Spawning Effects of Gonadotropic Hormone of Various Maturity Groups on Artificial Breeding of Clarias gariepinus (Osteichthytes: clariidae)

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ABSTRACT

This experiment is carried out to assess the effects of gonadotropic hormone of various maturity groups on the artificial spawning activity of Clarias gariepinus. The donor specimens which composed of males and females of gonad developmental stages I to V were regrouped. The experimental treatments were established as follows: unripe males (stages 1-III), ripe males (stages IV and V), gravid - immature females (stages I - III), gravid - mature females (stages IV - V), and a control (water for injection). Results of the experiment showed that hormones from the gravid-mature females induced more spawn than those of the other groups. Least spawn was induced by hormones of unripe males. The spawn induced by hormones of the unripe males and those of the gravid-immature females were significantly different. Comparatively, the spawn obtained by inducing with male hormones at stage V is higher than those of other stages within the group. In the female group, the highest spawn is induced by those at stage IV. Therefore, there is no relationship between recipients and the quantities of eggs produced per given weight of spawners. The observations may be very useful in the spawning of other clariid fish, due to their common family background.

Keywords: *Gonadotropic hormone, maturity groups, African catfish, induced spawning.*

INTRODUCTION

The extensive study and documentation of reproductive biology of various species of the *clariid* fish has resulted in increased interest in the cultivation of *Clarias gariepinus*. Difficulties associated with obtaining stock of fry and fingerlings of the African catfish (*C. gariepinus*) resulted in the practice of artificial propagation (Kali-Tchikati, 1995). Most investigations on induction of spawning in fish species used gravid fish as specimen, but there is no unanimity of opinion with regard to the action of injected hormones on ovulation and spawning (Sundararaj and Goswami, 1966 and Akpaniteaku and Nwuba, 2008). Many types of hormones were tried over the years, and as long as people have been culturing fish in intensive and semi-intensive manner, there has been a desire to control and maximize production of eggs and the resultant seed stock. Factors that determine success in induced breeding included season and environmental conditions, stage of gonad development, time interval between injection time to ovulation or spawning after the last injection

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(Lam, 1982). The gonadotropic hormone stimulates production of sex steroids on the gonads, with subsequent maturation of the gametes. This transmission from neutral information to hormonal control takes place at the interface between hypothalamus and pituitary (Harvey and Hoar, 1979). The concept of gonadotropin releasing hormone (GRH), which comes after the follicle stimulating hormone (FSH), is supported by the presence of gonadotropin releasing hormone activity in the pituitary extracts of various fish species (Crim, Peter and Billard, 1976). However, sexual differences in isolated gonadotropin in induced breeding exercises were reported by Breton, Prunet and Reinaud (1978); and the activity could depend on weight, sex and gonad stages of donors (Akpaniteaku, 2006). The present research therefore aims at assessing the spawning effects of gonadotropic hormone from male and female donors of various maturity groups in induced artificial breeding of *C. gariepinus*.

MATERIALS AND METHOD

The *C. gariepinus* specimens were obtained from live fish market at the bank of the Niger River at Onitsha in Nigeria, from April to September 2012. The hormone used for the induction of spawning were obtained from recategorized maturity groups based on gonad developmental stages I to V. Randomized block experimental design was adopted during the research. The experiments were divided into 4 treatments plus a control, and replicated 9 times. The following treatments were established:

Treatment 1: Injection water (control)
Treatment 2: Unripe males (stages I to III)
Treatment 3: Ripe males (stages IV and V)
Treatment 4: Gravid-immature females (stages I to III)
Treatment 5: Gravid-mature females (stages IV and V)

Male donors were assessed for maturity using physical behaviour, and ripe ones were determined by papilla-tip colour (Hogendoorn, 1979 and Akpaniteaku, 2006). Maturity status of the gonad was determined by adapting methods of Dadzie (1974). Weights of male and female donors ranging from 95 to 205g (mean 159 + 8.53g and 161 + 4.90g respectively) were matched with recipients.

Pituitaries of various donors were collected by methods of Viveen *et al*. (1986) and separately homogenized as injectable solution using water for injection, which also served as control experiment. The recipients were intramuscularly induced, and 12 hour latency allowed to ensure that all the ovulated eggs were released. They were reweighed before and after stripping. Spawning success was calculated by methods of Hogendoorn (1979):

Total number of eggs = prespawning weight - postspawning weight *x* 66.6.

Data were statistically analysed to determine means and standard error. They were also analysed by correlation coefficient, and analysis of variance (ANOVA).

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RESULTS AND DISCUSSION

Spawning effects of gonadotropic hormone from various donor groups are shown on table 1. The highest spawn was induced by hormone of gravid-mature female group-mean spawn 1290 $\pm$ 371 eggs. This was followed by spawning of 1164 $\pm$ 271 eggs, induced by hormone of the ripe males. The least spawn (571 $\pm$ 35 eggs) was recorded by recipients of unripe-male hormone. The differences between the number of eggs spawned by recipients of unripe-male and ripe-male hormones, as well as gravid-immature and gravid-mature female hormones were highly significant ($P < 0.05$). Spawn per weight of various recipients groups are shown on table 2. The spawn by recipients of gravid-immature female hormone with mean body weight of 175.07 $\pm$ 14.06g was 8%. This was followed by 6.25% spawned by recipients of ripe-male hormone with mean weight of 158.0 $\pm$ 15.29g. There was such a significant fluctuation in the weights of eggs spawned by various recipients as those that received by unripe-male hormone with mean weight of 173.3 $\pm$ 11.42g spawned 5.02% of the eggs.

Percentage spawn induced by hormone of various maturity groups is presented in Fig 1. More spawn (32.6%) was induced by hormone of gravid-mature females than those of other maturity groups. The spawn induced by hormone of ripe males (29.4%) was the second in ranking. There was significant difference ($P < 0.05$) between the spawn induced by unripe-male and gravid-immature female hormones - 14.4% and 23.3% respectively. A comparative spawn obtained by using hormones of male and female of various stages of gonad maturity is presented in Fig 2. In the male group, highest spawn (36.5%) was induced by hormones of those at stage V. While in the female group, highest spawn (33.34%) was induced by those at stage IV. At the second level of comparative ranking, 19.4% spawn was induced by hormone of those at stage IV of the male group. While 26.53% spawn was induced by hormone of those at stage V in the female group. The least in ranking was 13.57%, induced by hormone of those at stage II in the male group. This could be compared to 15.72% by hormone of those at stage III in the female group. Apart from difference in maturity stages of the males and females (stages V and IV respectively) which hormones induced the highest spawn, there was no significant difference ($P > 0.05$) in the various spawning. The least spawn induced by hormones of the two groups did not show any significant differences ($P > 0.05$).

Releasing of eggs at short latency time in small female breeders, may be the reason for limited hour grade than in the bigger female spawners of *C. gariepinus* (Hogendoorn and Vismas, 1980 and Akpaniteaku and Nwuba, 2008). This has indicated their ability to ovulate earlier than the bigger ones (Akpaniteaku and Nwuba, 2008), which contributed so much to the choice of weight range in the present research. Akpaniteaku (2006) reports that weights of the *C. gariepinus* were in line with field reports of spawnable weights of the fish species used in experiments. However the effect of both weights and gonadotropin of donors on ovulation could

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indicate that difference in weight is also a factor in the determination of hour grade (Akpaniteaku and Nwuba, 2008). In the present research, the effects of gonadotropin, and developmental levels of gonads seem to be determinants of the rates of spawning, in the fish species. This may be supported by the higher spawn induced by hormone of gravid-mature females (Table 1 and Fig. 1) than those of the other maturity groups. The quick effects of pituitary hormone from gravid females, and releasing of eggs by recipients before stripping was reported by Akpaniteaku (2006), as well as Akpaniteaku and Nwuba (2008).

Strong potent effects of gonadotropic hormone from the gravid-mature-female donor group seem to be responsible for the higher number of eggs obtained from the recipients (Table 1). Kings (1997) reports that as the body weight of fish increased, the number of eggs produced also increased, and this was linked to the continuous growth of fish after the number of ripe eggs in an ovary prior to spawning (fecundity) had stabilized. Oniye and Onimisi (2011) reports that some fish species could use 2.25% of their body weights for egg production, and this might fluctuate even among fish of similar sizes. The insignificant relationship ($r = 0.5$, $P > 0.05$) in the quantities of eggs spawned per weight of the recipients (Table 2) seems to be as a result of the size range of the fish species used in this study.

Table 1: Results of spawning obtained by using gonadotropic hormone of *Clarias gariepinus* of various maturity groups.

Recipient groups before stripping (g)	Mean weights after stripping (g)	Mean weights number of eggs	Mean estimated
A	160.5 ± 12.29	160.56 ± 12.29	0
B	173.3 ± 11.42	164.59 ± 12.16	571 ± 62
C	158.0 ± 15.29	147.97 ± 16.34	1164 ± 35
D	175.07 ± 14.06	161.10 ± 12.22	932 ± 271
E	165.01 ± 12.11	155.50 ± 13.20	1290 ± 371

Source: Experimentation, 2012

A - Recipients of injection water (Control) ;
B- Recipients of unripe-male hormone;
C- Recipients of ripe-male hormone;
D- Recipients of gravid-immature female hormone
E- Recipients of gravid-mature female hormone.

Table 2: Spawn per weight of various recipient groups of *Clarias gariepinus*.

DG	MWRBS	MWRAS	DMW(se)	PSWR
Injection water (control)	160.56 ± 12.29	160.56 ± 12.29	0	0
Unripe male	173.30 ± 11.42	164.59 ± 12.16	8.70	5.02
Ripe male	158.00 ± 15.29	147.98 ± 16.34	9.86	6.25
Gravid-immature female	175.1 ± 14.06	161.10 ± 12.22	13.97	8.00
Gravid-mature female	165.01 ± 12.11	155.50 ± 13.20	9.51	5.76

DG = *Donor groups,*
MWRBS = *Mean weight of recipients before stripping (g),*
MWRAS = *Mean weight of recipients after stripping (g),*

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DMW(se) = *Difference in mean weights (stripped eggs),*
PSWR = *Percentage spawn per weight of various recipients,*
SWR = *Spawn per weight of recipient*
Source: Experimentation, 2012

$$\text{Spawn per weight of recipient} = \frac{\text{Difference between weights before and after stripping}}{\text{Weight before stripping}} \times \frac{100}{1}$$

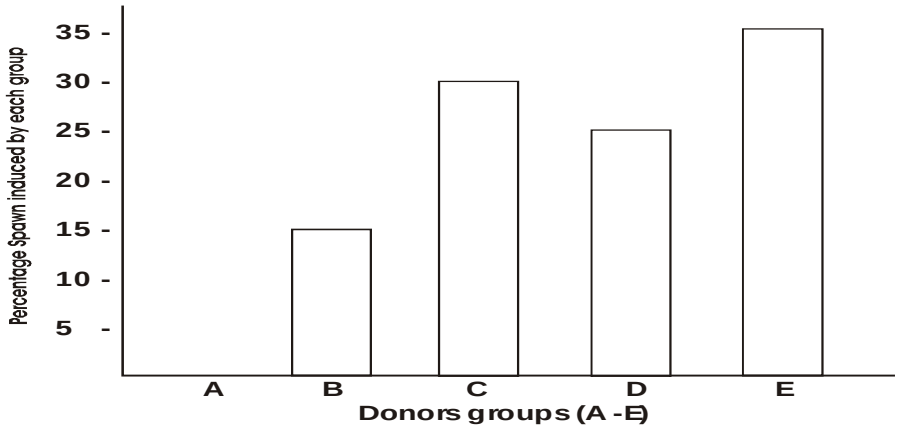

Fig 1: Percentage spawn obtained by using hormone of various maturity groups of *Clarias gariepinus*.

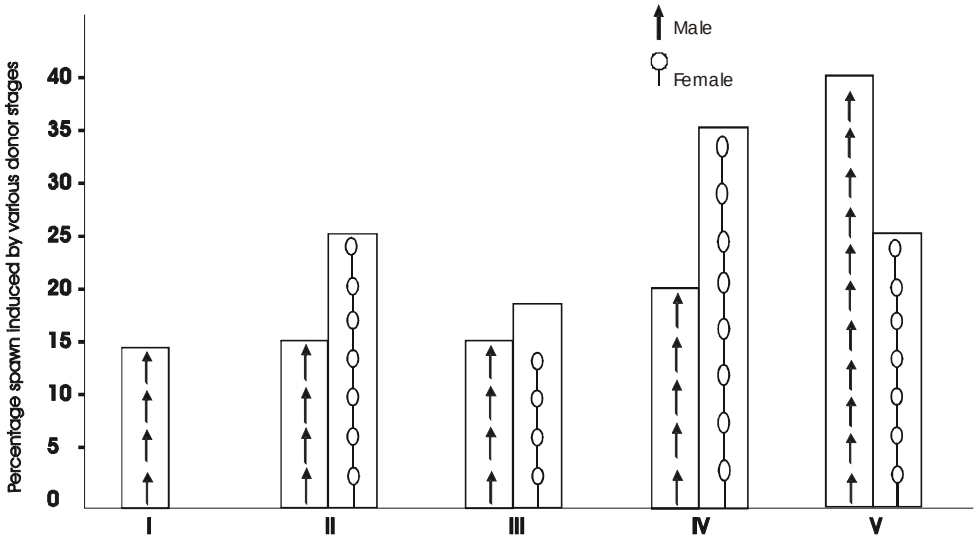

Fig 2: *Comparative spawn obtained by using hormone of male and female Clarias gariepinus at various developmental stages. N/B: Developmental stages of donors (I - V).*

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CONCLUSION

The use of gonadotropic hormone of homoplastic and heteroplastic origin by various workers resulted in spawning of the fish species at desired time of the breeding season. Mastering of various aspects of breeding could be achieved by investigating gonad standardization, gonadotropin potency and their effects on spawning. Judging from the results of the present research, hormones of gravid-mature females (especially those at stage IV), and ripe males (especially those at stage V), have proved to be more effective than those of other maturity groups, in induced artificial spawning of *C. gariepinus*. This observation may hence be very useful in the spawning of other *clariid* fish, because of their common family background.

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