mangu, around 60 kilometers South-East of Jos. The physico-chemical parameters of experimental water were taken three times in a day at 7 am, 12 noon and 6 pm respectively, using relevant instruments and was observed to be within tolerable range for Carp fish aquaculture as described [5-7].

Table 1. *Water quality parameters for panyam fish farm pond water.*

Parameters	Time			
	7 am	12 noon	6 pm	Mean
Temperature (ºC)	20.40 ± 0.32	22.23 ± 0.32	19.93 ± 0.1	20.86 ± 0.25
pH	7.48 ± 0.05	7.60 ± 0.11	7.55 ± 0.08	7.54 ± 0.05
Dissolved Oxygen (mg/L)	8.13 ± 0.19	8.73 ± 0.13	8.20 ± 0.09	8.35 ± 0.09
Total Dissolved Solids (mg/L)	133.67 ± 2.84	140.77 ± 2.58	135.88 ± 2.22	136.77 ± 1.54
Electrical Conductivity (µS/Cm)	237.21 ± 2.90	240.18 ± 3.55	230.28 ± 1.65	235.89 ± 1.78
Transparency (Cm)	42.33 ± 0.64	57.13 ± 0.68	42.37 ± 0.64	47.28 ± 1.49

Materials and Methods

A total of 50 *Cyprinus carpio* brood fish (25 male and 25 female) was obtained from Panyam Fish Farm, and were isolated in separate hapa net of 3 m by 7 m by 1.5 m dimension each, and fed intensively with 9 mm size of vital feed extruded floating pellets, for 3 months, before they were certified ready for spawning. 33 brood stocks (12 females and 21 males) was selected out of the 50 isolated brood fish, and used for this experiment.

Selecting the 33 brood stock was done after a period of screening activities (based on physically observable characters after little pressure was applied on the abdominal regions towards the genital area of each broodstock, to check quality of milk and eggs), and identify ready spawners.

Treatment 1

Evaluation of percentage hatchability of carp through uninduced natural spawning: Selected *Cyprinus carpio* fish was grouped three males to one female, per hapa, weighed and enclosed in hapanets with grasses. A total of three female and nine male brood stocks were used. No hormone was administered. Water temperature was observed to be maintained at 19°C-22°C, at a saturated Dissolved Oxygen level of 7.45 Mg/L–9.05 Mg/L, with water level increasing slowly from inlet. The paired broodstock were kept in hapa net (3 m × 1.5 m × 1 m) and volume of water was increased gradually to mimick flooding that can trigger egg release. After egg released and fertilization took place, the spawners were netted out of the hapa for incubation process to continue.

Fertilisation was done by the activities of spawners, kept together in the already prepared net with kakabans, where the male released milt on the eggs shed by the female spawners. This took place in 3 double hapa net of sizes 3 m × 1.0 m × l.5 m dimension of 0.5 mesh size with inner linning of netting material (1.0 mesh size) each of same dimensions, with three replicates and kakabans respectively.

To determine fertilisation rate, l gram of egg mass which was not inseminated was used. The time taken for the control eggs to become blurred (dead) was noted and the clear appearing eggs in the incubation tanks was counted and termed the fertilized eggs [8].

Percentage Fertilisation=(N-b) × 100

Where N represents the sample of spawned eggs, b represents number of bad eggs.

Treatment 2

Evaluation of percentage hatchability of carp by through induced natural spawning: Selected fish were grouped into male and female, and weighed. Upon weighing, a dosage of 0.8 ml of hormone per kilogram of the stocks body weight (for female), and 0.3 ml per body weight for male each of Ovaprim hormone was administered to the brood stock, at the pectoral fin and above the lateral line at an angle of 45° after the head region. A first dose of 20% of 0.8 ml ovaprim per kg of the stocks body weight was given to the female fish. This was given at 10 am of the first day, followed by a second dose of 80% of 0.8 ml ovaprim per kg of the stocks body weight, given to the female after 12 hours (10 pm) of the same first day to get the eggs ready for stripping. However, the male was not given this dose, and only a single doze of 100% of 0.3 ml per body weight of fish was given to the male fish, just at the same time interval the second dose was being given to the female brood fish. The first dose was administered by 10 am and the second dose by 10 pm to get the eggs ready for stripping.

With the hapa net well prepared and immersed in pond, stocked with newly filled grasses. Spawning took place after about 72 hours from time of the first dose administration i.e at about 10 am on the third day.

Brood stock was induced and allowed to spawn naturally. The female stock shed her eggs on the second day after about 13 hours (11 am in the second day) from the 10 pm of the first day (after the second dose was given by 10 pm of the first day), and pairing began with the display of the courtship behaviour between the male and female spawners.

Immediately after spawning, the brood stocks were removed from the net, to leave room for fry to hatch in the hapas. This they did on the third day at about 73 hour from the first dosage injection time.

In order to determine percentage fertilization, 1 gram of egg was obtained from the female by stripping after it was removed from the hapa. The gently stripped eggs were degummed by the application of 10% forma line.

To determine fertilisation rate, the 1 gram of egg mass which was not inseminated was used to determine fertilisation. The time taken for the control egg to become blurred (dead) was noted at 1 hour timing, and the clear appearing eggs in the incubation tanks was termed the fertilized eggs, as described, using percentage fertilization [8].

Degumming of eggs was done by the use of 10% formalin. The solution was poured on the 1 gram of eggs to make them distinctly separable and make ease for counting.

Number of eggs per gram was determined using an Electronic/ digital weighing balance, and counting was done on a glass slide slab in a Petri dish.

Incubation was carried out in the same 3 double hapa net of dimensions 3 m × l m × 1.5 m with finer mesh size 0.5 mm net lining each, with three replicates and kakabans respectively.

Eggs were monitored for 73 hours till hatching was successfully recorded. Incubation was done in hapa nets.

Treatment 3

Evaluation of percentage hatchability of carp through induced breeding by stripping in indoor concrete ponds: Selected fish was grouped into male and female, and weighed. Upon weighing, Ovaprim hormone was administered, at the pectoral fin and above the lateral line after the head region. This administration was done twice.

First, an initial dosage of 20% of 0.8 ml ovaprim per kg of the stocks body weight was given to the female fish, followed by a second dose of 80% of 0.8 ml ovaprim per kg of the stocks body weight, given to the female after 12 hours (10 pm) of the same first day to get the eggs ready for stripping. For male, only a single doze of 100% of 0.3 ml per body weight of fish was given to the male fish, just at the same time interval the second dose was being given to the female brood fish the male.

With concrete tanks and environment, stocked with newly filled grasses and well-conditioned, hatching took place in day three from first injection time.

Stripping in Indoor Concrete tanks was done manually by hand after a period 73 hours from the first dose. Stripping was by mild pressure application to let out milt and egg content from both spawners, after which a gram of eggs was scooped out for further evaluation process.

Degumming of eggs was done by the use of 10% formalin. The solution was poured on the 1 gram of eggs to make them distinctly separable and make ease for counting.

I determine number of eggs per gram using an electronic/ digital weighing balance, and counting was done on a glass slide slab in a petri dish, and a Spatula used to isolate and count eggs to determine number of eggs per gram.

To determine fertilization Rate, l gm of egg mass which was not inseminated was used to determine fertilization. The time taken for the control eggs to become blurred (dead) was noted at 1 hour, and the clear appearing eggs in the incubation tanks termed the fertilized eggs. This method was described [8].

Incubation was done in the concrete tanks, with close supervision of artificial fertilisation, removal of stickiness and hatching. Fry was nursed in same concrete tanks and other observations made.

Data analysis

The results were carried out using Excel Stat and Minitab 14 to highlight the possible heterogeneity between the populations.

Results

The result of number of eggs in one gram, fecundity, percentage hatchability, and number of fry in one litre of water, of the fry to post fry progenies of the crosses of the three different experiments on hatching Carp through un induced natural spawning, induced natural spawning, and induced spawning by stripping are shown in Table 2.

Table 2. *Hatching parameters of carp using three different breeding systems.*

Parameters	Rearing systems			P-value
	Un-induced natural spawning (T1)	Induced natural spawning (T2)	Induced breeding by stripping (T3)	
Weight of fish (g)	993.30 ± 23.30	996.70 ± 12.00	976.70 ± 17.60	-
Weight of Eggs (g)	144.50 ± 21.50	143.50 ± 25.00	153.50 ± 21.50	<0.01
No. of eggs in 1 g	702.00 ± 3.21^{c}	709.33 ± 4.91^{b}	733.33 ± 3.53^{a}	<0.01
Total No of Eggs	100737.00	102498.19	112566.16	
Fecundity (× 103)	107.85 ± 15.50	102.01 ± 18.48	98.81 ± 4.02	0.36ns
Percentage Fertilisation	73.12 ± 0.30^{c}	94.44 ± 0.40^{a}	89.86 ± 0.10^{b}	<0.01

No. of Post Fry per 1 L of water	838.00 ± 75.20^{c}	1572.36 ± 52.00^{b}	1896.33 ± 53.40^{a}	<0.01
Percentage Hatchability	37.54 ± 0.20^{c}	72.73 ± 0.93^{b}	94.10 ± 0.85^{a}	<0.01

Note: Hatching parameters of carp using three different breeding systems. (Means on the row with different superscript are statistically significant (p<0.05). NS=not significant).

The number of eggs in one gram was found to be highest (733.33 ± 3.53^{a}) in the brood fish from the purely artificial propagation (Induced spawning by stripping) setting, as compared to that of semi-artificial or induced natural spawning (702.00 ± 3.21^{b}) and completely natural (un-induced) spawning setting (709.33 ± 4.91^{b}) propagation with a significant difference at (P<0.05)

Total number of eggs shed was determined in line with the number of eggs in a gram to be 112566.16 in the brood fish from the purely artificial propagation (induced spawning by stripping) setting, as compared to that of induced natural spawning (102498.19) and completely natural (un induced) spawning (709.33 ± 4.91^{b}).

The higher fecundity (×103) was found in the natural propagation (107.85 ± 15.50), as compared to induced natural spawning (102.01 ± 18.48) and purely artificial i.e induced spawning by stripping method (98.81 ± 4.02) with no significant difference at (P<0.05).

Percentage Fertilisation was found to be highest in sample collected from the treatment of the induced natural spawning (94.44 ± 0.40^{a}) as compared to Induced spawning by stripping (89.86 ± 0.10^{b}) and un induced natural spawning using outdoor hapa net (73.12 ± 0.30^{c}).

Percentage Hatchability was found to be highest in sample collected from the treatment of induced spawning by stripping in indoor concrete tank system (94.10 ± 0.85^{a}) as compared to induced natural spawning (72.73 ± 0.93^{b}) and natural (un induced) propagation using outdoor Hapa net (37.54 ± 0.20^{c}).

Number of Post Fry in one litre of water at day seven was found to be highest in sample collected from the treatment of artificial propagation i.e. induced spawning by stripping in indoor concrete tank system (1896.30 ± 53.40^{a}) as compared to induced natural stripping (1572.30 ± 52.00^{b}) and completely natural propagation using outdoor Hapa net (843.00 ± 75.20^{c}).

Discussion

The number of eggs in one gram and total number of eggs generally was found to be highest (733.33 ± 3.53^{a}) in the brood fish from the purely artificial propagation setting (induced stripping), as compared to that of induced natural spawning or semi-artificial (709.33 ± 4.91^{b}) and completely natural setting or un induced natural propagation (702.00 ± 3.21^{c}) with a significant difference at (P<0.05). The significant difference here could be as a result of the application of Ovaprim hormone and the opportunity for complete stripping of the gravid brood stock. Ovaprim hormone is used commonly for inducing breeding on finfish artificially because it has a salmon gonadotropin-releasing hormone equivalent and a dopamine antagonist; this hormone is very effective for finfish species [9, 10].

A high quality seed production demands a particular nutrition of brood stock which significantly affects fecundity and survival [11]. From this study, all the brood stocks used were matured and healthy. They were isolated and given intensive care and intensive feeding for a period of three months. Obviously, the same high quality and ration of feed was fed the brood fish to satiation. Consequently, if fecundity were based on feeding alone, the three different treatments would have had no significant difference with number of eggs per gram. Also, another discussable reason for the statistical difference could be based on age of fish, genetic and inherent factors peculiar to the brood fish used by the respective treatments. However, during selection, brood fish used were seemingly of equivalent size, age, and weight. Common Carp is found to attain maturity when six to eight months old, the males about two months earlier than the females and at a smaller size, suggesting that the gene or age of the brood fish may not have been the sole cause of the significant difference. Hence, this could be due to hormone administration, and the complete stripping of eggs from the egg sac of the induced gravid female brood fish in the artificial breeding treatment [12].

The higher fecundity (×103) was found in the natural propagation using Hapa Net (107.85 ± 15.50), as compared to induced natural spawning (semi-artificial) (102.01 ± 18.48) and purely artificial or induced stripping (98.81 ± 4.02), but with no significant difference at (P<0.05). Though the difference was not significant, the greater number attained in the natural propagation system could be attributed to the lower stress on the brood fish, associated with the natural propagation system as compared to the semi-artificial and completely artificial propagation systems. This implies that the gravidity of all the brood stock used for the different treatments was intact, relative to their body weight.

Percentage Fertilisation was found to be highest in sample collected from the treatment of the induced natural spawning (94.44 ± 0.40^{a}) as compared to Induced spawning by stripping (89.86 ± 0.10^{b}) and un induced natural spawning using outdoor hapa net (73.12 ± 0.30^{c}) with a significant difference at (P<0.05). Possibly, the percentage of fertilization which was higher in treatment two (induced natural spawning of 94%), could also be as a result of the less stress on the brood stock which was already to shed eggs after hypophysation (inducement from action of Ovaprim on sex gamates). For fertilization to have occurred, milt from the male mixed with the eggs from the female. The union between the sex cells from both parents must have been without stress from handling on both brood stock as compared to the manual stripping of fish eggs and milt. Stress on brood fish affects reproduction potentials. Though the completely natural (un induced natural spawning) too was without handlers stress on the brood fish used, it is imperative that its lowest output could have been

from the fact that the completely natural process of spawning may not have had a 100% conducive breeding environment, which could draw attention to the fish being in a confined area or in captivity in the hapa net, thereby depriving the sex cells of brood fish from optimum development.

73% fertilisation yielded 37% hatchability in treatment one. 94% fertilization yielded 72% hatching success in treatment two, and 89% fertilization yielded 94% hatching success in treatment three. Keen observation shows however that the treatment of the Induced spawning by stripping did better than all other. Ordinarily, percentage fertilization should be commensurate to, or be a direct pointer to percentage hatchability. But in this experiment, the treatment with the highest percentage fertilization did not yield the highest percentage hatchability.

The Percentage Hatchability was found to be highest with a significant difference at ($P<0.05$) in sample collected from the treatment of artificial propagation through stripping in indoor concrete tank system (94.10 ± 0.85^{a}) as compared to induced natural spawning through stripping in outdoor hapa net system (72.73 ± 0.93^{b}) and natural propagation using outdoor hapa net (37.54 ± 0.20^{c}).

The knowledge of artificial breeding is a key aspect as it permits intensive production of a given species in controlled conditions [13]. This allows continued production of juveniles for restocking natural or artificial water bodies. This justifies the result obtained here, as the two treatments that were administered the ovaprim hormone had more hatching success, with other factors like water physico-chemical parameters same for every treatment. Also, reproduction of Carp is most often performed in hatcheries. After hatching, the larvae are transferred to small shallow pools or ponds with water rich in plankton, a sufficient food for the young Carp [14].

The number of Post Fry in one liter of water at day seven was found to be highest in the sample collected from the treatment of artificial propagation through stripping in indoor concrete tank system (1896.30 ± 53.40^{a}) as compared to semi-artificial propagation through stripping in outdoor Hapa net system (1572.30 ± 52.00^{b}) and natural propagation using outdoor Hapa net (843.00 ± 75.20^{c}). Considering the fact that there was no significant difference at ($P<0.05$) in the fecundity of all treatments, and the fact that the Hapa net used for the experiment was double netted (to avoid escape of fry into the water body, with the external layer of the netting of a smaller mesh size than the internal netting that housed the brood fish in the natural and semi-artificial treatments), the significant difference in the number of post fry in one litre of water at day seven after hatching could be obviously due to the complete stripping of the gravid and injected brood fish. It means that despite the conducive environmental conditions for the hatching of fry in all the treatments, the treatments without stripping may have obviously had some eggs left in the belly of the gravid female, ready for reabsorbtion. It also indicates that the use of hapa nets may have conditioned the brood fish to a limited space for movement, which could be a source of stress to the fish. Furthermore, the application of synthetic hormone is relevant to the total ripening of the eggs embedded in the brood fish, ready for fertilization, hence the significant difference.

Generally, Common Carp breeds in natural water bodies. However, artificial breeding in commercial farm level is much more important for the successful expansion of aquaculture and farmers economic condition [15].

Very importantly, I discovered from observation in the course of this study, and during the different and repeated trial experiments carried out in various farm settings (with different atmospheric and water physico-chemical parameters of water), that Common Carp *(Cyprinus carpio)* is a highly sensitive non tolerant fish species, and not as hardy or tolerant as other common culturable species of fish like Clarias gariepinus as we have commonly available in Nigeria, to have a hardy nature [16]. It also described to have a high tolerance to changeable environmental conditions [17]. The experiences gathered from these processes suggests the need for a highly professional and skilled handling of Common Carp *(Cyprinus carpio)* fish species, in addition to ensuring the right culture medium in order to achieve spawning and culturing success.

Conclusion

From the result obtained, the best method of Carp fish propagation for aquaculture is the induced spawning by stripping in indoor concrete tanks, which had 94% hatching rate as compared to 72% from induced natural spawning and 37% from un-induced natural spawning.

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