Effect of chemical shock (hydrogen peroxide) on the hatching rate of eggs, survival and growth performance of African catfish (*clarias gariepinus*).

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Abstract

Effect of chemical shock on hatchability, survival and growth performance of African catfish was studied in Adamawa State University Teaching and Research Fish Farm Mubi. Five (5) ripe brooders were purchased from Abdulfana fish Farm in Yola. The brood stocks were transported in 50 litres plastic cans, on arrival they were given salt bath at 5% for 5 minutes and conditioned for one week. Completely Randomized Design (CRD) was used for the research for a period of six weeks in the hatchery. Chemical shock (Hydrogen peroxide) at 0.1, 0.2, and 0.3% concentration was applied on the estimated 408 fertilized eggs for all the treatments except the control. Hydrogen peroxide at 0.3% concentration on fertilized eggs exposed for 10 minutes gave the highest hatchability of 62.25%. While chemical shock of 0.2% concentration for 10 minutes gave the least value 34.83% as presented. Twenty fingerlings from each treatment and control were set, replicated in triplicate and reared in the outdoor concrete tanks for another 24 weeks. The chemical shocked fry as well as the control were nursed and reared under same culture conditions. The feeding and water quality parameters were maintained within the optimum culture ranges. At the end of 24 weeks of the research, analysis of the results showed that there were significant differences (P<0.05) in the hatchability of eggs, survival rate, and growth performance among the control and chemically treated fry. The experiment revealed that Methylated spirit can be used at low concentration for 10–15 minutes to improve the hatchability of *Clarias gariepinus* eggs after fertilization.

Keywords: Hydrogen peroxide, Hatchability, Survival and growth performance, *Clarias gariepinus*, Mubi.

Introduction

Hydrogen peroxide (H_2O_2) is the simplest peroxide (a compound with an oxygen-oxygen single bond). It is also a strong oxidizer. Hydrogen peroxide is a clear liquid, slightly more viscous than water. In dilute solution, it appears colorless. Due to its oxidizing properties, hydrogen peroxide is often used as a bleach or cleaning agent. The oxidizing capacity of hydrogen peroxide is so strong that it is considered a highly reactive oxygen species.. Laboratory tests conducted by fish culturists in recent years have demonstrated that common household hydrogen peroxide can be used safely to provide oxygen for small fish [1].

Hydrogen peroxide releases oxygen by decomposition when it is exposed to catalysts such as manganese dioxide. Its decomposition produces oxygen and water, adding dissolved oxygen to its environment, thereby negating some Biochemical Oxygen Demand (BOD), problems [2]. 35% PEROX-AID, supplied by Eka Chemicals, Marietta, GA, is approved for the control of mortality in freshwater-reared finfish eggs due to saprolegniasis; freshwater-reared salmonids due to bacterial gill disease; and freshwater-reared cool water finfish and channel catfish due to external columnar is disease. Hydrogen peroxide has important roles as a signaling molecule in the regulation of a variety of biological processes. It also plays an important role in aging and cancer treatment [3]. The study in nature suggested observed that asthma sufferers have higher levels of hydrogen peroxide in their lungs than healthy people, which could be explained why asthma have inappropriate levels of white blood cells in their lungs [4]. Hydrogen peroxide is most commonly available as a solution in water. For consumers, it is usually available from pharmacies at 3 and 6 wt% concentrations. The concentrations are sometimes described in terms of the volume of oxygen gas generated; one milliliter of a 20 volume solution generates twenty millilitres of foxygen gas when completely decomposed, buyers must typically submit to inspection by the small number of commercial manufacturers [5]. The composition of external layer is responsible for the stickiness of fish eggs which usually occur after eggs are immersed in fresh water but not in saline solutions [6]. Better understandings V.E. composition and biochemistry during fertilization and embedding in aqueous media can facilitate desticking techniques and consequently the propagation. Vitelline envelope's proteins could be

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***Received:** 18-Oct-2022, Manuscript No. AAJFR-22-77656; **Editor assigned:** 21-Oct-2022, PreQC No. AAJFR-22-77656(PQ); **Reviewed:** 10-Nov-2022, QC No. AAJFR-22-77656; **Published:** 18-Nov-2022, DOI: 10.35841/AAJPTR-6.6.127*

***Citation:** Garba AT, Abigail E, Valdon SB, Peter KJ, Duwal SD. Effect of chemical shock (hydrogen peroxide) on the hatching rate of eggs, survival and growth performance of African catfish (clarias gariepinus). J Fish Res. 2022;6(6):127*

dissolved in biased pH media with or without saline solutions when acid anions calibrate proteins to sediment organic dissolvent in unheated conditions and by enzymes [7-13].

Simultaneously, many procedures try to cover the VE by using inert materials such as powder milk and other chemical. The use of alcalase led to nearly 100% egg unstickiness. Lower efficacy was reached for the combination of whole milk and talc (80–90%) and then whole milk only (10-70%), [10]. Palikoval et al. [14] found the lowest efficacy of 5% egg unsticking after the application of only (5%) talc. The method with alcalase was selected for further use because it provided good results of unsticking, time consumption and duration of egg handling. Fish eggs and embryos were made transparent for only about 2 minutes when the second clearing solution was used [14]. There are so many chemical compound used by fish farmers to remove stickiness on fish eggs apart from the normal physiological salt solution and fresh milk. This chemicals include: Fullers earth used to reduce the adhesiveness of fish eggs to improve hatchability, Urea and tannic acid used to denature the adhesive component of fish eggs at concentrations of 15g urea and 20g NaCl/5liters of water for approximately 6 minutes, followed by a separate solution of 0.75 g tannic acid/5litres of water for an additional 6 minutes. These amounts will treat approximately 400,000 eggs. Sodium sulfite used in a 1.5% solution for 5 to 8 minutes to treat eggs in order to improve their hatchability. Papain used in a 0.2% solution to remove the gelatinous matrix of fish egg masses in order to improve hatchability and decrease the incidence of disease [15].

Materials and Methods

The research was conducted at the Department Fisheries and Aquaculture, Teaching and Research Fish Farm Adamawa State University Mubi. The entire area is located approximately between latitude 90 55' and 100 45' North and longitute130 0' and 150 5' East. It lies in the north eastern part of Adamawa State 2020 [16].

The hatchery was used for the chemical shock treatments, incubation, hatching, nursing of larvae and fry. Four hundred and eight (408) fertilized eggs were incubated for each treatment and hatched. Twenty four (24) plastic aquaria with volume 53 cm x 36 cm x 42 cm (L X B X D) were used after being fitted with aerated mini flow through system. Completely Randomized Design (CRD) design was used for the experiment in the hatchery environment using 24 plastic bowls fitted with flow-through system. Each concentration of the chemical was replicated three times according to the shock duration of 0, 5, 10 and 15 minutes respectively. Twenty 20 fingerlings each from chemically treated and control experiment were stocked in each of the 24 outdoor culture receptacle (concrete tanks) measured 1m x1m x 1m in triplicates at the experimental tanks section after their 5 weeks in the indoor hatchery. The choice of twenty four tanks was in line with Akinwande et al. bringing to 480 the total number of fingerlings in the 24 tanks [17].

Nine bloodstock were used for the experiments. Human Gonadotropin Hormone (Trade mark: Ovaprim) was used to induce the female brood fish at a dosage of 0.5ml per kilogramme fish body weight. The injection was given intramuscularly above the lateral line just below the dorsal fin. The point of injection was massaged lightly with finger in order to distribute the Ovaprim evenly throughout the muscle and to prevent a backflow. The injected fish was kept in a plastic bowl to undergo a latency period of 12hours 23 minute. Hydrogen peroxide produce by Eka Chemicals, Inc., Marietta, GA, containing 6%w/v hydrogen peroxide with stabilizer (100ml) was used at concentration of 0.1%, 0.2% and 0.3% respectively. These were obtained by dissolving 1ml, 2ml and 3ml of Hydrogen peroxide in 99ml, 98ml and 97ml of water respectively.

Results

The results of the research is shown in the below tables (Tables 1-4).

Discussion

All the mean water quality parameters collected during the experiments, fell within the optimum range. The ammonium value ranged from 0.031-0.041. Schram suggested that African catfish be cultured in water with ammonia concentration not more than 0.34 mg/l to reduce the rate of risk of reduced growth and feed intake. Temperature ranged between 27.21-28.280C

Table 1: *Effect of Hydrogen peroxide duration on the Hatchability of Clarias gariepinus eggs.*

Duration (minute)	Treatments				
	1	2	3	4	5
0	224 ± 0.78^{a}	226 ± 0.44^{a}	225 ± 0.83^{a}	223 ± 0.29^{a}	0.921
5	218 ± 0.42^{c}	217 ± 0.13^{c}	217 ± 0.83^{c}	215 ± 0.34^{c}	1.105
10	196 ± 0.41^{d}	199 ± 0.67^{d}	187 ± 0.23^{d}	117 ± 0.24^{b}	1.101
15	223 ± 0.25^{b}	222 ± 0.33^{b}	221 ± 0.67^{b}	220 ± 0.00^{b}	1.102

Means in the same row, having the same superscript are not significantly different (P>0.05).

Table 2*: Effect of Hydrogen peroxide concentration on the Hatchability of Clarias gariepinus eggs.*

Contration (%)	Treatments				
	1	2	3	4	5
0	225 ± 0.83^{a}	224 ± 0.78^{a}	226 ± 0.44^{a}	223 ± 0.29^{a}	0.921
0.1	217 ± 0.83^{c}	218 ± 0.53^{c}	215 ± 0.34^{c}	217 ± 0.13^{c}	1.104
0.2	199 ± 0.67^{d}	196 ± 0.41^{d}	187 ± 0.23^{d}	177 ± 0.24^{d}	1.101
0.3	222 ± 0.33^{b}	221 ± 0.67^{b}	223 ± 0.25^{b}	220 ± 0.00^{b}	1.103

Means in the same row, having the same superscript are not significantly different (P>0.05).

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Table 3: *Mean Standard length, Total length and weight gain of Clarias gariepinus fingerlings treated with Hydrogen peroxide for 4 Months.*

Treatment Code	Standard length(cm)	Total Length (cm)	Total Body weight(g)
HS00	3.22 ± 0.79[a]	4.10 ± 0.90[b]	7.11 ± 0.77[b]
HS11	3.20 ± 0.71[b]	4.11 ± 0. 77[b]	7.23 ± 0.80[a]
HS22	3.21 ± 0.64[b]	4.12 ± 0.78[b]	7.10 ± 0.87[b]
HS33	3.23 ± 0.78[a]	4.14 ± 0. 91[a]	7.44 ± 0.88[a]

Table 4*: Cumulative percentage mortality /survival rates of Clarias gariepinus fish reared for the period of 4 months after treatment with Hydrogen peroxide.*

Treatment Code	Initial Stocking per tanks	% Mortality (1)	% Mortality (2)	Survival	% Survival
HS00	20	3	15	17	85
HS11	20	4	20	16	80
HS22	20	5	25	15	75
HS33	20	4	20	16	80

this fall within the acceptable tropical fish culture temperature range of 25.0-32.00C. Moody and Folonunsho observed that 26.0-30.00C was ideal for tropical fish. The dissolved oxygen (DO) ranged from 4.66-6.78mg/l. the high rate of D.O during the first and second month was due to combined flow through and aerator applied [18,19]. The pH observed was 7.74-7.94, however, Valdon obtained pH values of 6.83-7.49 in the assessment of water quality for fish production in some concrete ponds in Njoku (1997) and Onuaha (1991) [20-24] were of the view that pH value in fish culture should range between 6.5-9.0. Conductivity observed ranged from 54.20-54.57 ucms-1, this was in line with the report of Ugwu and Mgbenka [25]. From the results obtained, the use of hydrogen peroxide at 0.3% has improved hatchability of *C. gariepinus* eggs with hatchability of 222 ± 0.33, with the control which has the highest hatchability of 225 ± 0.83 under the same treatment. According to Mohammed 95% can be recorded in control experiment under good hatchery management. Apart from increasing the percentage hatchability, the use of hydrogen peroxide on fish eggs also helps to differentiate fertile eggs from infertile eggs immediately after fertilization at a recommended dosage. Fertilized eggs without hydrogen peroxide (control) will take many hours before differentiation could be observed on the eggs. Hydrogen peroxide increases the dissolved oxygen level of water when added to it [26]. This happens because hydrogen peroxide releases oxygen during decomposition, when it is exposed to catalyst such as manganese dioxide. It is typically applied to a wastewater system where there is a retention time of 30 minutes to 5 hours before hydrogen sulfide is released. Hydrogen peroxide oxidizes the hydrogen sulfide and promotes bio-oxidation of organic odours. It also decomposes to oxygen and water, adding dissolved oxygen to the system, thereby negating some Biochemical Oxygen Demand (BOD) [2].

Hydrogen peroxide supplied by Eka Chemicals, Inc., Marietta, GA, was not yet approved by NAFDAC to be used in fish hatchery for the control of mortality in freshwater-reared finfish eggs due to saprolegniasis; freshwater-reared salmonids due to bacterial gill disease; and freshwater-reared cool water finfish and channel catfish due to external columnar is disease. This drug is approved as an OTC product, and a prescription is not required. There are no limitations on acceptable daily intake; there is no required withdrawal time; and no tolerance has been set for residues in fish tissues [27].

Conclusion

The following conclusions were drawn from the results of the experiments conducted:

Hydrogen peroxide can be used to improve the hatchability of *Clarias gariepinus* eggs at low concentration of 0.3% for 15 minutes. The use of hydrogen peroxide can help breeder to differentiate clearly between the fertile and infertile eggs after fertilization within a short period of time before hatching. Stickiness of eggs after fertilization can be reduced using hydrogen peroxide. The chemical could be used in fish hatchery as disinfectants for the control of mortality in freshwater-reared finfish eggs.

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