Journal of Agriculture, Environmental Resources and Management
www.saerem.com
ISSN2245-1800(paper) ISSN 2245-2943(online)
6(4)1-800;**June**.2024; pp70- 80

The Effectiveness of Changing Water in Rearing *ClariasGariepinus* (Burchell, 1822) Fingerlings

Yale B. Kutwal, MARY Obioha and Godiya J. Dan

Federal University Wukari, Taraba State. Email: kutwalyale@yahoo.com

Abstract

The number of times water can be changed within one or two weeks plays an important role in fish production/culture. The aim of this work was to determine the number of times water should be renewed in a week or more for the high production of Clarias gariepinus fingerlings in the laboratory. 180 fish fingerlings with mean initial weight (0.65±0.20g) and length (5.61±0.12cm) were procured from Makurdi and brought to the fish hatchery unit of Biological Sciences in a 50 litres container. After acclimatization for two weeks, they were randomly distributed into four treatments of 60litre bowls maintaining 45 litre water level with 15 fingerlings each. Treatments 1, 2, 3 and 4 renewed water at 2days interval for 2, 4, 6 and 8 days respectively after a period of 5 weeks. The statistical tool used was One-way analysis of variance (ANOVA) and Duncan multiple range for mean differences. The result revealed that treatment 3(31.67±0.33 ºC) had the highest temperature. Similarly, oxygen was highest in treatment (3 and 4) with 5.0±0.00 g/L each. It was also revealed that treatment 3(49.33±1.45g) had the highest mean weight gain, treatment 4 (7.63cm) had the highest mean increase in length while the highest mean survival rate was recorded in treatments 1 & 4 (64.67%) each. The results were all significantly (P<0.05) different from each other. Changing of water after 5days is therefore recommended for rearing of C. gariepinus.

Key words: Renewal, Acclimatization, Clarias gariepinus, Temperature, Bowls

Introduction: Water is the habitat of fish and other aquatic organisms. It is the medium in which they carry out their life functions such as feeding, swimming, breeding, digestion and excretion (Okokotu and Nwachi, 2014); Bronmark & Hansson, 2005; Adewumi & Olaleye, 2011) and its access to adequate, regular and constant supply of good quality water is vital in any aquaculture project. According to Sikoki & Veen (2004), any water body is a potential medium for the production of aquatic organisms. Water quality parameters can be divided into three main categories: physical (density, temperature); chemical (pH, conductivity, nutrients) and biological (bacteria, plankton and parasites) (Wokoma and Njoku, 2017). All living organisms have tolerable limits of water quality values in which they perform optimally (Marium, chantha, Naz, Khan, Safdar, and Ashaf, 2023); Nyong, &Nweze, 2012). A sharp drop or increase within these limits have adverse effects on their body functions.

Water quality is one of the most critical factor besides good feed/feeding in fish production. It is not constant but varies with the time of the day, season, weather conditions, water source, soil type, temperature, stocking density, feeding rate and culture systems. For a successful aquaculture venture, the dynamics and management of water quality in culture media must be taken into consideration.

A report by FAO, (2016) ; Nyong, &Nweze, 2012).; showed that aquaculture continues to grow more rapidly than all other animal food-producing sectors in the world and unlike terrestrial farming, where the largest part of the production is on the basis of a limited number of species. Aquaculture produces more than 220 species (FAO, 2012; Abduleaheem *et al*. 2018; Ajani, Dawodu and Bello-olusoji, 2011). The importance of fish farming aspect of aquaculture cannot be overemphasized as this art has provided about 40% of the dietary intake of animal protein and constitutes a third of the world's supply of fish products which is lower in total fat and calories compared to meat or poultry, hence a healthy protein choice (El-Sayed and El-Ghobasshy,2011). Neuman, (2004); Nyong, and Nweze, 2012). and Abdulraheem *et al*., (2018) reported that, fish culture is one of the promising resources of animal proteins for the future.

Earthen pond culture system has been the method of fish culture in Nigeria but recently, tank culture system is gaining grounds as lands become costly and scarce (Abdulraheem, Adeosun, Bamidle, Idi-ogede, Onimisi and Okoche, 2018); Nyong, and Bassey.2019) . There is need therefore, to maximize the available land to have maximum control over the fish production. Fish culture with particular reference to *Clarias gariepinus* has become an important sector in terms of contribution to food and incomes (White, 2013; Eriegha and Ekokotu, 2017).

The understanding of the physical and chemical qualities of water is critical to successful aquaculture. According to Ajana, Adekoya, Agankanuwo.; Nyong, and Bassey.2019) ;(2006); Marium *et al*. (2023), water determines the success or failure of an aquaculture operation to a greater extent. Natural self-cleaning mechanism of the water bodies helps in keeping water quality at desired level for better performance of fish. However, under culture, effort has to be made continually by maintaining adequate water quality for better growth performance of the fish. Aeration is one method commonly used to improve dissolved oxygen (Torrans and Steeby, 2008). However, it has been expensive and not easily gotten by local fish farmers in the rural areas since that is where many fish farmers are found. Therefore, determining the best renewal day in one per week in *Clarias gariepinus* rearing will increase the fish production.

Materals and Methods: The study was carried out in the Hatchery Unit of Biological Sciences Department, Federal University Wukari, Taraba State**.** One hundred and eighty African catfish *Clarias gariepinus* fingerlings were procured from commercial farm, Gboko, Benue State. They were transported early in the morning inside 50litre container with perforated opening close to the handle. In the hatchery, they were released inside a 100 Liters bowls with similar temperature which prevented shocking. The bowl was covered with net tied to the opening to prevent jump out. They were allowed to acclimatized for two weeks and were fed with commercial feed Copen.

Four treatments consist of two (2) replicates each giving a total of twelve (12) bowls were used. After acclimatization, 15 fish each were randomly distributed in the treatment bowls of 60 liters of water in all the treatments. The Treatment (1) Renewal of water after 2 days; Treatment (2) 4; Treatment (3) 6 and Treatment (4) 8 days (control). The African Catfish *C. gariepinus* fingerlings in the hatchery were fed twice daily at 700 hours in the morning and 1600hours in the evening. The effectiveness of water renewal was determined for each experimental set up. The water quality parameters measured were Temperature, pH, CO_2, conductivity and Dissolved oxygen in rearing *C. gariepinus.*

Data were recorded every renewal day. The weight was determined with an electronic scale of model KERN 572. The water levels were reduced to ¾ in each bowls. The live fish were then swept in hand net. They were separately placed on the scale and the readings for weight were recorded. They were then placed in measuring board graduated in centimeters for length. Temperature and dissolved oxygen were measured in situ, with a WTM, OxiCal – SL portable electronic probe. The water pH was also measured with Suntex model SP-701 pH meter. Data were then subjected to one-way analysis of variance (ANOVA) and the Statistical Package for Social Sciences (SPSS) version 22 was used for the analysis.

Results: The result of some physicochemical parameters of the water is shown in Table 1. The highest temperature was noted in treatment 3 (31.67±0.33ºC) followed by treatment 4(30.63±0.33) while treatments 1 and 2 were the lowest with 30.33±0.33 each and there was no significant ($p>0.05$) difference in all the treatments. The highest dissolved oxygen concentration (5.00±.00 mg/L) was observed in treatment 1 and 3 followed by treatment 2 with

4.00±0.00 while the lowest of 3.67±0.00 was recorded in treatment 4 and there was also no significant (p>0.05) difference in all the treatments. Treatments 3 had the highest pH of 7.67±0.17 followed by treatment 1 (7.5±0.00). Treatment 4 (7.33±0.17) was the next while treatment 2 (6.83±0.33) was the lowest and there was no significant difference (P>0.05) in all the treatments. Ammonia (µmol/L) was highest in treatments 2, 3 and 4 with 5.00±0.00 each while the lowest was observed in treatment 1 (1.00±0.58). There was no significant difference (p>0.05) between treatments 2, 3 and 4 but there was between treatment 1 and the other treatments.

Table 1; water quality parameters of experimental medium of *C. gariepinus* for period of the work

Some Water quality parameters	T1	T2	T3	T4
Temperature(°c)	**30.33±0.33**	**30.33±0.33**	**31.67±0.33**	**30.67±0.33**
pH	**7.50±0.00**	**6.83±0.33**	**7.67±0.17**	**7.33±0.17**
Dissolved oxygen(g/L)	**5.00±.33**	**4.00±0.00**	**5.000±.00**	**3.67±0.00**
Ammonia (µmol/L)	**1.00±0.58**	**5.00±0.00**	**5.000±.00**	**5.00±0.00**
CO2 (pmm)	**20.5±0.35**	**21.00.3±2**	**21±3 0.22**	**19.6 ±0.22**
Conductivity(S/m)	**23 ± 0.01**	**0.25± 0.00**	**0.24 ± 0.03**	**0. 31 ± 0.01**

Key; T **=** Treatment**,** T1 = 2 days, T2 = 4days, T3 = 6days, T4 = 8days

Growth Performance: The result of mean growth performance indices of *C. gariepinus* fingerlings exposed to different treatments was presented in Table 2. The highest value of total length was observed in treatment 3 (25.47±15.92), standard length in treatment 4 (08.64±01.30), weight gain in treatment 3(49.33±1.45), and percentage weight gain in treatment 3(34.01±17.38). while those exposed to treatment 2 had the lowest mean total length (9.32+01.07), then treatment 1 had the lowest mean standard length (7.60.1.18) and mean weight in 4 (026.00±11.47). The fingerlings reared in treatment 4 had the lowest mean percentage weight gain (31.86+17.74). The mean specific growth rate was highest in treatment 4 (0.8420±0.21) and the lowest was in treatment 1(00.06±00.05) and they were all significantly (p<0.05) different from each other. The highest mean survival rate was in treatment 1 (64.67±3.76, followed by T2, T3 and T4 in descending order. This could have been because of the decreases in dissolved oxygen'

Table 2; Showing Mean Total, Standard length, Weight gain, Percentage weight gain and

Specific Growth Rate of *Clarias gariepinus*

Indices of growth performance	T1	T2	T3	T4
Total length (cm)	**09.580±1.88**	**09.32±01.07**	**25.47±15.92**	**09.72±01.13**
Standard length (cm)	**07.600±1.18**	**08.26±01.06**	**008.40±01.12**	**08.64±01.30**
Weight gain (kg)	**36.00±2.51**	**42.33±1.67**	**49.33±1.45**	**42.67±5.36**
Percentage weight gain (%)	**32.87±17.20**	**33.361±7.24**	**34.01±17.38**	**31.86±17.74**
Survival rate (%)	**64.67±3.76**	**62.33±8.09**	**61.33±5.24**	**58.34±3.76**
Specific growth rate (%)	**00.06±00.05**	**00.07±00.03**	**00.36±00.02**	**0.842±0.21**

Key; T = Treatment

Discussion

This study revealed that increasing in changing of water when rearing *C. gariepinus* fingerlings could increase the amount of Dissolved Oxygen Concentration and decrease the amount of ammonia, temperature and pH of the water. It is in line with the work of Dauda , A.B., Ajadi, Salele, Ikpe, Basir, Oladapo, and Pelebe (22023). This process may occur in nature by flow through water falls, rapids and photosynthesis by aquatic plants (Sidell and Brien, 2006). Although the highest water temperature (31.67 ºC) still fell within the range of 22 - 35 ºC tolerated for optimum fish growth in the tropics (Collins and Watson, 2020). The lower value of dissolved oxygen concentration available to the controlled fingerlings during the study indicated that lack of water aeration might reduce the dissolved oxygen concentration in the controlled fingerlings. To support the above submission, it was documented that aeration will always increase levels of dissolved oxygen because it helps to oxidize ammonia to nitrates and reduce the build-up of carbon dioxide (www.ag.auburn.edu/fish). Although, the dissolved oxygen concentration of 4.00±0.47 mg/L consumed by the controlled fingerlings was within the range of 3-5 mg/L for fry, fingerlings and adults as reported by Food Agriculture Organization (FAO, 2016). The findings of this study showed that ammonia concentration was not influenced by water aeration. Although, the ammonia concentration of 0.26±0.05 to 0.28±0.05 mg/L were within the range of 0.01-1.55 mg L for fresh water fingerlings as documented by Zhou and Boy (2015). This could be attributed to daily removal of left over feed and fecal samples from experimental tanks. Thus, preventing or reducing the risk of buildup of ammonia from all the treatments (Ayanwale *et al*., 2014). Similarly, water pH was also not influenced by water aeration. The changes in water pH values (range = 7.28±0.34 to 758±0.49) from all the treatments were within the tolerance range of 6-8 documented for juvenile of *H. bidorsalis* and *C. gariepinus* (Ayanwale, Tsadu, Lami, Falusi and Baba, 2014). The biochemical oxygen demand of the controlled fingerlings (0.95±0.54 mg/L) was below the acceptable range of 1-5 mg/L recommended for fish growth in the tropics. This submission also agreed with the findings of Ayanwale *et al*. (2014) who reported that daily removal of left over feed and fecal samples from experimental tanks might reduce the bacterial load of the non-aerated water. The study also indicated that total and standard lengths of the *C. gariepinus* fingerlings were not influenced by water aeration from 0-12 h. This is an indication that fish (*Heteroclarias* fingerlings) could regulate their metabolic rate (growth rate) over a range of 3-5 mg/L of dissolved oxygen concentration and will not affect its physiological or metabolic activity (FAO, 2018).

The significant lower values of total and standard lengths of the *C. gariepinus* fingerlings exposed to 2 days of water change may be attributed to the works of fish constantly disturbed by early water change, had lesser growth performance compared to those raised in water that was renewed every 5 days and 7 days. This is likely because of continuous interference with the dynamics of the pond system on a daily basis as a result of frequent disturbance of the water surface FAO (2017), who documented that laboratory studies showed that the expected minimal levels of DO are not lethal but reduced growth rate and activity of the fish. The significant increase in the indices of growth performance except Specific Growth Rate (SGR) of the fingerlings exposed to treatment 4 of water change were in conformity with the works of Okomoda *et al*. (2016); Jambo *et al*. (2015) and Ustundag and Ferit (2015) but were not in conformity with the work of Dauda *et al*. (2023). They reported that fingerlings expressed high appetite when exposed to oxygen saturation. Their feeding action toward feeds and its utilization as well as unstressed environment ultimately lead to better growth performance indices. However, renewing water every eight days gave the fingerlings enough time to recover and resume active feeding, leading to better SGR (0.842±0.21). Reducing the time of water change to two days and beyond also negatively affected growth performance (0.06±0.02), basically due to frequent disturbance especially temperature could deteriorate their metabolic activities.

Conclusion: The study clearly demonstrates that water qualities and frequency of water renewal have effect on growth performance of African catfish fingerlings. The study revealed that increang frequency of water change in the rearing of *C. gariepinus* fingerlings could increase the amount of Dissolved Oxygen Concentration and ammonia and decrease the temperature and pH of the water.

Recommendations;Water should be renewed within 4 to 6 days and quantity of feed should be weighed in respect to the weight of the fish before administering (Weight –feed relationship should be calculated).

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