

THE EFFECT OF LIGHT AND DARK EXPOSURE ON GROWTH RESPONSE OF *Clarias gariepinus* FINGERLINGS REARED IN GLASS AQUARIA.

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ABSTRACT.

The study was carried out to determine the effect of light and dark exposures on the growth response of *Clarias gariepinus* fingerlings. A total of 120 four-week old *Clarias gariepinus* fingerlings (mean weight $0.52g \pm 0.02$) were stocked into 20 litres of bore-hole water in glass aquarium (60x30x30) cm. Complete light, dark and normal photoperiods were the experimental conditions evaluated. Growth indices such as mean weight gain and mean increase in standard lengths were significantly ($p < 0.05$) highest in the dark exposure with the following values respectively: ($4.19 \pm 0.02g$) and ($4.11 \pm 0.19cm$). Also, percentage survival (82.5%) in the dark exposure was higher than light and control (45% and 70% respectively). Light exposure had higher cannibalism rate (42.5%) than the dark and control (0% and 5% respectively). Deep shiny black skin colouration was observed among the fingerlings in the dark exposure, while those in the light and control experimental conditions exhibited lighter and normal skin colourations respectively. The experimental conditions were not influenced by the water quality parameters (mean pH: 8 ± 0.1 and temp: $28.1 \pm 0.60^\circ c$) since their values were within the tolerable limit for fish culture throughout the 42 days experimental period.

INTRODUCTION

World fish production from Fisheries and Aquaculture is currently at record level (FAO, 2002). Fish products are very important for food security, providing more than 15% of total animal protein supplies (FAO, 2002). The catfish, for instance, offers great promise for aquaculture exploitation because of its omnivorous feeding habits, sedentary lifestyle, air-breathing habit, favourable food conversion, high resistance to diseases, relatively low requirements for water quality, the possibility for high stocking density, yield of about 55% quality meat of its body weight, and good market potential (Appelbaum and McGeer, 1998). Among the catfish species that have been cultured with success is *Clarias gariepinus*. However, the rearing of *Clarias gariepinus* fingerlings is still faced with several problems. For instance, the fingerlings exhibit strong cannibalism, which results in low survival rate and overall growth performance. According to previous reports, *Clarias gariepinus* larvae and fingerlings show unusual behaviour. They have the ability to feed under dark condition and can be reared under dim light or dark conditions (Hossain *et al.*, 1998, Appelbaum and Kamler, 2000), indicating that their behaviour must be dependent on sensory organs other than the eye. Environmental conditions can affect feed intake, growth and water quality. Factors, such as photoperiod and light intensity, may be important in this context. Fish can behave in a variety of ways under different conditions and on time of day. There is paucity of information on growth response of *Clarias gariepinus* fingerlings reared under total dark and light conditions respectively. Therefore, the objective of this paper is to study the growth response of *Clarias gariepinus* fingerlings reared under 24-hour light and 24-hour dark experimental conditions.

Materials and Methods

200 four-week old *Clarias gariepinus* fingerlings were sourced from the hatchery unit of Federal College of Freshwater fisheries Technology, Baga, Maiduguri Borno state. They were acclimatized for a period of seven days, during which they were fed twice daily ad-libitum. Two experimental conditions of total light (24 hours photoperiods) using a Land lite 14watt model of fluorescent bulb and a total dark(00hours

photoperiods) in a total dark room with a control (no influence on photoperiod) was set up using glass aquaria tanks of dimension 60 x30 x30 cm. The experimental conditions including the control were set up in replicates, thus making a total of six (6) aquaria used for the experiment. A total of 120 fingerlings of *Clarias gariepinus* fingerlings were selected at random from the acclimatized population and stocked at 20 fingerlings per aquarium containing 20 litres of bore-hole water. Prior to the stocking, biometric parameters like total length, standard length and body weight were measured using standard measuring ruler and a digital weighing balance (Mettler Toledo AB54) respectively. Feeding was done daily at 5% body weight in two instalments with 0.8-1.2mm pellet size commercial fish feed (Coppens). The fish were fed at 08.00hrs and 17.00hrs. Aeration was ensured throughout the period of the experiment using aerator (Blagdon Koi Air KA50) and air stones in each aquarium. Samplings were done fortnightly to determine the growth response of the fingerlings. Water quality parameters like pH and temperature were measured using pH meter (Model Tashmel and Tashmel USA) and mercury in-glass thermometer respectively. The experiment lasted for forty-two days (42 days).

Variations in the data generated from parameters in the various experimental conditions were evaluated using Analysis of variance (ANOVA) at 95% probability level, while Duncan New multiple Range Test (DNMRT) was employed to ascertain the difference between means of parameter with significant difference using SPSS version 16.0.

Results and Discussion.

Colour Observation

During the experimental period, it was observed that there was colour variation on the test organisms according to experimental conditions. The fishes in the dark condition were observed to have shiny deep dark colouration in contrast with the fishes in the light condition with lighter colouration. The fishes in the control had normal colouration. This colour variation became more prominent in the third week of the study.

The result of physicochemical water quality parameters such as temperature and pH were given in Table 1. The ranges of values of the physico-chemical parameters during the experimental period were as follows: pH 7.9 -8.1 and temperature 27.5 – 28.2 °C. Mean temperature and pH were found to be unaffected by the experimental conditions. The recorded mean values of all these parameters were within the acceptable limits for fish growth and health (Boyd 1979; Mazik *et al.* 1991). The result on Table 2 shows that the mean cannibalism rate was highest in the Light condition (42.5%) as compared to the control and dark condition with 5% and 0% respectively. The mean survival rate was found to be highest in the dark experimental condition (82.5%) and was closely followed by the control and light conditions with 70% and 45% respectively. 25% mortality rate was recorded as the highest for the control, while 17.5% and 12.5% were recorded for dark and light experimental conditions respectively. The highest mean weight gain (table 3), was observed in the dark condition (4.18g) with 0.53g and 4.71g for the mean initial and final weights respectively. This was followed by the mean weight gain of the control (2.46g) and the light condition (2.37g) with 0.54g and 3.00g as well as 0.50g and 2.87g as the mean initial stocking weight and mean final weight for the dark and light conditions respectively.

Table 1: Mean water quality values

Experimental condition	Temp/°c	pH
Total Light	28.2 ± 1.56	8.0 ± 0.00
Total Dark	27.5 ± 0.28	8.1 ± 0.00
Control	28.7 ± 0.57	7.9 ± 0.07

Table 3 indicated that the dark condition had the highest mean increase in standard length (4.1cm) and mean increase in the total length (4.49cm) with 1.65cm, 5.68cm and 1.88cm, 6.37cm as the corresponding mean initial and final standard length and mean initial and final total length respectively. This was followed by the control with mean increase in standard length of 4.00cm and means increase in total length of 4.54cm with 1.6cm, 5.6cm and 1.88cm, 6.42cm as the corresponding mean initial and final standard length and mean initial and final total length respectively. The light condition recorded the least value of 3.58cm, with 1.68cm and 5.26cm as the corresponding values for mean increase in standard length mean initial and final total length respectively. 1.88cm, 6.19cm and 4.31cm were recorded as mean values for initial, final total length and increase in total length respectively.

Table 2: Survival, mortality and cannibalism rates of *Clarias gariepinus* fingerlings reared under different photo conditions.

Experimental condition	Survival rate (%)	Mortality rate (%)	Cannibalism rate (%)
Total Light	45	12.5	42.5
Total Dark	82.5	17.5	0
Control	70	25	5

Previous studies also have shown that *Clarias gariepinus* larvae, juvenile and fingerlings can be reared under continuous dark conditions and survival rates under dark condition are better than continuous light or alternating light and dark conditions. (Adewolu, *et al.* 2008 and Almazan- Renda *et al.* 2008). The result of this present work is in coherence with this finding. Britz and Pienaar (1992) also demonstrated that the activity of *Clarias gariepinus* larvae and juvenile under dark condition is higher than under light condition. This study revealed that, the activity of *Clarias gariepinus* fingerlings in the dark condition increased, consequently resulting into reduced cannibalism rate as opposed to the situation in light and control conditions. Dada (2009), also reported that fry of *Clarias gariepinus* reared in a dark vessel had the highest survival rate and growth performance, this is also in consonance with the result of this present study.

Table 3: Weight gain of *Clarias gariepinus* fingerling reared under different experimental photo conditions.

Experimental condition	Mean initial stocking Wt. (g)	Mean final stocking Wt. (g)	Mean weight gain (g)
Total Light	0.50 ± 0.02 ^b	2.87 ± 0.02 ^c	2.37 ± 0.06 ^c
Total Dark	0.55 ± 0.06 ^a	4.74 ± 0.06 ^a	4.19 ± 0.02 ^a
Control	0.56 ± 0.06 ^a	3.07 ± 0.06 ^b	2.51 ± 0.07 ^b

Means with same superscript on the same column are not different significantly (p > 0.05)

Table 4: Increase in length of *Clarias gariepinus* reared under varied experimental photo conditions.

Experimental condition	Mean initial total length (cm)	Mean final total length (cm)	Mean increase in total length (cm)	Mean initial Standard length (cm)	Mean final standard length (cm)	Mean increase in standard length (cm)
Total Light	1.88 ± 0.06 ^a	6.19±0.02 ^c	4.30±0.01 ^c	1.68± 0.01 ^a	5.24±0.21 ^b	3.55 ± 0.02 ^b
Total Dark	1.88 ± 0.06 ^a	6.37±0.01 ^b	4.48±0.06 ^b	1.62± 0.05 ^a	5.73± 0.13 ^a	4.11 ± 0.19 ^a
Control	1.88 ± 0.00 ^a	6.45±0.05 ^a	4.57±0.05 ^a	1.64± 0.01 ^a	5.66± 0.06 ^a	4.02 ± 0.10 ^a

Means with same superscript on the same column are not different significantly ($p > 0.05$)

The result of this present study showed that the reduced fingerlings activity under light condition made the fingerlings to be more pre-disposed to cannibalism. The best growth performance which was recorded under the dark condition can be primarily attributed to the fact that the fingerlings are nocturnally active and therefore prefer dark environment to that where there is high light intensity. The data presented here, therefore, suggest that *Clarias gariepinus* fingerlings can be reared successfully under continuous dark condition, since high survival rate and decreased rate of cannibalism is a key factor towards ensuring a successful and profitable aquaculture.

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