EFFECTS OF TWO SYNTHETIC HORMONES AND LATENCY PERIOD ON THE BREEDING INDICES OF *CLARIAS GARIEPINUS* (BURCHELL, 1822)

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BY

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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc) DEGREE IN FISHERIES, DEPARTMENT OF BIOLOGICAL SCIENCES, AHMADU BELLO UNIVERSITY, ZARIA NIGERIA

MAY, 2014.

DECLARATION

I declare that, the work in this thesis entitled "EFFECTS OF TWO SYNTHETIC HORMONES AND LATENCY PERIOD ON THE BREEDING INDICES OF *CLARIAS GARIEPINUS"* (Burchell, 1822) has been performed by me in the Department of Biological Sciences under the supervision of Prof. S.A. Abdullah and Prof. J. Auta.

The information derived from the literature has been dully acknowledged in the text and list of references provided. No part of this thesis was previously presented for another degree or diploma at any University.

Abubakar Minin MOHAMMED _____ Signature _____ Date

DEDICATION

This piece of research work is dedicated to members of my family for their effort to put me through in this work. This research work is also dedicated to Almighty Allah the creator of everything.

CERTIFICATION

This thesis entitled "EFFECT OF TWO SYNTHETIC HORMONES AND LATENCY PERIOD ON THE BREEDING INDICESS OF *CLARIAS GARIEPINUS"* (Burchell, 1822) written by Abubakar Minin MOHAMMED meets the regulations governing the award of Master of Science (M.Sc) Degree in Fisheries, Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

This study examined the effect of ovaprim and ovatide at various latency periods on the breeding indices of *Clarias gariepinus.* Twelve broodstocks of *Clarias gariepinus* were sourced for this experiment from Federal Department of Fisheries Farm, Kaduna. The experiment was designed to consist six treatments that is, 1A, 1B, 2A, 2B, 3A, 3B. Two broodstock consist of male female were used for each treatment. Group of Treatment "1" were injected with ovaprim and ovatide at 0.5ml/kg body weight each for 8 hours before stripping. Group of Treatment "2" were injected with ovaprim and ovatide at 0.5ml/kg body weight for 10 hours before stripping. Group "3" were injected with ovaprim and ovatide at 0.5ml/kg body weight for 12 hours before stripping. The injection was done intramuscularly above the lateral line and below the anterior end of the dorsal fin. The stripped eggs were counted using gravimetric method and were fertilized and incubated using hapa-net as substrate. Physicochemical parameters of water were also observed and recorded. The fish administered ovaprim at 0.5ml/kg body weight at the latency period of 12 hours had highest number of stripped eggs (53,260) also with highest percentage fertilization (83.57%) ($P \leq 0.05$) the highest body weight of hatchlings was obtained from the group injected for 8 hours before stripping using ovaprim (0.5ml/kg) although there was no significant difference with that of 10 hours latency period ($P > 0.05$). The hormones used in this research work performed very well because all the treatments involved responded positively to the two hormones but ovaprim performed significantly ($P \leq 0.05$) better than ovatide in all aspects. Ovaprim and Ovatide are therefore recommended for induced spawning of *Clarias gariepinus* at latency periods between 10 hours and 12 hours at the temperature range of 26^{o}C-27 ^{o}C.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Fingerlings production is essential to fish farming but production of fingerlings in Nigeria is associated with challenges, such as appropriate hormones in terms of quality and dosage environmental conditions, appropriate latency periods and availability of brood stock e.t.c. (Sahoo *et al*., 2004). Some of the reported works on the effects of Ovaprim on gonad maturation include demonstration of high success rate in a tropical ornamental fish, ovulation was 92.8% and spermiation rate was 97.5% (Hill *et al.,* 2005). Induced spawning, artificial fertilization and egg incubation were studied in Green sauge on and results showed that best treatment was GnRHa injected only in a single dose of 10ùkg for males and a 19g/kg resolving dose for female (Vae Eenennam *et al.,* 2008). Their findings also showed that the females held at a temperature of 12–13^{o}C ovulated at 14hrs and 49,000 to 115,000 eggs were collected from each female (Van Eenennam, *et al.*, 2008).

Fasasi (2003), estimated the demand-supply gap of fish in Nigeria as 1.0 million tonnes, and fingerlings demand supply gap was estimated to be over 500 million. This high demand for fish fingerlings in the growing aquaculture industry today, has called for the need in terms of artificial propagation of warm water fish species, and the only reliable and dependable source is through induced breeding.Induced breeding involves the use of techniques such as hypophyzation (the use of pituitary extract to induce ovulation) and synthetic hormones to artificially provoke ovulation and spawning in fish (Lam, 1982). Apart from being able to obtain quality fish seed (stocking material), induced breeding can also be used to develop strains superior to their genitors by the method of selective breeding and hybridization(FAO2007).

These techniques permit the incubation and hatching of eggs under well protected weather independent conditions. The spawning or breeding of fish is season independent when induced (Sahoo et al., 2003). Induced breeding as a technique serves as a manifold aimed at producing large quantity of egg, fry and fingerlings for the purpose of utilization in culture or restocking wild water bodies.

Hormonal spawning of *Clarias gariepinus* has been investigated over the past three-four decades (Roltman *et al.,* 1991). Various hormones including Deoxycorticosterol Acetate (DOCA) (Adigun *et al.,* 1983), Leutenizing Hormone (LH) (Brzuska, 1991), Ovaprim (Audu, 2009) and Ovatide have been used to induce spawning in different fish species.

Many years of research investigating hormonal triggers for ovulation and spermiation in fish went into the development of ovaprim. Ovaprim developed by Syndel Laboratories Ltd China contains an analogue of salmon gonadotropin releasing hormone (sGnRH) and dopamine *antagonist* (Nandeesha *et al.,* 1990). Ovatide consists of synthetic peptide and salmon analogue product of Hemmopharmaceutical Ltd India.

Success of artificial propagation of *Clarias gariepinus* through induced breeding under controlled environmental condition is mostly dependent on the latency period and humidity/temperature of the environment (Sahoo *et al.,* 2007). Therefore, the role of latency period in terms of spawning and fertilization of fish egg needs to be systematically evaluated.

Latency period which is the time interval between the time of hormonal treatment and stripping of egg plays an important role in the success of spawning and fertilization of fish egg (Zonneveld *et al.,* 1998).

Clarias species, from a biological point of view, is one of the ideal culture species all over the world (Bruton, 1996). *Clarias gariepinus* is considered as a species that withstands adverse environmental conditions is highly fecund and easily spawned under captive conditions. According to Bruton (1996), it has a wide tolerance of relatively poor water quality conditions in which most of other freshwater fish species would find it difficult to survive. High environmental tolerance and wide food spectrum are the main reasons why *C. gariepinus* is excellent for tropical and subtropical pond fish culture (Haylor, 1989). The "hardness" of this species makes it an ideal candidate for highly intensive culture, without pre-requisite pond aeration or high water exchange rate (Nandeesha *et al*.,1991). Under natural condition, the breeding season of this species, just like any other fish species of family Clariidae, is limited to a few months (Bruton, 1979). Spawning starts with the onset of the rainy season and usually takes place in flooded areas between May and September in the savannah regions of Nigeria (Aluko et al., 1999).

1.2 Statement of the Research Problem

The successful large scale cultivation of any organism for human consumption demands that the resources be easily renewable as it is clearly unacceptable to cultivate any organism when the supply of the young ones can not be easily replenished.

Demand for fingerlings in Nigeria far out weighs their production especially with improvements in fish farming hence a challenge. Furthermore, sourcing of fingerlings of *C. gariepinus* from the wild is common because of perceived difficulty in artificial breeding.

The difficulty in the determination of genetic performance of fingerlings as well as introduction of parasites and diseases in to the farm are some of the problems associated with sourcing fingerlings from the wild water bodies.

1.3 Justification

Fish is highly nutritious, contains high levels of poly unsaturated fatty acids including Omega 3 fatty acids which lowers blood cholesterol level. Fish has also be found to contain Unidentified Growth Factors (UGF) and Unidentified Immune Factors (UIF) (Nwakoyey et al., 2007).

Clarias gariepinus was chosen for this work, because it has ability to tolerate low dissolved oxygen concentration, it can also respire anaerobically over a short period of time. *Clarias gariepinus* also has wide range of general acceptance by both fish farmers and consumers. *Clarias gariepinus* is also regarded as universal receptor of feed.

Artificial fertilization through hormonal treatment has the following advantages: better rate of fertilization and hatching, better condition for growth and survival, easier handling of fertilized egg and milt collected can be used efficiently without much wastage.

Adequate knowledge of latency period reduces the risk of egg wastage and enhances the level of spawning and fertilization of egg

1.4 Aim and objectives of the study

The aim of this research work is to determine the efficacy of two synthetic hormones on fingerlings production at various latency periods.

The specific objectives were :

I. To examine the efficacy of Ovaprim and Ovatide on the maturation and viability of fish eggs

II. To determine the best latency period for ovulation and hatchability of fish egg.

III. To examine the relationship between the latency period and growth performance of *Clarias gariepinus* fingerlings

IV. To determine the effect of ovaprime and ovatide on the survival and growth rate of *Clarias gariepinus* fingerlings.

1.6 Hypotheses

I. There is no significant difference in the efficacy of Ovaprim and Ovatide on the maturation and viability of fish egg.

II. Latency period has no significant effect on the ovulation and hatchability of *Clarias gariepinus* egg.

III. There is no relationship between the latency period and growth performance of *Clarias gariepinus* fingerlings.

IV. Hormonal treatment has no significant effect on the survival and growth rates of *Clarias gariepinus* fingerlings.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Artificial Propagation of Fish

Production of fish in captivity has necessitated artificial means in propagating fish species. This ensures the frequent and continuous production of fish by fish farmers which guarantee the supply of fish at any time. Gonadal development may be impaired or even cease completely in captivity. This necessitates humans to exercise certain level of control over the reproductive process of captive fish. Induced ovulation and coordinated spawning is a valuable tool for fish culturists (Powell *et al.*, 1998).

Environmental and hormonal manipulation of ovulation in fish have become of practical importance in the fish farming industry for several reasons. it is important to solve the problem of spawning asynchrony which necessitates frequent broodstock handling (Crim and Grebe, 1984., Lin and Peter, 1996), secondly, by accelerating or delaying gametogenesis in captive broodstock, spawning may be scheduled to yield fry whenever needed (Lam, 1983). Moreover, induced breeding makes possible hybridization between closely related species (Lam, 1982, Kim *et al.*, 1995, Park *et al.*, 1996).

Artificial fertilization involves the collection of gametes from the male and female fish. To achieve this, hormones must be used to induce ovulation and spermiation. Different types of hormones have been used to induce breeding, including human hormone analogues, fish and amphibian pituitary extracts. Doses of hormones could be administered either once or twice in which, the first is termed the priming dose and the second dose is called the resolving dose. The choice and dosage of hormone

depends on certain factors ranging from efficacy of hormone, species of fish and cost to availability of hormone (Nguenga *et al*.,2000)

Induced breeding through the use of hormones has to do with the assessment of the maturity of breeders as the success of such technology to a large extent depends on adequate and accurate information about the state of the gonad. Gravid fish can be ascertained by examining the external features and appearance (large soft abdomen, reddish in colour and swollen gonad papilla) (Nguenga *et al.,* 2000).

According to Battaglence and Selosse (1996), success in induced spawning depends largely on the knowledge of the optimum dose of hormone to be used and latency period i.e. the time between administration of hormones and stripping of egg.

2.2 Hormones used for induced spawning

Lam (1982) stated that, induced spawning involves induction of final oocyte maturation (germinal vesicle migration and breakdown) and or ovulation of female and induction of spermiation in male, which is followed by either stripping of egg or fish is left to spawn naturally.

The adoption of induced breeding technique in fish culture has enhanced the breeding of a number of species that do not spawn under confinement e.g *Clarias* spp. Unlike prolific spawners such as *Tilapia* spp. Common carp and I *punctatus* that can spawn freely in captivity. This could be seen as one of the major contributions of induced breeding techniques since its first application in Brazil in 1935 (Adebayo *et al*., 2008)

Fish fingerlings production, involves a series of breeding and feeding activities which results in the mass production of stocking material under controlled environmental condition usually in hatchery (Adebayo and Popoola, 2008). Hormones irrespective of

the type, are meant to hasten the ripening of the eggs within few hours when the genitals of the breeders are fully ripe and are in the resting phase.

Different hormones that have been demonstrated by several researchers include crude pituitary extracts, human chorionic gonadotropin (hCG), Deoxy corticosterol acetate (DOCA), Ovatide, Ovaprim, Luteinizing Hormone Releasing Hormone (LH-RH) as well as Ovuline.

2.3 Ovaprim

Ovaprim, a synthetic analogue of salmon GnRH is the popular hormone used by aquaculturists in Nigeria for inducing ovulation in different fish species. Ovaprim is a mixture of the analogue of salmon gonadotropin–releasing hormone (SGnRHa) and a dopamine antagonist domperidone (Goudie *et al,.* 1992). It is usually administered at a dose of 0.5ml/kg of body weight of broodstock. However, Mahapatra (2004) reported a functional dose of 2m1/kg of body weight for females of the asiatic catfish, *Clarias batrachus*.

Powell *et al.* (1998) used two GnRH analogues (ovaprim 0.5ml.kg^{-1} and ovaplant day, 1.4 kg day^{-1} for coho and trout respectively for 21 days) to determine whether treatment to induce spawning causes an increase in pre-spawn mortality, advances spawning date, compresses the spawning season or had any deleterious effect on the progeny of the Coho Salmon, *Onchorhynchus kisutch* and the rainbow trout On*chorhynchus mykiss.* It was reported that both hormones advanced spawning date for both species of fish and that pre-spawn mortality was zero, the treatment also compressed the spawning season i.e. the duration of the spawning within the treated groups was less than the untreated groups.

More recently, ovaprim has been used by induce breeders the world over and has been yielding good result. Ovaprim itself has been used successfully in the Australian eel-tailed catfish (*Neosilurus ater).* (Chea and Lee, 2000), red –tailed tinfoil barb, *Barbonymus altuse* (Mohammad *et al.,*1994), the thai Mahseer, *Totambroides* and *T.douronensis* (De Silva *et al.,* 2004), walking catfish, *Clarias batrachus.* (Saboo *et al.,* 2005), and a number of ornamental fish species. Khan *et al,* (1992) reported the successful spawning of Rohu and Mariga with ovaprim at fish hatchery Islamabad Pakistan. Nandeesha *et al* (1990) used ovaprim to induce breeding in Indian major carps. Goudie *et* al. (1992) tested ovaprim on channel catfish *Ictalus punctatus* in U.S.A Chea and Yeo (1994) induced spawning in the walking cat fish, *Clarias batrachus* with ovaprim in Malaysia. Haniffa and Srindhar (2002), induced spawning in spotted murrel, *Channa punctatus* using hCG and ovaprim. Doses of 1000Iμ/kg to 3000Iμ/kg of body mass of hCG and 0.1m1 to 0.7m1/kg of ovaprim were administered in a single dose. Result showed that increase in dosage of hormones, produced elevated values in egg out-put. Spawning was complete among fishes injected with 0.5ml ovaprim and 3000Iμ/kg hCG. Nandeesha *et al.* (1993), Francis (1996) and Haniffa (1996) reported that the dosage of ovaprim for induced spawning in Carp and Murrel ranged between 0.3ml/kg and 0.6ml/kg body weight.

Cheah and Lee (2000) induced twenty gravid female catfish (*Neosilurus ater*) with 0.25, 0.5, 0.7 and 1.0ml/kg body weight of ovaprim and twenty males with 0.5ml/kg body weight of ovaprim at the same time as the females were treated, the workers observed that ovulatory response was positive when the fish were administered 0.5, 0.7 or 1.0ml/kg body weight of ovaprim.

According to their report, *N. ater* requires lower dosages for induced ovulation compared to the other catfish spp. Cheah *et al*. (1993) reported that ovulation in *C.batrachus* was achieved only when ovaprim was administered at the level of at least 0.7ml/kg body weight.

Nwokoye *et al.*(2007) investigated induced propagation of red-mud cattfish, *Heterobranchus bidorsalis* using ovaprim and pituitary extracts obtained from *H.bidorsalis.* A total of 60 gravid females and 20 mature males were injected in 10 spawning trials over 70 days. The report of the research showed that, ovaprim performed significantly better ($P<0.01$) in almost all the parameters investigated. The researchers therefore, recommended the use of ovaprim for induced spawning.

2.4 Ovatide

An injectable inducing hormone consisting of GnRH analogue in combination with dopamine antagonist is also efficient in induced spawning (Gupta *et al*., 2002 and Sahoo *et al.,* 2004). Ovatide is a product of Hemmopharmaceutical Ltd with antagonist called peptide. It is available in liquid form just like other synthetic hormones.

Use of ovatide at a dose of 0.4ml–0.5ml/body weight of female *C. gariepinus* found more successful than ovaprim (Pande *et al.,* 2002). A rate at 95–100% fertilization with 90–98% hatching success in *Labeo rohita* using ovatide at water temperature ranging between 28^0–31^0C was reported by Dwivedi and Reddy (1986).

2.5 Latency period

Latency is described as the time interval between injection of the female fish and stripping of eggs (Zonneveld *et al.,* 1988). The induced breeding of *C. gariepinus* depends largely on the latency period (Hogendoorn and Vismans, 1980).

The latency period of 10 hours is unarguably the best for *C. gariepinus* at the temperature of 29.5^0C. At latency period lower than that, there will be insufficient action of the hormonal treatment leading to failed ovulation (Tan-fermin *et al.,* 1997). The latency period of 18 and 22 hours after hormonal treatment at the temperature of 23^0C resulted in poor fertilization and hatching rates., (Ohata *et al.,* 1996, Oyelese, 2006). The latency period of 12 hours in fish injected with 0.5ml/kg body weight resulted in good fertilization and hatching rate (Sahoo *et al.,* 2007). Latency period could be reduced by increasing the hormonal dosage and also increase in temperature (Sahoo *et al.,* 2007). The female fish injected with ovaprim at the dose 0.5ml and 1.0ml/kg body weight did not release egg before 12 hours until pressure was applied to the belly. Female fish injected with 1.5ml/kg body weight of ovaprim released egg after 11 hours of injection (Sahoo *et al.,* 2007).

Success of artificial propagation of *C. gariepinus* through induced breeding under controlled environmental conditions is mostly dependent on the latency period and humudity/temperature (Tan-fermin *et al.,* 1997).

Egg stripped before the optimum time shows low fertilization, low hatchability and low survival of the hatchlings in both indoor and outdoor hatcheries. Also, if the time of stripping (i.e latency period) is too high, there would be loss of quality in the gonadal products (Tan-fermin *et al.,* 1997).

2.6 Selection of Broodstock

Broodstock should be selected for the visible features and generic traits that are desirable by producer (Kelly, 2004). Broodstock should weigh at least 500g and almost 1.2kg. This is because larger fish are difficult to handle and often results in substantial egg losses in stripping and broodstock weighing less than 500g may not bear enough egg.

Mature female fish normally have a well distended, swollen abdomen from which ripe eggs can be obtained by slightly pressing the abdomen towards the genital papilla. Ripe eggs are generally uniform in size with the nucleus appearing as a small dark portion in the centre of the egg. Mature female fish also has a reddish or rose coloured genital papilla for female brood fish, they should weigh more than 300g and not less than 8 months old (De Graaf and Janssen, 1996). Freedom from physical injuries is also highly recommended. Fish should be checked for suitable body conformation and free from hemorrhage on the skin.

2.7 Administration of Hormone

The brood stock are usually administered with hormones to induce final maturation and ovulation. Hormones are administered through injection. Two methods can be employed in hormone injection: intra-muscular and intra – peritoneal method. The most common method used, is the intra–muscular method through the dorsal muscles (De Graaf and Janssen, 1996).

Brzuska (2003) reported the administration of carp pituitary extract and aquaspawn (Synthetic GnRH-a and domperidone) on *C. gariepinus* by intra-peritoneal means.

2.8 Stripping and Fertilization of Eggs

The traditional method of fertilization involves the stripping of eggs from the female fish. This is only possible after the final maturation of the eggs; a process that involves nuclear migration to the poles in the egg, fusion of the yolk, breakdown of the germinal vesicle then the first meiotic division and then ovulation. These processes are irreversible once triggered by the right dosage of hormones (De Graaf and Janssen, 1996).

The speed of ovulation is directly proportional to water temperature hence the higher the water temperature, the faster the ovulation process. According to Legendre (1986), latency time depends more on temperature than on the hormone dose. Eggs could be stripped within 14hours of a dose of 1.51 U/g of HCG, at a temperature of 27^0 to 29^0C.

Stripping of the females is carried out via a gentle press on their abdomen with a thumb from the pectoral fin area towards the genital papilla. Ovulated eggs usually flow out easily as a thick jet from the vent into a container; usually plastic containers are used. De Graaf and Janseen (1996) pointed out that with fluctuating water temperatures during the day; it is difficult to establish the actual mean water temperature hence eggs being stripped too early resulting in very low hatching rates. It is always much safer to strip eggs later rather than earlier. Stripping too early leads to total loss of eggs and stripping too late leads to loss of some eggs. When stripped at the right time, eggs will ooze out easily. Ripe eggs when stripped appear transparent and flattened (Sahoo *et al.,* 2007).

Males of the African catfish cannot be stripped hence sperm is obtained surgically or by sacrificing the male. Stripping of semen from catfishes is difficult because the

testes are located deep within the body cavity and are covered by other organs (for example, gut and stomach). Therefore, during stripping, most of the pressure applied to the abdomen is on the other organs. In addition, the ripe milt gathers along the convex lobular edge of the testes rather than passing through the sperm ducts. This condition has been described for two African catfish species, C. *gariepinus (*Hogendoorn, 1979*)* and *H. longifilis* (Oteme *et al.,* 1996). However, Viveiros *et al* (2001), showed that the absence of seminal vesicle extensions induced by treatment with 17a-methyltestosterone facilitated the collection of semen by stripping from *C. gariepinus*.

If the male is killed, the body surface should be thoroughly dried after which the testis is dissected and placed in a small container or bottle. The testis is rapidly cut into small pieces using a scissor or razor and the milt is pressed out. The milt is usually diluted with 9 gL^{-1} solution of physiological salt before being added to the stripped eggs. This method has the advantage of being able to fertilize eggs from a large number of females. The milt is stirred into the eggs continuously using a soft plastic spoon or a feather because the eggs will become sticky if they are not stirred. After stirring for about one minute, the fertilized eggs can be transferred to incubation tanks.

Haniffa *et al*, (2000) reported various fertilization rates for natural and artificial hormones used on the striated murrel *channa striatus*. The highest percentage of fertilization (95-98%) was observed in ovaprim-injected *C.striatus* while the lowest occurred in fish injected with pituitary extract (60-70%). Cheah and Lee (2000) reported fertilization rates of 77.5-89.9% for the Australian eel-tailed catfish *N. ater* (Perugia) administered with ovaprim at dosages of 0.5, 0.75 and 1.0 $mL.kg^{-1}$.

2.9 Hatching

From the point of fertilization to hatching, developmental processes involved are also temperature dependent; the higher the water temperature, the faster the eggs will hatch. Renewal of water is necessary to ensure the renewal of dissolved oxygen. Haylor and Mollah (1995) reported that *C. gariepinus* eggs can be successfully hatched in ambient water temperatures between 20 and 35^0C, although at 30^0C the hatching rate is significantly improved. At 15^0C, the authors reported total embryo mortality within 62 hours. The period of hatching is directly related to temperature such that synchronous hatching is encouraged by high temperature within the specific temperature range.

Clarias eggs are naturally adhesive. If there is no proper substrate present, soon after spawning the eggs will congeal into a large mass and most, if not all will die. If spawned on a proper substrate, the eggs are well separated and disbursed. Incubation and hatching involves the use of different substractes. These could be natural or artificial. Examples include: Concrete slabs, roots of aquatic plants such as water hyacinth, water lettuce (*Pistia stratiotes*) etc, brushe places in ponds or in a happa and mosquito net mesh etc.

Macharia *et al.* (2005) conducted a comparative study of hatching rates of African catfish (*Clarias gariepinus*) eggs on different substrates. They reported that natural substrates (roots of the water lettuce or Nile cabbage (*Pistia stratiotes*), water hyacinth pond weed (*Cereatophyllum dermasum*) and green grass leaves (*Commelina* sp) performed better than artificial substrates (kakaban mats, sisal mats, papyrus mats and nylon mats) this was attributed to the fact that, natural substrates were able to float more, hence providing enough oxygen for the eggs.

Hatching starts 23–28 hours after fertilization at temperature between 25^0C–27^0C. Newly hatched fry can swim actively immediately after hatching. Fry prefers the dark corners of incubation tanks. Colour of fry is reddish on first day after hatching and becomes dark by third day. Simultaneously the barbels start to develop and the fish scatter in tanks. The yolksack is absorbed within 4–5 days, but the fish can consume external food earlier, after partial absorption of yolksack on second – third day of hatching. Mouth of fry develops quickly. Only rotifer – size food (50-400um) is accepted by fry on the first day of feeding (Peteri *et al.*, 1992).

Chea and Lee (2000), induced ovulation in the Australian eeltailed Catfish *N. ater* (Perugia) with Ovaprim at doses of 0.25, 0.5, 0.75 and 1.0mlkg^{-1} per body weight. The hatching rates ranged from 76.6-82.0% for dosages of 0.5, 0.75, and 1.0ml/kg.

A maximum percentage hatchability of 95.42% has been recorded in the cross involving male *H.longfilis* and female *C.anguillaris* (Aluko 1995). A lower parentage hatchability of 54.10% was obtained for the F_2 generation produced by crossing F_1 hybrids (*H.longifilis* x C. *anguilaris*) with both male and female *C.anguilaris*. Nwadukwe (1995) analyzed the production, early growth and survival of *C. garipinus* and *H.longifilis* and their F_1 hybrids in ponds. Fertilized eggs were incubated in aerated static–water in fibre glass troughs. Hatching rates were not found to be significantly different between any two of the four catfish groups produced.

Brazil and Wolters (2002) examined egg hatching success and fry and fingerling growth of channel catfish *I. punctatus* to determine if ozonation of hatchery water would facilitate increased stocking densities without sacrificing growth characteristics. Egg masses reared in ozonated water hatched 18-24hr sooner than

those in unozonated water, but hatching rates in ozonated and unozonated waters, were not significantly different.

2.10 Survival Rates

The more important factors influencing larval survival are hatchery design, water temperature, water flow rate and prophylactic parasitic treatment (Fourie, 2006). Haylor and Mollah (1995) discovered that temperature significantly affected wet weight at first feeding. They reported that temperature between 20 and 35^0C affected the time until the onset of first feeding. Yolksac absorption and the point when unfed larvae no longer have the ability to consume feed offered to them (point-of-no-return). The duration between attaining feeding ability, yolksack absorption and the point-of-no-return are inversely related to temperature. So that at temperatures of 20 and 25^0C

Madu and Ita (1990) compared growth and survival of hatchings of *Clarias* sp. *Clarias* hybrids and *Heterobranchus* sp. in an indoor hatchery. They reported that *C. anguilaris* had the highest percentage survival (78.8%).

Survival rates depend on stocking density and carrying capacity of the rearing facility. If stocking density exceeds the carrying capacity of the tank, mortality is bound to be high. Madu et al ,(1989) stocked fry of the common carp *C.carpio* in nursery tanks (6 x 6 x 1.5m) at rates of 80, 107, 133, 160 and 180 fry per m^3. They reported a generally good survival rate for all stocking densities ranging from 82.6% to 96.0%. The highest percentage survival (96.0%) was obtained at 133 fry m^{-3} while the lowest (82.6%) was obtained at 107 fry m^{-3} Nwadukwe (1995) successfully hybridized *C.gariepinus* and *H.longifilis* to produce reciprocal F_1 progeny. After rearing eight-day old fry of each group in fertilized nursery ponds, he discovered that F_1 hybrid from *H.longifilis* maternal parent had the best survival rates at the end of 18 days.

Sarka *et al.* (2004) reported a survival rate of 90% as at day four for fry of vulnerable Indian carp *Cirrhinus reba* propagated artificially with ovaprim. This rate however dropped to 55% after 15 days of larva rearing.

2.11 Growth Rate

The performance of fish can be evaluated according to their growth rate or specific growth rate. Although both these growth parameters can be used, the specific growth rate of fish tends to give a clearer indication of fish growth (Fourie, 2006).

Madu *et al.*, (1989) reported higher growth rates (0.03 mg) for fry of the common carp *C. carpio* stocked at 80 fry m^{-3}. However, they recommended a stocking density of 133 fry /m^2 for maximum fry survival when transferred outdoors. Aluko *et al.*, (1999) studied the growth performance of intraspecific hybrids of three strains (Kainji, Jos and Onitsha) of *H. longifilis*. Over a period of five months, they reported the best weight gain of 0.35g/day for the Kainji strain among the parental groups and the least value of 0.32 g/day was obtained in the Onitsha strain. They further reported that among the intraspecific hybrids, the Jos-Kainji cross gave the best weight gain (0.45–0.48g/day) and the least length gain of 0.063cm/day. The least weight gain of 0.33g/day was recorded for the Jos-Onitsha groups though these were longer (0.085cm/day).

Nwadukwe (1995) reported that F1 hybrid crosses between maternal *H.longifilis* and paternal *C.gariepinus* had the best growth rate compared to the reverse of parental order. He further reported that the reciprocal cross showed intermediate growth rate between both parents. At harvest, differential growth was less pronounced among both hybrids than among the parents (Fourie, 2006).

Physicochemical parameters of water have significant effect on the growth of fingerlings. Brazil and Wolters (2002) reported better weight gain for fingerlings of channel catfish *I.punctatus* reared for 85 days in ozonated water than fish reared in unozonated waters. Feed conversion rates of 1.06 and 1.15 under ozonated and unozonated conditions, respectively, were significantly different. They reported that dissolved oxygen levels in ozonated water remained above 85% saturation during and immediately following freezing, while oxygen concentrations in unozonated waters routinely fell below 3.5mg/L (40% of saturation). Water clarity improved and chemical oxygen demand was reduced after ozonation.

2.12 Biological Characteristics of *Clarias gariepinus*

Clarias gariepinus, from a biological perspective is one of the ideal aquaculture species in the world. It is able to withstand adverse environmental conditions, is highly fecund it has a wide tolerance of relatively poor water quality conditions in which other fresh water fishes would find it difficult to survive. This high tolerance makes it possible to stock in significantly higher stocking density than any other fresh water fish species. High environmental tolerance and wide food spectrum are the main reasons why *Clarias* species is excellent for tropical and subtropical pound fish culture (Haylor, 1989).

Incubation and lavae rearing does not need sophisticated facilities. A simple method of seed production is highly effective for this species. The “hardness” of the species makes it an ideal candidate for highly intensive culture, without prerequisite pond aeration or high water exchange rates. According to De graff and Janseen (1996). Since 1970s *C. gariepinus* has been considered to hold great promise for fish farming

in Africa. This catfish has a high growth rate, is very resistant to handling stress and is well appreciated in a wide number of African countries.

Under natural conditions the annual breeding season of this species as for most Clariidae, is limited to a few months (Bruton, 1979). The internal gonadal maturation rhythm for *Clarias* species seems to differ from region to region. Spawning starts with the onset of the rainy season and takes place in flooded areas between May and September in the savannah regions of Nigeria.

In captivity, the African catfish usually reaches sexual maturity at 6-9 months of age (Goos and Richter, 1996). From this moment on, post-vitellogenic eggs and ripe sperm cells are present. However, although oogenesis and spermatogenesis seem to be normal, final oocyte maturation, ovulation, spermiation and reproduction behavior do not occur. It is likely that, under laboratory and fish-farming conditions the regulation of these processes is incomplete due to unavoidable stress. Natural conditions are hard to mimic on a large scale in a fish farm. In order to overcome this problem and to be able to induce production artificially by means of hormonal treatments, it is essential to investigate the successive steps in the endocrine regulation of reproduction of *Clarias* species (Goos and Richter, 1996).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Broodstock Sourcing and Management

A total of 12 mature male and female *Clarias gariepinus* weighing between 0.95-1kg were obtained from Federal Department of Fisheries (FDF) Farm, Mando, Kaduna. The brood stocks were conveyed in plastic containers to the research garden of Department of Biological Sciences,Ahmadu Bello University, Zaria,where the bloodstock were acclimatized for 2 weeks.

During acclimatization period, brood stock were fed with a commercial floating feed.. The feeding was done two times daily at the rate of 5% body weight as recommended by Audu et al., (2010) and feeding stopped 24 hours prior to the breeding exercise.

3.2 Experimental Site

The research was conducted using the water flow through system in the fish hatchery unit of the Department of Biological Sciences, Ahmadu Bello University, Zaria. The hatchery is a water flow-through system made up of four components. The components are: culturing chambers, two macro filtration chambers, a sterilization chamber and a sedimentation/water reservoir. The municipal tap water served as the source of water in the hatchery for hatchling production.

3.3 Experimental Design

The experiment was designed to consist six treatments that is, 1A, 1B, 2 A, 2B, and 3A, 3B.

Treatment 1A: ovaprim with latency period of 8hrs

Treatment 1B: ovatide with latency period of 8hrs

Treatment 2A: ovaprim with latency period of 10hrs

Treatment 2B: ovatide with latency period of 10hrs

Treatment 3A: ovaprim with latency period of 12hrs

Treatment 3B: ovatide with latency period of 12hrs

The plate I, shows the experimental setup.

3.4 Mode of Administration of Hormones

The hormones were administered intramuscularly above the lateral line and below the anterior end of the dorsal fin. After the injection was given to the fish, the site of injection was pressed slightly before removing the needle to prevent the hormone from running out. Injections were given at various intervals based on the stipulated latency periods. The injected brood stocks were kept separately in plastic containers with about 10 liters of water each for the period of stipulated latency period.

The female fish of Treatment 1A was injected with ovaprim at 0.5ml/kg body weight and allowed for a period of 8hrs before stripping of egg.

The female fish of Treatment 1B was injected with ovatide at 0.5 ml/kg body weight and allowed for a period of 8hrs before stripping of egg.

The female fish of Treatment 2A, was injected with ovaprim at 0.5 ml per body weight and allowed for a period of 10hrs before stripping of egg.

The female fish of Treatment 2B was injected with ovatide at 0.5 ml/kg body weight and allowed for a period of 10hrs before stripping of egg.

The female fish of Treatment 3A was injected with ovaprim at 0.5 ml/kg body weight and allowed for a period of 12hrs before stripping of egg.

The female fish of Treatment 3B was injected with ovatide at 0.5 ml/kg body weight and kept for a period of 12hrs before stripping. Plate II shows the mode of administration of hormones.



Plate I: Experimental Set-up



Plate II: Administration of Hormone

3.5 Stripping and Artificial Fertilization of Egg

Stripping is a term used to describe the removal of egg or milt from fish. The females were stripped by slight pressing of the abdomen in anterior-posterior direction. The eggs were stripped into a Petri dish and immediately male milt was collected and carefully mixed for at least 30 seconds using sterilized bird feather.

The first set of stripping was done at the end of the 8 hrs latency period (Treatment 1A and1B). Second set of stripping was done at the end of 10 hrs latency period. And the third set of stripping was done at the end of 12 hours latency period. Plate III shows the mode of stripping of egg.

3.6 Estimation of Stripped Eggs and Percentage Fertilization.

Gravimetric method was used to estimate the number of eggs spawned. A quantity of eggs stripped was weighed using weighing sensor and reading was taking which was used for further estimate of all the stripped eggs.

The fertilized eggs were differentiated from the unfertilized eggs by the presence of "eyes spot" the swollen nature of fertilized eggs and also the grayish colour of fertilized eggs. The unfertilized eggs appeared opaque, pale and white. The percentage fertilization was estimated using the following equation.

$$Pf = \frac{N - n}{N} \times \frac{100}{1}$$

Where Pf = Percentage fertilization

N= Total number of spawned eggs

n= Number of unfertilized eggs

Unhatched eggs were counted using hatchery method and it was used to determine percentage hatchability.

$$\text{Percentage hatchability} = \frac{No.\ of\ \ incubated\ eggs - No.of\ \ unhatched\ eggs}{Total\ \ No.\ of\ \ eggs\ incubated} \times 100$$



Plate III: Stripping of Egg

3.7 Incubation and Hatching of Eggs

The fertilized eggs were placed in incubators with water depth of 20cm each for hatching. A continuous water flow through system was maintained during the incubation period. The two hundred watts bulbs and thermostatic heater in the hatchery were used to maintain room temperature at 29^0C-30^0C and water temperature at 26^oC – 27^oC during incubation.

Hatching was observed within the period of 18 hrs – 20hrs of incubation.

3.8 Physicochemical Parameters

The physiochemical parameters of water such as temperature, pH and electrical conductivity were recorded using Hanna portable combo waterproof pH/TDS/Temperature, tester model HI 98130 and dissolved oxygen was determined using D.O. meter model 611-R labtech.

3.9 Management of Hatchling

Few hours after the completion of hatching, hatchlings were transferred to new containers to avoid pollution shock. Water was changed once daily for a period of one month indoor. After three days of hatching, hatchlings were gradually introduced to artificial feed. At this period, Artemia was given to them as fry food for a period of one month after which they were transferred to the open tanks in the research garden of the Department of Biological sciences, Ahmadu Bello University,Zaria. During this period, fry were exposed to compound feed with diameter of 2mm for a period of two months. And after two months, the size of feed given to the fingerlings changed to 3mm coppens for another one month at the rate of 5% body weight which marked the end of the experiment.

During this period of four months, the mortality rate on each treatment was recorded, the body weight[mg] was taken using weighing sensor and both standard and total

length[ml] were measured with the aid of measuring ruler. The plate IV shows hatchlings.

3.10 Data Analysis

One way analysis of variance was used to determine the significant differences at 0.05 confidence level in the mean number of spawned eggs, fertilized eggs, hatched eggs, growth performance and survival rate of *Clarias gariepinus* using different hormones at various latency periods

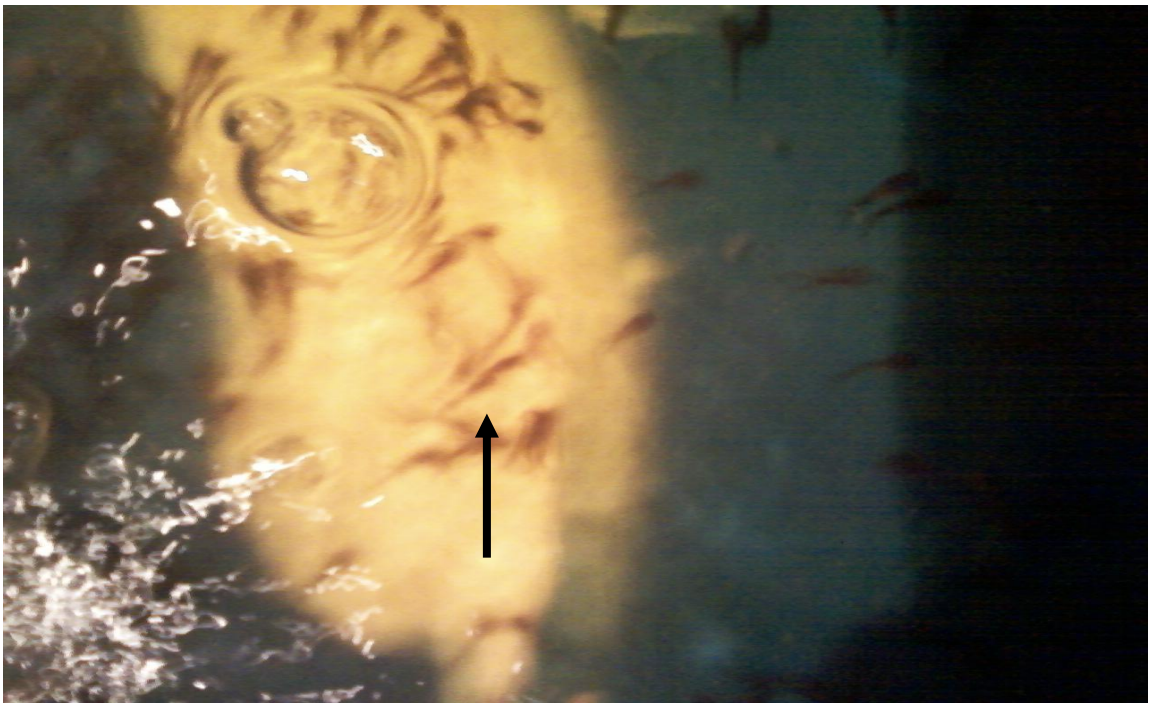


Plate IV: Hatchlings

CHAPTER FOUR

4.0 RESULTS

4.1 Effect of Ovaprim on the Breeding Indices of *Clarias gariepinus*

All the three fish administered the Ovaprim (0.5ml) per body weight responded well to the treatment as shown in (Table 4.1). The fish administered Ovaprim (0.5ml) per kg body weight at twelve hours of latency period had the highest number of eggs stripped which was about 53,266 eggs, the mean percentage of fertilized egg was 83.57%. The mean number of eggs hatched was 37,360, with percentage hatchability of 92.8%. Followed by fish administered by the same dose of Ovaprim at ten hours of latency period and the least was the group of fish administered the same dose of Ovaprim at eight hours of latency period.

Group of fish administered ovaprim (0.5ml/kg body weight) at the latency period of twelve hours also had the highest survival rate (57.1%) followed by group of fish administered the same dose of Ovaprim at ten hours of latency period (45.2%) and the least was the group treated with same those of Ovaprim at eight hours of latency period (42.3%). (See table 4.1).

4.2 Effect of Ovatide on the Breeding Indices of *Clarias gariepinus*

The three female brood stocks of *Clarias gariepinus* administered Ovatide (0.5ml) per body weight responded well to the treatment (Table 4. 2). The fish administered Ovatide (0.5ml) per kg body weight at the latency period of twelve hours had the highest number of stripped eggs (50,362) in terms of Ovatide treatment, with the mean of number of fertilized eggs (36,720) and percentage fertilization of 72.91%. The mean number of egg hatched was 30.126 leaving the percentage hatchability at 82.04%. The survival rate was 53.4% which was also the highest under Ovatide

Table 4.1: Effect of Ovaprim on the Breeding Indices of *Clarias gariepinus*

Latency period	Number of stripped eggs	Number of fertilized eggs	Number of hatched eggs	Percentage fertilization (%)	Percentage hatchability (%)	Survival rate (%) ovaprim
8 hours	10,150±0.3^{c}	5,624±0.4^{c}	2,354±04^{c}	55.41±013^{c}	41.86±0.24^{c}	42.3±1.41^{c}
10 hours	30,362±0.5^{b}	23,302±0.3^{b}	19,224±0.3^{b}	76.75±1.21^{b}	82.59±0.53	45.2±0.62^{b}
12 hours	53,266±0.2^{a}	44,251±0.02^{a}	37,360±0.1^{a}	83.57±1.13^{a}	92.82±1.62^{a}	57.1±0.34^{a}

Mean within the column with the same superscript are not significantly different (P>0.05)

Table 4.2: The Effect of Ovatide on the Breeding Indices of *Clarias gariepinus* at various latency period.

Latency period (hour)	Number of stripped eggs	Number of fertilized eggs	Number of hatched eggs	Percentage fertilization (%)	Percentage hatchability (%)	Survival rate (%)
8	8,532±0.82^{c}	3,450±0.03^{c}	2,210±0.42^{c}	44.44±1.90^{c}	64.06±1.82^{c}	41.2±2.01^{c}
10	21,250±0.4^{b}	15,320±0.06^{b}	10,230±0.3^{b}	72.09±1.93^{b}	66.78±1.96^{b}	44.2±1.13^{b}
12	50,362±0.32^{a}	36,720±0.02^{a}	30,126±0.12^{a}	72.91±2.24^{a}	82.04±1.88^{a}	53.2±1.46^{a}

Mean within the same column with the same superscript are not significantly different (P>0.05)

treatments. Followed by the fish treated with the same dose of the Ovatide at ten hours of latency period and the least was the group treated at eight hours of latency period using the same hormone and dosage.

The mean number of eggs stripped from the fish administered ovatide (0.5ml/kg body weight) at ten hours latency period, had the second highest number of eggs stripped was 21,250. The mean number of eggs fertilized was 15,320 with percentage fertilization of 72.09%. Mean number of hatched eggs was 10,230 with the percentage hatchability at 66.78%.

The mean number of eggs stripped from the fish administered ovatide (0.5ml/kg body weight) at eight hours latency period, was 8,532 which signifies the lowest level of spawning. The number of fertilized eggs was 3,450 with percentage fertilization of 40.44% mean number of hatched eggs was 2,210 leaving the percentage hatchability at 64.06%. (See table 4.2).

4.3 Weight of progenies of Fish Treated With Ovaprim and Ovatide at Various Latency Periods

The highest body weight in terms of growth performance of the fingerlings was obtained in group treated with Ovaprim (0.5ml) per kg body weight at eight hours of latency period (5.95 ± 0.205^{a}). The second highest body weight was observed in the group of fish treated with the same dose of Ovaprim at ten hours of latency period (5.18 ± 0.261^{b}) and the least was obtained in the group of fish treated with Ovaprim at twelve hours of latency period (4.51 ± 0.076^{a}) (Table 4.3).

Table 4.3: Weight of progenies of Fish Treated with Ovatide and Ovaprim at various latency periods

Sampling Time (wks)	Ovatide			Ovaprim		
	Latency period			Latency period		
	8hrs	10hrs	12hrs	8hrs	10hrs	12hrs
0	1.08 ± 0.02^{b}	1.06 ± 0.02^{b}	1.07 ± 0.02^{b}	1.25 ± 0.04^{a}	1.17 ± 0.06^{a}	1.05 ± 0.2^{b}
2	1.36 ± 0.02^{bc}	1.33 ± 0.2^{c}	1.31 ± 0.02^{c}	1.58 ± 0.06^{a}	1.48 ± 0.07^{ab}	1.30 ± 0.02^{c}
4	1.74 ± 0.03^{bc}	1.65 ± 0.02^{c}	1.60 ± 0.02^{c}	2.00 ± 0.07^{a}	1.83 ± 0.09^{b}	1.59 ± 0.03^{c}
6	2.07 ± 0.02^{bc}	2.02 ± 0.03^{c}	1.95 ± 0.03^{c}	2.49 ± 0.08^{a}	2.24 ± 0.11^{b}	1.94 ± 0.04^{c}
8	2.54 ± 0.11^{bc}	2.45 ± 0.04^{c}	2.36 ± 0.03^{c}	3.05 ± 0.10^{a}	2.71 ± 0.14^{b}	2.34 ± 0.04^{c}
10	3.06 ± 0.03^{bc}	2.93 ± 0.04^{c}	2.82 ± 0.04^{c}	3.68 ± 0.12^{a}	3.24 ± 0.16^{b}	2.84 ± 0.05^{c}
12	3.62 ± 0.04^{cd}	3.46 ± 0.05^{d}	3.33 ± 0.05^{d}	4.37 ± 0.15^{a}	3.83 ± 0.19^{bc}	3.34 ± 0.06^{d}
14	4.23 ± 0.04^{bc}	4.05 ± 0.11^{c}	3.90 ± 0.05^{c}	5.12 ± 0.17^{a}	4.47 ± 0.22^{b}	3.90 ± 0.06^{c}
16	4.92 ± 0.11^{bc}	4.68 ± 0.11^{c}	4.52 ± 0.06^{c}	5.95 ± 0.21^{a}	5.18 ± 0.26^{b}	4.51 ± 0.08^{c}

Means on the same row with the same superscript are not significantly different ($p > 0.05$)

4.4 Length of progenies of Fish Treated With Ovaprim and Ovatide at Various Latency Periods

The length of fish has correspondence with their body weight. The highest length (9.79±0.04a) was obtained in the group of fish treated with Ovaprim (0.5ml) per kg body weight at latency period of eight hours, followed by the group of fish treated with Ovatide (0.5ml) per kg body weight at eight hours of latency period (9.533 ± 0.127^{ab}) and the least was observed in the group of fish treated with Ovatide (0.5ml) at twelve hours of latency period. (Table 4.4).

4.5 Mean Water Quality Parameters

The success of artificial propagation of fish through induced breeding depends to a large extent on water quality parameters. Based on this fact, some water quality parameters were recorded and the mean readings showed below:

Temperature (T^o) was 27^oC, pH was 6.4, conductivity was at 54.10S/M and Dissolved Oxygen was 6.20mg/l (Table 4. 5). The above readings signified the suitability of the medium for conduct of the research. (See table 4.5).

Table 4.4: Length of progenies of Fish Treated with Ovatide and Ovaprim

Sampling	Ovatide			Ovaprim		
Time (wks)	Latency period			Latency period		
	8hrs	10hrs	12hrs	8hrs	10hrs	12hrs
0	2.08 ± 0.018^{abc}	2.04 ± 0.019^{c}	2.05 ± 0.019^{bc}	2.15 ± 0.006^{a}	2.12 ± 0.057^{ab}	2.05 ± 0.021^{bc}
2	2.64 ± 0.022^{ab}	2.54 ± 0.024^{bc}	2.53 ± 0.022^{c}	2.74 ± 0.077^{a}	2.66 ± 0.070^{a}	2.52 ± 0.025^{c}
4	3.33 ± 0.030^{ab}	3.16 ± 0.030^{bc}	3.08 ± 0.035^{c}	3.43 ± 0.008^{a}	3.20 ± 0.136^{bc}	3.10 ± 0.030^{c}
6	4.12 ± 0.039^{a}	3.87 ± 0.037^{b}	3.73 ± 0.061^{b}	4.22 ± 0.010^{a}	3.87 ± 0.158^{b}	3.82 ± 0.036^{b}
8	5.01 ± 0.048^{a}	4.68 ± 0.044^{b}	4.51 ± 0.066^{b}	5.12 ± 0.012^{a}	4.72 ± 0.175^{b}	4.68 ± 0.085^{b}
10	5.96 ± 0.097^{a}	5.60 ± 0.054^{c}	5.39 ± 0.073^{c}	6.13 ± 0.015^{a}	5.67 ± 0.195^{bc}	5.58 ± 0.085^{c}
12	7.05 ± 0.107^{ab}	6.62 ± 0.064^{cd}	6.38 ± 0.080^{d}	7.25 ± 0.017^{a}	6.74 ± 0.219^{bc}	6.58 ± 0.085^{cd}
14	8.24 ± 0.117^{ab}	7.74 ± 0.074^{cd}	7.46 ± 0.088^{d}	8.47 ± 0.026^{a}	7.90 ± 0.246^{bc}	7.67 ± 0.090^{cd}
16	9.53 ± 0.127^{ab}	8.97 ± 0.085^{cd}	8.65 ± 0.098^{d}	9.79 ± 0.038^{a}	9.18 ± 0.277^{bc}	8.95 ± 0.199^{cd}

Means within the same column with the same superscript are not significantly different ($p > 0.05$)

Table 4.5: The Mean Water Quality Parameters During the Period of the Research

	Range	**Mean**
Temperature (T^oC)	26.0-27.8	27.0±0.41
pH	6.2 – 6.6.	6.4±0.02
Conductivity (S/M)	52.0 – 55.6	54.10±0.62
Dissolved Oxygen (Mg/L)	6.1 – 6.3	6.20±0.03

CHAPTER FIVE

5.0 DISCUSSION

5.1 Discussion

In fish as in other animals, natural final maturation and release of egg (ovulation) is regulated and brought about by the release of gonadotrophic hormones.(Bruzca et al., 2003). Such gonadotrophic hormones are the leuteinizing hormone (L.H) and follicle stimulating hormone (F.S.H). Gonadotrophin. thus released, reach the ovary and trigger off final maturation of eggs and ovulation.

Direct injection of gonadotropins in to a suitable brood fish by- passes the fish's own gonadotropin producing system, Chea et al., (1993). However, ovulation may not follow inducement and may even be inhibited by the suppression of the mechanism.

Fertilization and quality of hatchlings are influenced by the quality of the broodstock and the chances of milt penetrating the egg, (De Graaaf et al., 1995). According to Eyo et al, (1997), some of the environmental factors affecting the development of spawn eggs are temperature, dissolved oxygen, pH etc. Extreme sudden changes in these parameters may stress the broodstock, thus affecting the level of response of fish to the treatment.

In the course of this investigation, after inducing broodstock with Ovaprim and Ovatide at various latency period using the same dosage per kg body weight of brood stock, it was discovered that all fish responded to the treatment in terms of ovulation of egg, but the highest ovulation was obtained in the fish treated with Ovaprim (0.5ml per kg body weight) at the latency period of twelve hours, (table 4.1). This result is in line with the work of Hogendoon and Wieme (1976). "The induced spawning of *C. gariepinus* depends largely on latency period". The least ovulation was obtained in

the fish treated with Ovatide at the same dosage at the latency period of eight hours, (table 4.2). This investigation is in line with the work of Tan-fermin, *et al*, (1997)which said that, latency period lower than ten hours there will be insufficient action of hormonal treatment leading to failed ovulation.

The highest number of egg was obtained at 12 hours of latency, followed by 10 hours and lastly, 8 hours of latency period. 12 hours latency period is significantly higher ($p \leq 0.05$) than that of 10 hours and that of 10 hours significantly higher($P \leq 0.05$) than that of 8 hours i.e. 12 hours > 10 hours > 8 hours.

In terms of fertilization of fish egg, fish treated with Ovaprim (0.5ml) per kg body weight at twelve hours of latency period had the highest mean number of fertilized eggs with percentage fertilization of about 83.57%, and also highest hatchability of about 92.82%,(table4.1). This result is similar to the work of Bruzsca and Adamek (1990) that Ovaprim produced the best result in fecundity in the closely related species with adequate latency period. In comparing the efficacy of Ovaprim and Ovatide at the same dosage using the same latency period, Ovaprim performed better than Ovatide ($p \leq 0.05$). This result agrees with that of Nandeesha *et al*, (1991) who found out that nearly 38 percent more fry can be obtained by using Ovaprim in place of Ovatide.

Considering the survival rate of hatchlings/fingerlings, it was found out that the fish treated with Ovaprim (0.5ml per kg body weight), at twelve hours of latency period had the highest survival rate (57.7%) i.e. ($p<0.05$), (table 4.1). and the least survival was observed in the fingerlings obtained from the brodstock treated with ovatide at eight hours of latency period. This result is in line with the work of Sahoo, *et al*,

(2007) who found out that latency period at twelve hours in fish injected with 0.05ml per kg body weight resulted in good fertilization, hatching and survival rate.

Percentage hatchability is significantly higher with the latency period of 12 hours ($P \leq 0.05$ and those of 10 hours and 8 hours are not significantly different ($P > 0.05$).

All the samples showed significant difference in the mean weight of the progenies of fish treated with Ovatide and Ovaprim ($P \leq 0.05$) at 8 hours latency period but at 10 hours and 12 hours latency periods, there were no significant differences in the mean weight of progenies of fish treated with Ovatide and Ovaprim ($P > 0.05$), (table 4.3).

The mean weight of progenies was reducing with increase in latency period, i.e the higher the latency period, the smaller the weight of progenies. This could be attributed to some unidentified factors that could play part in the growth performance of hatchlings/fingerlings of *C. gariepinus.*

In terms of length of progenies, although the lengths corresponded with the body weight, the highest length was obtained in the group of progenies of fish treated with Ovatide at eight hours of latency period (9.53ml) followed by progenies of fish treated with Ovaprim at the same dose at the latency period of eight hours. This followed the same pattern with body weight which was reducing with increase in latency period and this called for more investigation on the relationship between fish growth performance and latency period.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

From the all indications, it is concluded that both hormones i.e ovaprim and ovatide could be used for induced spawning of C. gariepinus at 0.5ml per kg body weight. Also, the success of artificial propagation of C. gariepinus through induced breeding under controlled environmental condition is mostly depend on latency period and temperature. For all parameters investigated, ovaprim performs better than ovatide. This study also indicates that if eggs are stripped before the optimum time, there will be low ovulation, low fertilization, low hatchability and low survival of fingerlings. In terms of latency period it is also concluded that 12 hours of latency period yields best results throughout the investigation except in terms of fish weight and lenght.

6.2 Recommendations

Based on the findings during investigation, the following recommendations are made;

- Ovaprim and ovatide could be used for induced breeding of C. gariepinus.
- The latency period between 10 and 12 hours could be used for induced breeding of C. griepinus.
- More research work should be conducted on the relationship between the growth perform of C.gariepinus fingerlings and increase i0 n latency period.

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APPENDICES

Fish Weight at 1st Sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	1.2960		
ovatide 12hr latency period	10	1.3100		
ovatide 10hr latency period	10	1.3290		
ovatide 8hr latency period	10	1.3640	1.3640	
ovaprim 10hr latency period	10		1.4770	1.4770
ovaprim 8hr latency period	10			1.5750
Sig.		.300	.060	.102

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish weight at 2nd sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	2.0000	.21401	.06768	1.8469
ovaprim 10hr latency period	10	1.8320	.28596	.09043	1.6274
ovaprim 12hr latency period	10	1.5900	.09298	.02940	1.5235
ovatide 8hr latency period	10	1.7390	.10093	.03192	1.6668
ovatide 10hr latency period	10	1.6490	.07666	.02424	1.5942
ovatide 12hr latency period	10	1.5990	.07310	.02312	1.5467
Total	60	1.7348	.21330	.02754	1.6797

fish weight at 2nd sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	1.5900		
ovatide 12hr latency period	10	1.5990		
ovatide 10hr latency period	10	1.6490		
ovatide 8hr latency period	10	1.7390	1.7390	
ovaprim 10hr latency period	10		1.8320	
ovaprim 8hr latency period	10			2.0000
Sig.		.064	.205	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minitrinput.sav
```

Descriptives

fish weight at 3rd sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence .. Lower Bound
ovaprim 8hr latency period	10	2.4910	.25946	.08205	2.3054
ovaprim 10hr latency period	10	2.2440	.35173	.11123	1.9924
ovaprim 12hr latency period	10	1.9370	.11490	.03633	1.8548
ovatide 8hr latency period	10	2.0720	.06861	.02169	2.0229
ovatide 10hr latency period	10	2.0210	.09457	.02991	1.9533
ovatide 12hr latency period	10	1.9520	.08702	.02752	1.8897
Total	60	2.1195	.26989	.03484	2.0498

fish weight at 3rd sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	1.9370		
ovatide 12hr latency period	10	1.9520		
ovatide 10hr latency period	10	2.0210		
ovatide 8hr latency period	10	2.0720	2.0720	
ovaprim 10hr latency period	10		2.2440	
ovaprim 8hr latency period	10			2.4910
Sig.		.162	052	1 000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish weight at 4th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence
					Lower Bound
ovaprim 8hr latency period	10	3.0470	.31560	.09980	2.8212
ovaprim 10hr latency period	10	2.7120	.42677	.13496	2.4067
ovaprim 12hr latency period	10	2.3350	.13866	.04385	2.2358
ovatide 8hr latency period	10	2.5440	.09536	.03016	2.4758
ovatide 10hr latency period	10	2.4460	.11335	.03585	2.3649
ovatide 12hr latency period	10	2.3580	.10475	03313	2 2831
Total	60	2 5737	33555	.04332	2 4870

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	2.3350		
ovatide 12hr latency period	10	2.3580		
ovatide 10hr latency period	10	2.4460		
ovatide 8hr latency period	10	2.5440	2.5440	
ovaprim 10hr latency period	10		2.7120	
ovaprim 8hr latency period	10			3.0470
Sig.		.075	.117	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish weight at 5th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ...
					Lower Bound
ovaprim 8hr latency period	10	3.6780	.38270	.12102	3.4042
ovaprim 10hr latency period	10	3.2400	.51277	.16215	2.8732
ovaprim 12hr latency period	10	2.8380	.15083	.04770	2.7301
ovatide 8hr latency period	10	3.0560	.10058	.03180	2.9841
ovatide 10hr latency period	10	2.9270	.13499	.04269	2.8304
ovatide 12hr latency period	10	2.8190	.12494	.03951	2.7296
Total	60	3.0930	.40366	.05211	2.9887

fish weight at 5th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovatide 12hr latency period	10	2.8190		
ovaprim 12hr latency period	10	2.8380		
ovatide 10hr latency period	10	2.9270		
ovatide 8hr latency period	10	3.0560	3.0560	
ovaprim 10hr latency period	10		3.2400	
ovaprim 8hr latency period	10			3.6780
Sig.		.091	.150	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minminput.sav
```

Descriptives

fish weight at 6th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence Lower Bound
ovaprim 8hr latency period	10	4.3670	.46246	.14624	4.0362
ovaprim 10hr latency period	10	3.8270	.60670	.19186	3.3930
ovaprim 12hr latency period	10	3.3420	.17725	.05605	3.2152
ovatide 8hr latency period	10	3.6160	.11626	.03676	3.5328
ovatide 10hr latency period	10	3.4630	.15924	.05036	3.3491
ovatide 12hr latency period	10	4.0470	.18697	.05912	3.9133
Total	60	3.7770	.47936	.06188	3.6532

fish weight at 6th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05			
		1	2	3	4
ovaprim 12hr latency period	10	3.3420			
ovatide 10hr latency period	10	3.4630			
ovatide 8hr latency period	10	3.6160	3.6160		
ovaprim 10hr latency period	10		3.8270	3.8270	
ovatide 12hr latency period	10			4.0470	
ovaprim 8hr latency period	10				4.3670
Sig.		.092	.169	.152	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish weight at 7th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	5.1230	.54912	.17365	4.7302
ovaprim 10hr latency period	10	4.4740	.71142	.22497	3.9651
ovaprim 12hr latency period	10	3.8980	.20687	.06542	3.7500
ovatide 8hr latency period	10	4.2290	.14004	.04428	4.1288
ovatide 10hr latency period	10	4.0470	.18697	.05912	3.9133
ovatide 12hr latency period	10	3.8950	.16992	.05373	3.7734
Total	60	4.2777	.57339	.07402	4.1295

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovatide 12hr latency period	10	3.8950		
ovaprim 12hr latency period	10	3.8980		
ovatide 10hr latency period	10	4.0470		
ovatide 8hr latency period	10	4.2290	4.2290	
ovaprim 10hr latency period	10		4.4740	
ovaprim 8hr latency period	10			5.1230
Sig.		.089	.171	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY wt BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\mininginput.sav
```

Descriptives

fish weight at 8th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	5.9460	.64811	.20495	5.4824
ovaprim 10hr latency period	10	5.1770	.82501	.26089	4.5868
ovaprim 12hr latency period	10	4.5090	.24118	.07627	4.3365
ovatide 8hr latency period	10	4.9150	.18810	.05948	4.7804
ovatide 10hr latency period	10	4.6840	.21874	.06917	4.5275
ovatide 12hr latency period	10	4.5150	.19710	.06233	4.3740
Total	60	4.9577	.67041	.08655	4.7845

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	4.5090		
ovatide 12hr latency period	10	4.5150		
ovatide 10hr latency period	10	4.6840		
ovatide 8hr latency period	10	4.9150	4.9150	
ovaprim 10hr latency period	10		5.1770	
ovaprim 8hr latency period	10			5.9460
Sig.		.077	.210	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\mininin~ut.sav
```

Descriptives

fish length at stocking

	N	Mean	Std. Deviation	Std. Error	95% Confidence Lower Bound
ovaprim 8hr latency period	10	2.1480	.01932	.00611	2.1342
ovaprim 10hr latency period	10	2.1240	.17964	.05681	1.9955
ovaprim 12hr latency period	10	2.0520	.06795	.02149	2.0034
ovatide 8hr latency period	10	2.0820	.05770	.01825	2.0407
ovatide 10hr latency period	10	2.0350	.06005	.01899	1.9920
ovatide 12hr latency period	10	2 0510	.05971	.01888	2.0083
Total	60	2 0820	.09494	.01226	2 0575

fish length at 1st sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovaprim 12hr latency period	10	2.5200		
ovatide 12hr latency period	10	2.5250		
ovatide 10hr latency period	10	2.5440	2.5440	
ovatide 8hr latency period	10		2.6400	2.6400
ovaprim 10hr latency period	10			2.6590
ovaprim 8hr latency period	10			2.7370
Sig.		.648	.055	.065

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
DATASET ACTIVATE DataSet1.
SAVE OUTFILE='C:\Users\BRUNODERAGUH\Desktop\minininput.sav'
 /COMPRESSED.
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav

fish length at 2nd sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0 05		
		1	2	3
ovatide 12hr latency period	10	3.0830		
ovaprim 12hr latency period	10	3.1000		
ovatide 10hr latency period	10	3.1550	3.1550	
ovaprim 10hr latency period	10	3.1960	3.1960	
ovatide 8hr latency period	10		3.3300	3.3300
ovaprim 8hr latency period	10			3.4250
Sig.		.241	.060	.277

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish length at 3rd sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	4 2200	.03127	.00989	4.1976
ovaprim 10hr latency period	10	3.8730	.50011	.15815	3 5152
ovaprim 12hr latency period	10	3.8200	.11353	.03590	3.7388
ovatide 8hr latency period	10	4.1200	.12293	.03887	4.0321
ovatide 10hr latency period	10	3.8670	11700	.03700	3.7833
ovatide 12hr latency period	10	3.7300	.19437	.06146	3.5910
Total	60	3.9383	.28422	.03669	3.8649

fish length at 3rd sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05	
		1	2
ovatide 12hr latency period	10	3.7300	
ovaprim 12hr latency period	10	3.8200	
ovatide 10hr latency period	10	3.8670	
ovaprim 10hr latency period	10	3.8730	
ovatide 8hr latency period	10		4.1200
ovaprim 8hr latency period	10		4.2200
Sig.		.221	.345

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC DUNCAN ALPHA(0.05).
```

Oneway

[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav

Descriptives

fish length at 4th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	5.1240	.03748	.01185	5.0972
ovaprim 10hr latency period	10	4.7160	55342	17501	4.3201
ovaprim 12hr latency period	10	4.6800	.26998	.08537	4.4869
ovatide 8hr latency period	10	5.0100	15239	.04819	4.9010
ovatide 10hr latency period	10	4.6800	.14103	.04460	4.5791
ovatide 12hr latency period	10	4.5090	.21021	.06647	4.3586
Total	60	4.7865	.34188	.04414	4.6982

fish length at 4th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05	
		1	2
ovatide 12hr latency period	10	4.5090	
ovaprim 12hr latency period	10	4.6800	
ovatide 10hr latency period	10	4.6800	
ovaprim 10hr latency period	10	4.7160	
ovatide 8hr latency period	10		5 0100
ovaprim 8hr latency period	10		5.1240
Sig.		.136	.365

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\mininput.sav
```

Descriptives

fish length at 5th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ...
					Lower Bound
ovaprim 8hr latency period	10	6.1360	.04695	01485	6.1024
ovaprim 10hr latency period	10	5.6720	.61714	.19516	5.2305
ovaprim 12hr latency period	10	5.5800	.26998	.08537	5.3869
ovatide 8hr latency period	10	5.9600	30623	09684	5.7409
ovatide 10hr latency period	10	5.6020	17002	05376	5.4804
ovatide 12hr latency period	10	5.3910	23106	07307	5.2257
Total	60	5.7235	.39989	.05163	5.6202

fish length at 5th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05		
		1	2	3
ovatide 12hr latency period	10	5 3910		
ovaprim 12hr latency period	10	5.5800		
ovatide 10hr latency period	10	5.6020		
ovaprim 10hr latency period	10	5.6720	5.6720	
ovatide 8hr latency period	10		5.9600	5.9600
ovaprim 8hr latency period	10			6.1360
Sig.		.082	.052	.231

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish length at 6th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ... Lower Bound
ovaprim 8hr latency period	10	7.2520	.05514	.01744	7.2126
ovaprim 10hr latency period	10	6 7350	.69300	.21915	6.2393
ovaprim 12hr latency period	10	6.5800	.26998	.08537	6.3869
ovatide 8hr latency period	10	7.0500	.33747	.10672	6.8086
ovatide 10hr latency period	10	6.6230	.20089	.06353	6.4793
ovatide 12hr latency period	10	6.3750	.25413	.08036	6.1932
Total	60	6.7692	.45532	.05878	6.6515

fish length at 6th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05			
		1	2	3	4
ovatide 12hr latency period	10	6.3750			
ovaprim 12hr latency period	10	6.5800	6.5800		
ovatide 10hr latency period	10	6.6230	6.6230		
ovaprim 10hr latency period	10		6.7350	6.7350	
ovatide 8hr latency period	10			7.0500	7.0500
ovaprim 8hr latency period	10				7.2520
Sig.		.151	.369	.055	.214

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

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[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minimlnput.sav
```

Descriptives

fish length at 7th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence ...
					Lower Bound
ovaprim 8hr latency period	10	8.4700	.08233	.02603	8.4111
ovaprim 10hr latency period	10	7.9030	.77842	.24616	7.3462
ovaprim 12hr latency period	10	7.6700	.28304	.08950	7.4675
ovatide 8hr latency period	10	8.2400	.36878	.11662	7.9762
ovatide 10hr latency period	10	7.7430	.23300	.07368	7.5763
ovatide 12hr latency period	10	7.4630	.27897	.08822	7.2634
Total	60	7.9148	.51627	.06665	7.7815

fish length at 7th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05			
		1	2	3	4
ovatide 12hr latency period	10	7.4630			
ovaprim 12hr latency period	10	7.6700	7.6700		
ovatide 10hr latency period	10	7.7430	7.7430		
ovaprim 10hr latency period	10		7.9030	7.9030	
ovatide 8hr latency period	10			8.2400	8.2400
ovaprim 8hr latency period	10				8.4700
Sig.		145	226	065	204

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.

```
ONEWAY lgth BY hmntype
  /STATISTICS DESCRIPTIVES
  /MISSING ANALYSIS
  /POSTHOC=DUNCAN ALPHA(0.05).
```

Oneway

```
[DataSet1] C:\Users\BRUNODERAGUH\Desktop\minininput.sav
```

Descriptives

fish length at 8th sampling

	N	Mean	Std. Deviation	Std. Error	95% Confidence Lower Bound
ovaprim 8hr latency period	10	9.7900	.11972	.03786	9.7044
ovaprim 10hr latency period	10	9.1770	.87609	.27704	8.5503
ovaprim 12hr latency period	10	8.9500	.37786	.11949	8.6797
ovatide 8hr latency period	10	9.5300	.40014	.12654	9.2438
ovatide 10hr latency period	10	8.9740	.26970	.08529	8.7811
ovatide 12hr latency period	10	8.6540	.30916	.09777	8.4328
Total	60	9.1792	.58140	.07506	9.0290

fish length at 8th sampling

Duncan[a]

hormonal and latency period treatments	N	Subset for alpha = 0.05			
		1	2	3	4
ovatide 12hr latency period	10	8.6540			
ovaprim 12hr latency period	10	8.9500	8.9500		
ovatide 10hr latency period	10	8.9740	8.9740		
ovaprim 10hr latency period	10		9.1770	9.1770	
ovatide 8hr latency period	10			9.5300	9.5300
ovaprim 8hr latency period	10				9.7900
Sig.		.145	.301	.090	.209

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 10.000.