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Effect of Water Volume on Growth, Survival Rate and Condition Factor of *Clarias gariepinus* Hatchlings Cultured in Different Enclosures

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Authors' contributions

This work was carried out in collaboration between all authors. Author SAO designed the study, wrote the protocol, and wrote the first draft of the manuscript and laboratory work. Authors KGS and TFS performed the statistical analysis, managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Fry management in aerated, none aerated aquarium and hapa system were determined in Fish Hatchery of Faculty of Agriculture, Shabu Lafia, Nasarawa State University Keffi, Nigeria to assess condition factor, percentage survival rate, increase in total body length and percentage weight gain. Two hundred hatchlings each of *Clarias gariepinus* were put into12.6 litres of water of 35 x 30 x 15 cm aquarium (with aerator and without aerator) and those of hapas (35 x 30 x 15 cm dimensions) were placed each in 1000 litres of water (aerated and none aerated) in 3 replicates. The fry were fed at 5% of their body weight with Artemia shell free as fry conventional food. The feeding was done four times daily at ¼ part of the 5% body weight for the period of sixteen days. Temperature (27.45±0.05ºC), pH (7.56±0.03); dissolved oxygen (8.20±0.03 mg/L), total alkalinity (15.36±0.03 mg/L) and free carbon dioxide (4.30±0.03 mg/L) monitored in the various treatments were not significantly different from each other. The Percentage weight gain (1117 and 1067),

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percentage survival rate (92.83 and 91.33), increase in total body length (1.07 and 1.07cm) and condition factor (11.99 and 11.44) of *the* fry in hapa system (aerated and none aerated respectively) were significantly ($p<0.05$) higher than those of aquaria treatments. The results of aerated and none aerated hapa treatments were not significantly different ($P>0.05$) from each other. The use of hapa as improved system for mass production of *C. gariepinus* fry is highly recommendable in the large body of water.

Keywords: Aquarium; aerator; fry; hatchlings; hapa; Clarias gariepinus.

1. INTRODUCTION

Clarias gariepinus is one of the widely cultivable fish in Nigeria due to acceptability and its resistance to poor water quality [1]. In spite of remarkable success on the hatching of *Clarias gariepinus,* the survival at fry stage is still a limiting factor [2]. This can be attributed to lack of proper awareness and technicality involved in principles of hatchery management especially the problem of ammonia accumulation and fungi from waste food and faecal materials. The fry of *Clarias gariepinus* fish is mass produced in most hatcheries but the percentage survival rate of the fry is low compared to the number of hatchings in every hatchery operation [3]. Identification of some causes for the low and variable survival of *C. gariepinus* fry was reported in Cameroon to be predation (primarily by amphibians and aquatic arthropods) and cannibalism (exacerbated by low food availability) [3]. The mortality rate of *C. gariepinus* fry is still significantly high even when factors like predation and cannibalism are controlled. Therefore, there is need for solution to the problem of fry mortality in the hatchery especially in the first two weeks of active live. The uses of Hapa for mass production of *C. gariepinus* fry need to be investigated especially when predation and cannibalism factors are controlled [2]. Nylon or "mosquito" net cages commonly referred to as hapas or net-hapa hatchery/nursery system has been reported to be very efficient for the production of high quality *Tilapia* fish seeds for stocking ponds [4]. Performances of Dutch *Clarias* juvenile stocked at different densities in out-door hapas was also reported in feeding experiment by [5]. The use of hapa for *Clarias gariepinus* feeding experiment was also documented by [6]. In this study, the efficiency of hapa system in high volume of water in mass production of *C. gariepinus* fry is examined to assess its effects on condition factor, percentage survival rate, increase in total body length and percentage weight gain of the fish in sixteen days.

2. MATERIALS AND METHODS

Two hundred hatchlings of *C.gariepinus* fry were put into 12.6 litres of water in 35 x 30 x 15 cm glass aquarium with aerator (Awa), glass aquarium without aerator (awta) while hapa with aerator (hapwa) and hapa without aerator (hapwta) (size 35 x 30 x 15 cm each) were placed in 1000 litres of water. The whole set up of the treatments were in 3 replicates. In the construction of hapas, materials and methods reported by [2] was employed. The hapas were made of brown colour plankton net and they were submerged to same depth of water level like those of the aquaria. The fry were fed with Artemia shell free four times daily at ¼ part of 5% of their body weight (to avoid cannibalism and to increase food availability) for the period of sixteen days. The condition factor, percentage weight gain, increase in total body length (cm), and percentage survival rate were determined as follows:

i. Condition factor (k) = (weight gain (g) / L^3) x 100 Where L = total length in cm attained during the experiment [7].
ii. Increase in total body length in cm = final length – initial length at the start of the experiment [8].
iii. Survival rate (%) = (No. alive after the experiment/Total No. of fry at the start of the experiment) x 100
iv. Percentage weight gain = (final weight (g) – initial weight (g) /initial weight (g)) x 100 [9].

The weight was taken using digital sensitive scale while the increase in total length was taken using a tape rule graduated in millimeter and centimeters. Cannibalism was eradicated by feeding the fry adequately and timely. All dead fry were collected and recorded on daily bases just before feeding using siphoning method [10]. Replacement of ⅔ of the water in aquarium was done daily. Temperature (°C), pH, alkalinity (mgL^{-1}), free Carbon oxide (mg/L) and dissolved oxygen (mL^{-1}) in water used for each treatment were collected in depth of 2.00 cm below the water surface. The use of thermometer, pH meter and the methods of [11] were employed for the determination of water quality parameters in this experiment. The data obtained were analyzed using descriptive statistics, analysis of variance and Duncan's multiple range tests for the level of significant difference between means at probability of 0.05.

3. RESULTS AND DISCUSSION

3.1 Water Quality Parameters

Table 1 shows water quality parameters of source of water for all treatments monitored in this study. The temperature for each of the treatment 'Awa', 'Awta', 'Hapwa' and 'Hapwta' in all the treatments were not significantly different ($p>0.05$) from each other. Similar results of insignificant difference were recorded for Carbon dioxide, Total alkalinity, Dissolved oxygen and pH throughout the period of the experiment. Results of each treatment were not altered by water parameters in this experiment as they were not significantly different in the treatments and the water was from same source. The average temperature, dissolved oxygen, total alkalinity and carbon dioxide for the various treatments observed in this study were within acceptable range [12].

3.2 Percentage Weight Gain

Results in Fig. 1 shows that the percentage weight gain of the *C. gariepinus* fry were not significantly different in the aerated and none aerated hapa. The aerated and none aerated hapa treatments significantly ($P<0.05$) had the best weight gain (%) in this experiment. The aerated and none aerated aquaria were significantly the same in percentage weight gain. Regular changing of (⅔) of the volume of water in the aquarium could have minimize deterioration of the water quality in the in the aquarium but in mass production of fry, hapa system will lessens effort and inputs with better results compared to aquaria tanks.

3.3 Percentage Survival Rate

The results of percentage survival rate of this experiment are shown in Fig. 2. The Hapa system (Hapwta and Hapwa) and aquaria (Awa, Awta) were significantly different from each other ($P<0.05$). Although the survival rate of fry was very encouraging and results were very close for the Hapwta and Hapwa (92.83 and 91.33 respectively), the results of Hapwa was not significantly better than Hapwta in large volume of water. In a small volume of water, such as in small tanks there is need of aeration as the dissolved oxygen can be depleted by the fry. In all the results, hapa system, whether aerated or not, stands significantly the best in the production of *C. gariepinus* fry because it takes care of ammonia level, predators, and aquatic arthropods [2] which may directly and indirectly affect the fry. The least value of survival rate (%) of fry was in aquarium without aerator because of dissolved oxygen utilization. This is clear indication that additional accessories are needed to run the none hapa system in successful rearing of *C. gariepinus* fry.

3.4 Increase in Total Body Length (cm)

The results of the fry increase in total body length during the period of the experiment are shown in Fig. 3. Aerated and none aerated hapa were significantly same ($P>0.05$) but they were significantly ($P<0.05$) better than the results of increase in the body length of those of aerated aquarium tanks. The large water volume might be the major factor helping the water quality for growth as others factors like predation [3] and cannibalism were controlled. This investigation also indicated that growth in length can be achieved in hapa system.

3.5 Condition Factor

Results of the effects of treatments on the condition factor of the fry are shown in Fig. 4. *C. gariepinus* fry in Hapa with aerator and Hapa without aerator significantly had the highest condition factor (11.99,11.44). They were significantly different ($P<0.05$) from other treatments of the experiment. The least condition factor (8.18) was found in aquarium without aerator and it is not significantly different from the aquaria with aerator. The regular changing of ⅔ of the water daily in the aquarium must have minimized the adverse effect of the none aeration of the aquarium, hence the none significant difference recorded. The Hapa system produced a good result because of the large volume of water and the plankton net that allow for the ammonia from waste food and faecal material to go out of the hapa. Holding fry in hapas to protect them from both amphibians and aquatic arthropods, was reported to have decreased mortality by 5.7 percent and installation of bird-netting over the hapas reduced mortality by 21.7 percent [3]. Although the fry in hapa were restricted to the same size of 35 x 30 x 15 cm like those in aquaria, the water volume (1000 litres of water) from the surrounding normalizes the water quality in the Hapa. The hapa with aerator yielding significantly (p>0.05) the same result with hapa without aerator, indicates that in hapa system of large body of water, dissolved oxygen in the water can naturally sustains the given fry. This results show that with or without aeration, the fry can survive in hapa system in a large volume of water.

Table 1. Water quality parameters of source of water for treatments in this study.

Parameter	Awa	Awta	Hapwa	Hapwta
Temperature (°C)	27.43±0.04	27.43±0.06	27.44±0.02	27.43±0.05
pH	7.45±0.02	7.46±0.03	7.47±0.03	7.46±0.03
Total alkalinity (mg-^{1})	15.21±0.03	15.21±0.01	15.21±0.02	15.21±0.03
Dissolved oxygen (mg-^{1})	8.20±0.03	8.21±0.03	8.20±0.03	8.20±0.01
Carbon dioxide (mg-^{1})	4.20±0.01	4.20±0.03	4.20±0.02	4.20±0.03

Awa = Aquarium with aerator, Awta = Aquarium without aerator, Hapwa = Hapa with aerator, Hapwta = Hapa without aerator

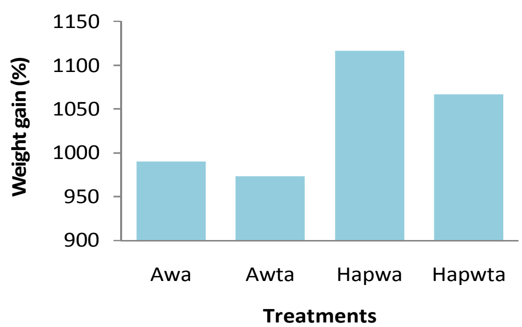

Figure 1: Effect of treatments on weight gain (%) *Clarias gariepinus* fry

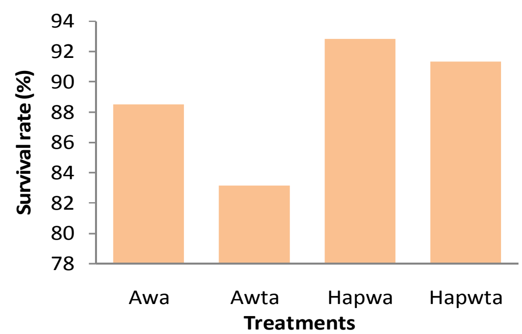

Figure 2: Effect of treatments on survival rate (%) *Clarias gariepinus* fry

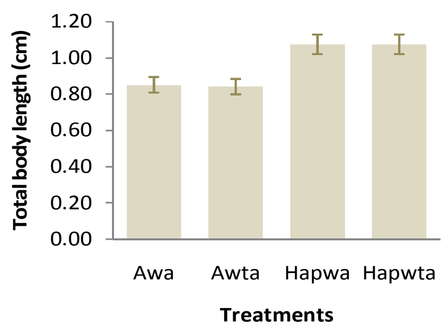

Figure 3: Effect of treatments on increase in total body length (cm) *Clarias gariepinus* fry

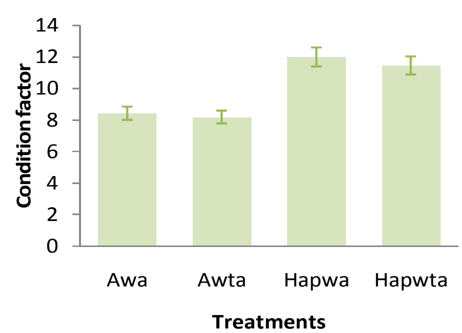

Figure 4: Effect of treatments on condition factor of *Clarias gariepinus* fry

Awa = Aquarium with aerator, Awta = Aquarium without aerator, Hapwa = Hapa with aerator, Hapwta = Hapa without aerator.

4. CONCLUSION AND RECOMMENDATIONS

The use of hapa in mass production of *C. gariepinus* fry is significantly better than the aquarium especially in large volume of water body. The Percentage weight gain, percentage survival rate, increase in total body length and condition factor of *C. gariepinus* fry in hapa system is significantly higher than those studied in aquaria. The use of hapa as an improved system for mass production of *C. gariepinus* fry is highly recommendable in the large body of water.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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