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Influence of various pH regimes on hatching success and hatching time of *Clarias gariepinus* (Butchell 1822) eggs.

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ABSTRACT:

A laboratory experiment was conducted to assess the Hatching success and Hatching time of *Clarias gariepinus* eggs as influenced by various pH treatments. Experimental solution comprising various pH ranges (2-12) was constituted using HCl and CaOH solutions as the case may be. Forty *Clarias gariepinus* eggs were distributed in each 3.5liter plastic basin containing different pH regimes and were allowed to stand for 24 hours incubation. Results showed that extreme pH of 2-3 and 10-12 were 100% lethal to *Clarias gariepinus* eggs. The median lethal hatching pH (ML50HpH) were found to be 4.45 and 9.40 for acidic and alkaline treatment respectively while the optimal hatching pH is 6.0 with hatchability of 75%. However pH of 4, 5 and 10 caused a prolongation in embryogenesis, which resulted in delayed hatching time when compared with other pH treatments. There was significant ($p<0.05$) effect of various pH regimes on hatching success and hatching time of *Clarias gariepinus* eggs.

Keywords:
Clarias gariepinus, pH, Hatching success, Hatching time.

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INTRODUCTION

The concept that every recipient water body has capacity to assimilate contaminants has been the basis for establishment of quality criteria for aquatic life by different international and national organizations (Train 1979). According to European Inland Fisheries Advisory Commission (EIFAC 1987) water quality criteria for fresh water fish should ideally permit all stages in the life cycle to be successfully completed and in addition should not produce conditions in a river water which would either taint the flesh of the fish or cause them to avoid a stretch of river where they would otherwise be present or give rise to accumulation of deleterious substances in fish to such a degree that they are potentially harmful when consumed.

In establishing water quality criteria for inland fisheries the acidity or alkalinity of the water has been an important factor (Alabaster and Lloyd, 1982). In water quality criteria for pH values, ORSANCO (1955) reported that although fish has been found at pH values between 4 and 10, the safe range is between 5 and 9, and for maximum productivity the pH value should be between 6.5 and 8.5. Streams with pH values as low as 2.0 to as high as 4.0 may occur in the vicinity of industries as a result of industrial pollutants (Kneese and Bower 1968). These pollutants may include acids such as sulphuric acid discharged by chemical and other industrial plants. pH changes in H_2O are also affected by alkalis such as NaOH which is a waste from many industries including soap manufacturing, textile dying, rubber reclaiming and leather tanning (Kneese and Bower, 1968). However in acid waters, the absence of fish or reduction in its population may be associated with other factors, such as lack of nutrients, high temperature or super saturation of dissolved gases other than the presence of hydrogen ions.

The African Catfish, *Clarias gariepinus* is very popular for fish farming. *C. gariepinus* inhabit calm waters from Lakes, Streams and Rivers to Swamps, some of which are subject to seasonal drying (Chervinski, 1983). It is highly consumed in Nigeria and recently commercial production has gained popularity. Therefore this present research was aimed to assess the influence of different pH regimes on hatching success and hatching time of *C. gariepinus*.

MATERIALS & METHODS

Clarias gariepinus eggs used in this experiment were obtained (artificially induced method) from the hatchery department of African Regional Aquaculture Centre (ARAC) Port Harcourt.

Hypophysation and Egg Production:

The female and male *Clarias gariepinus* used in this work had been kept in facilities of the African Regional Aquaculture Centre (ARAC) Port Harcourt.

Female *C. gariepinus* were chosen on the basis of ovarian biopsy of the Oocytes as described by Legendre (1986). Males were chosen on the basis of possession of pointed and hyperamic urino genital papillar (Hogendorn, 1979). Hormone administration was carried out according to (Woynarovich and Horvarth, 1980) between 15.00 and 17.00 hours with Carp pituitary suspension at a dose of 6mg/kg body weight and at an induction temperature of 26.5^{o}C. A total of four female *Clarias gariepinus* were injected. After latency period of about 10 hours, ovulated eggs were removed from the induced female *Clarias gariepinus* into dry receptacle by hand stripping. The stripped eggs were thoroughly mixed together with plastic spoon. Two *Clarias gariepinus* males were killed. Milt extracted from these males into 0.9% sodium chloride (NaCl) saline solution were pooled together and used in fertilizing the *Clarias gariepinus* eggs. Fertilization was enhanced by addition of freshwater to the mixture of eggs and milt. Part of the fertilized eggs was incubated on bunched strands of polyethylene fibers (kakaban) placed in the experimental containers.

pH Treatments:

Thirty-three (33) plastic container of 3.5 litre volume were used for the study. 2 liters of bore-hole tap water was poured into each container. To obtain the required pH values, Hcl was added drop wise (for acidity) or CaoH solution added (for alkalinity) while the values were read using a pH meter ATC pH meter HI 8915 (Alabaster and Lloyd, 1982). The pH values ranged between 2 and 12.

Stocking of Egg for Incubation and Hatching:

The bowls were stocked uniformly with 40 eggs per bowl for incubation and hatching. All eggs were exposed to the relevant pH in triplicate and in steps of one pH unit by successively decreasing or increasing the pH levels. Of several parameters thought to contribute to acidity and alkalinity effects on embryonic stage of fishes, pH a key parameter was tested. In pH tolerance of embryos, the following variables were examined, hatching success and hatching time. Hatching success was determined as the number of successfully hatched individuals per container. Hatching time was calculated as the period between fertilization and time of hatch.

Water Quality Monitoring:

Water temperature records in each container were taken twice daily, morning (8.00am-9.00am) and evening (5.00pm – 6.00pm) using mercury in-tube thermometer. Dissolved oxygen (D.O) content was determined using Jenway D.O. meter (Model 3050, England). Dissolved oxygen (D.O) and pH measurements were observed every morning (8.00am-9.00am).

Data Analysis:

Data collected on Hatching Success and Hatching time were subjected to analysis of variance (ANOVA) and the treatment means were separated using Least Significant Difference (LSD) at 5% significant level.

RESULTS

Hatching Success and Hatching time:

Table I shows the hatching success of *Clarias gariepnus* in various incubation pH regimes. The result of the hatching success shows a zero hatching at pH 2.0, 3.0, 11.0 and 12.0. Hatching occurred between pH4.0 and pH10.0 The optimal hatching pH was at pH6.0 with hatchability of 75%, the values dropped towards the extremes of the pH treatments with recorded values of 32% and 44.16% for pH 4.0 and pH 10.0 respectively (**Table 1**). The observation of the cumulative hatching time of *C. gariepinus* showed delayed hatching time in pH4.0 pH5.0 and pH10.0 when compared with other pH treatments. (**Table 2**).

Water Quality Records:

Dissolved oxygen content of the medium was approximately 6.0mg/l throughout the study. The temperature also remained approximately constant at 26.5^{o}C.

DISCUSSION

The survival rate of 75% and the resulting LC50 at pH 4.45 and at pH 9.40 (**Fig. 1**) indicate a high pH tolerance of *Clarias gariepinus* eggs. This result collaborates with that of Warner *et al* 1991, Andren *et al* 1989, on high pH tolerance in embryonic survival of fishes and amphibians. Milbrink and Johansson (1975) also reported that the viability of Roach (*Rutilus rutilus*) and Perch (*Perca fluviatilis*) eggs kept in natural lake waters with a range of acidities was reduced at low pH values of 5.5 and 4.7. Similar studies with Pike (*Esox lucius*) gave a corresponding result at pH of 5.0. Kwain (1975) found that no Rainbow trout eggs survived at pH values of less than 4.5 but that there was reasonable survival above pH 5.0. Menendez (1976) also found reduced viability of eggs of Brook trout at pH values below 5.1 with alevin mortalities occurring below 6.0. At high pH values, Volodin (1960) discovered that the median lethal pH was 8.0 but at pH 9.0 hatching was delayed. Delayed hatching or longer embryonic time under low and high pH conditions presumably raises the mortality risk in the embryonic stage in particular by egg predators (Rowe et al, 1964). Meanwhile Swingle (1961) and Calabrase (1969) have already stated that acid and alkaline death points of pH are approximately pH4 and pH11 respectively.

Below pH 4.0 and pH 11.0, high embryonic mortality occur due to a denaturation of the hatching enzyme and subsequently to deformations of the embryo (Urch and Hedrick 1981).

Table 1: Hatching success of *C. gariepinus* eggs in various incubation pH.

pH Regime	Mean number incubated	Mean number at hatch	Mean % hatch
2	40	0	0
3	40	0	0
4	40	13	32.5
5	40	27.67	70.17
6	40	30	75
7	40	28.3	71.0
8	40	24	60
9	40	20.3	51.67
10	40	17.67	44.16
11	40	0	0
12	40	0	0

Figure 1: Mean Percentage Hatch against pH

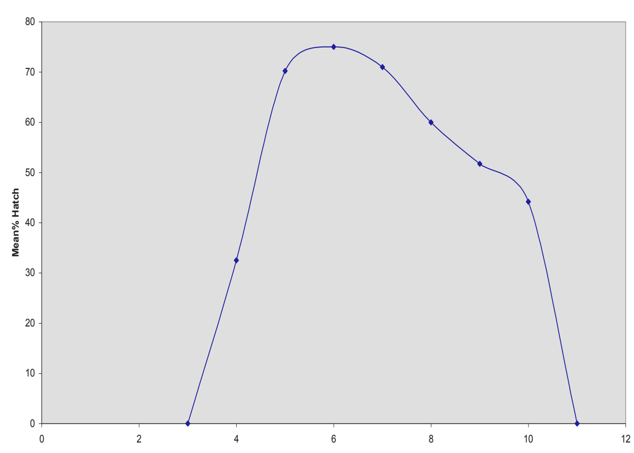

TABLE 2: Hatching time of *C. gariepinus* eggs in various incubation pH.

pH treatments	Mean No incu-bated	Mean No. at hatch	Mean time of hatch	Hatching range in hours	Observation
2	40	0	0	0	No hatching
3	40	0	0	0	No hatching
4	40	13	540 mins	26-36	Delayed hatching
5	40	27.67	480 mins	24-33	Delayed hatching
6	40	30	280 mins	24-29	Normal hatching
7	40	28.3	260 mins	24-29	Normal hatching
8	40	24	340 mins	24-30	Normal hatching
9	40	20.3	340 mins	25-32	Normal hatching
10	40	17.67	440 mins	28-36	Delayed hatching
11	40	0	0	0	No hatching
12	40	0	0	0	No hatching

The study shows the importance of monitoring and maintaining the chemistry of water as it affects Hatchability of fish eggs. This could be harnessed by fish aquaculturists and those in the study of environmental disturbances.

Nigerian inland waters are known to be prone to industrial waste disposal which are many a times untreated or poorly treated. The consequences of these waste is reduction in pH (high acidity or high alkalinity) and this goes a long way to affect embryonic development of fishes. Efforts to make our water bodies free from waste should therefore not be relaxed.

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