CARD International Journal of Agricultural Research and Food Production (IJARFP)
ISSN: 2536-7293 (Print): 2536-7307 (Online)
Volume 2, Number 2, June 2017
http://www.casirmediapublishing.com

Comparative Growth Performance of two Strains of African Sharptooth Catfish, *Clarias gariepinus* (normally Pigmented and Albino) fed Commercial Catfish Diets in Collapsible Tarpaulin Tanks

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ABSTRACT

This study compared growth performance of two strains (normally pigmented and albino) of African sharptooth catfish, *Clarias gariepinus* fed commercial diets in collapsible tarpaulin tanks. Fingerlings were stocked at 20 fish per m^2 and replicated three times for the normally pigmented and albino *C. gariepinus*. The fish were fed twice daily at 6% body weight, and the culture period lasted 20 weeks (140 days). Results showed significant differences in crude protein, nitrogen free extract and ash levels between the normally pigmented and albino *C. gariepinus* ($p<0.05$). However, crude lipid, fibre and energy deposits in the tissues of both strains of *C. gariepinus* exhibited no significant differences ($p>0.05$). Mean length gain, mean weight gain and mean growth rate were significantly different ($p<0.05$) in both the normally pigmented and albino *C. gariepinus*. Specific growth rate and survival rate were insignificantly different ($p>0.05$) between normally pigmented and albino *C. gariepinus*. Feed utilization results showed significant difference ($p<0.05$) in feed consumed, protein consumed and protein productive value between the normally pigmented and albino *C. gariepinus*. However, feed conversion ratio, feed conversion efficiency and protein efficiency ratio were insignificantly different ($p>0.05$) between both strains of *C. gariepinus*. The growth performance (mean weight gain) of the normally pigmented strain was better compared to that of the albino. The albino strain can still grow to be used as food fish as well as its being a good ornamental choice.
Keywords: normally pigmented, albino, growth performance, *Clarias gariepinus*

INTRODUCTION

Fish is the cheapest source of animal protein consumed by the average Nigerian accounting for about 40% of the total protein intake. [1]World per capita fish consumption had risen from 9.9 kg in 1960s and 14.4 kg in 1990s to 20 kg of animal protein intake in 2014.[2] The dwindling fish supplies from the wild has made aquaculture a very popular alternative source of table fish. The vigorous growth in aquaculture, which according to FAO (2016) now provides half of all fish for human consumption, isattributed to improvement in the state of the fish stock and fisheries management.[2]According to the report, aquaculture marginally supplied 7% of fish for human consumption in 1974, which increased to 26% in 1994, and 39% in 2004 but in 2014 the total contribution of aquaculture to total global fish production rose to 44.1%.

The main goal of the aquaculture value chain is to optimise growth and to produce fish of high quality.[3]Fish farmers have the desire to produce table-sized fish within the shortest possible time[4][5] thus, the choice of species to culture is critical in the realization of this goal. In Africa, especially Nigeria, the species most cultured are *Clarias gariepinus, Heterobranchu sp.* and their hybrids.[6]They are widely cultured owing to their high market prices, fast growth rate ability to withstand adverse pond conditions especially low oxygen content, and disease resistant.[7][8]

The African sharptooth catfish is a dominant freshwater fish, large and eel-like. The body colouration usually varies from black to light brown, often marbled in shades of olive green and grey; under parts of the head and abdomen are pale cream to white.[9][10]A departure from this normal colouration is found in the albino. Albinism is the lack of body and eye pigmentation due to the absence of melanin in chromatophores and has been observed in many species.[11][12][13][14][15][16]The inability of or absence of certain genes that specify the production of the dark pigment melanin in skin cells is believed to cause albinism.[17] In most fishes, the absence of colour is linked to mutations in the genes of the tyrosinase family, with attendant melanin deficiency in the skin of albinos, and impairment of eye development.[18] The distinctive appearance has made them of interest for commercial aquaculture,[13] aquarium breeding and genetic studies as well.[19] Total or partial albinism has been reported in over

20 species of teleosts globally.[20] Albino strain had also been noted in *Clarias gariepinus*.[21] Preliminary investigation into comparative growth performance of the normal pigmented and the albino *C. gariepinus* so far was limited to the fry and fingerlings stages. This present work aimed at assessing the growth performance and feed utilisation of normal pigmented and albino *Clarias gariepinus* from the fingerling to the advanced juvenile stage in collapsible tarpaulin tanks.

MATERIALS AND METHODS

Study Area

The experiment was conducted in Saekufr Fish Farm located at Obio Nsit, Nsit Ibom Local Government Area, Akwa Ibom State, Nigeria. The study lasted 20 weeks (140 days) using 6 collapsible tarpaulin tanks of 1m x 1m x 1m.

Collection and Stocking of Experimental Fish

Fingerlings of normally pigmented *Clarias gariepinus* and albino *C. gariepinus* were obtained from the fish hatchery of Institute of Oceanography, University of Calabar, Cross River State, Nigeria. They were brought in two 50 litres Jerry cans to the study area. The fingerlings were produced on the same day and were obtained at four (4) weeks old. At the experimental site, they were fully acclimated in two separate 1m x 1m x 1m collapsible tarpaulin tanks for two weeks. During this period, they were fed twice daily with 1.2 mm – 1.5 mm starter commercial fish feed (coppens) containing 50% crude protein.

Experimental Procedure

Twenty (20) fingerlings of each type of fish were randomly assigned to a separate 1m x 1m x 1m collapsible tarpaulin vat. Water volume was maintained at 0.6 M^3 throughout the experiment. The stocking rate was 20 fish per m^2. There were three replicates for the normal pigmented *C. gariepinus* and the same for the albino *C. gariepinus*. The weights of fish in each replication of the two treatments were taken with Mettler Toledo (Model PB602) weighing balance (0.01g) and individual length taken with a measuring board. Initial mean weight and total length was 0.53g and 0.82cm for normally pigmented and 0.8g and 1.23cm for albino *C. gariepinus* respectively were used at the start of the study. Water volume was maintained at 0.6 M^3 throughout the experiment. Ten fingerlings of each strain of *C. gariepinus* were collected for proximate analysis at the beginning of the experiment.

Routine Feeding and Measurement

The fish in each tank were fed with commercial feed (Multi feed) at 6% body weight per day in two rations given at 7.00-8.00 hours and 18.00-19.00 hours. The fish were fed six (6) days weekly, no feeding was done on the days of weighing. Weighing of the fish and length measurement were conducted fortnightly, number of fish in each tank noted and the quantity of feed to be given to each replication over the following fortnight was adjusted to 6% of the new biomass.

Water Quality Management

Each tank was filled to about 60% capacity (60cm depth). About three quarter of water in each tank was changed every seven days except on the day of weighing when the water was completely drained. Dissolved oxygen, pH and temperature of water in all the tanks were monitored weekly using Hanna multi parameter kit (Model HI9828)

Data Collection

At the end of the experiment, the weight, length and the number of fish in each tank were ascertained and recorded. One fish from each replication of treatment was picked and subjected to proximate analysis using the official method of the AOAC (2005).[22] Growth performance and feed utilization indices and survival rates were determined using the following formulae:

Growth Performance Indices

Weight gain (g): [23]

Weight gain $= W_2 - W_1$

Where;

W_2 = Final weight

W_1 = Initial weight

Mean Growth Rate (MGR): [24]

$$MGR = \frac{W2 - W1}{0.5\,(W1 + W2)} \times \frac{100/t}{1}$$

Where;

W_2 = Final weight

W_1 = Initial weight

t = Feeding period

Specific Growth Rate (SGR): [25]

$$SGR = \frac{100\ \times InW2 - InW1}{Rearing\ period\ in\ days}$$

Where;

In W_2 = Natural Logarithm of final weight

In W_1 = Natural Logarithm of initial weight

Survival Rate (SR): [26]

$$SR = \frac{Total\ no.of\ fish\ harvested}{Total\ no.of\ fish\ stocked} \times 100$$

Feed utilization indices

Feed Conversion Efficiency (FCE): [27]

$$FCE = \frac{Weight\ gain}{Feed\ intake} \times \frac{100}{1}$$

Feed Conversion Ratio: (FCR): [28]

$$FCR = \frac{Feed\ intake\ (g)}{Weight\ gain\ (g)}$$

Protein Efficiency Ratio (PER): [29]

$$PER = \frac{Weight\ gaing}{Protein\ intake\ (g)}$$

Where, Protein intake

$$Protein\ intake = \frac{\%\ protein\ in\ feed\ \times total\ diet\ conusumed}{100}$$

Protein Productive Value (PPV):[30]

$$PPV = \frac{100\ \times protein\ gain\ (g)}{protein\ intake\ (g)}$$

Statistical Analysis

The data obtained during the experiment were analysed with a t-test to compare the means for significant difference ($P<0.05$). The Social

Science Package for Social Sciences (SPSS) version 16.0 was used for the analysis.

RESULTS

Water Quality Analysis during the Study

The mean physico-chemical indices of water during the culture period are presented in Table 1. Results show that dissolved oxygen, pH and temperature values were fairly constant throughout the experimental period. There was no significant difference ($p<0.05$) in water quality parameters for both normally pigmented and albino *Clarias gariepinus*.

Table 1: Mean water quality parameters during the study for pigmented and albino *C. gariepinus*

Parameters	DO (mg/l) (Means ± SE)	pH (Means ± SE)	Temperature (Means ± SE)
Pigmented *C. gariepinus*	8.30 ± 0.03^a	7.30 ± 0.06^a	25.90 ± 0.12^a
Albino *C. gariepinus*	8.33 ± 0.05^a	7.40 ± 0.06^a	25.91 ± 0.11^a

Means with same superscripts along the column are insignificantly different ($p>0.05$)

Body Composition of normally Pigmented and Albino *C. gariepinus*

Table 2 presents the body composition of normally pigmented and albino *C. gariepinus* during the study. Great differences were obtained in the mean percentage tissue compositions between the initial and final values in both the normal pigmented and albino *C. gariepinus*. Significant differences were obtained in the means of crude protein, nitrogen free extract and ash levels between the pigmented and albino *C. gariepinus* ($p<0.05$). Mean values of crude lipid, fibre and energy deposits in the tissues of both strains of *C. gariepinus* however exhibited no significant differences ($p>0.05$).

Table 2: Mean proximate composition of carcass of normally pigmented and albino *C. Gariepinus* during the study

Parameters	Normally pigmented (%)	Albino (%)
Crude protein	49.75 ± 0.65[a]	47.58 ± 0.20[b]
Crude lipid	13.41 ± 0.67[a]	13.33 ± 0.23[a]
Crude fibre	9.79 ± 0.09[a]	8.95 ± 0.31[a]
Nitrogen free extract (NFE)	11.46 ± 0.18[b]	17.18 ± 0.07[a]
Ash	14.4 ± 0.07[a]	12.82 ± 0.17[b]
Energy value (kcal)	365.55 ± 8.46[a]	378.95 ± 3.00[a]

Means with different superscripts along the row are significantly different (p<0.05)

Growth Response of normally Pigmented and Albino *C. gariepinus*

The growth performance and survival rate of both pigmented and albino *C. gariepinus* were assessed in the basis of the indicators shown in Table 3. Fig. 1 shows the biweekly cumulative weight gain during the culture period. The results showed that mean length gain (MLG), mean weight gain (MWG) and mean growth rate (MGR) were significant different ($p<0.05$) in both the normal pigmented *C. gariepinus* and albino *C. gariepinus*. The performances of the normal pigmented were generally superior to those obtained in the albino strain. Similarly, though, the values of specific growth rate (SGR) and mean survival rate (SR) were nominally higher in normal pigmented C. gariepinus than in albino C. gariepinus but were insignificantly different ($p>0.05$).

Table 3: Mean growth performance of normally pigmented and albino *C.gariepinus* during the study

Parameters	Normally pigmented (Mean ± SE)	Albino (Mean ± SE)
Initial total length (cm)	0.82	1.23
Final total length (cm)	28.41	23.55
Mean length gain (cm)	27.59 ± 0.60[a]	22.32 ± 0.31[b]
Initial body weight (g)	0.53	0.8
Final body weight (g)	182.79	107.45
Mean weight gain (g)	182.26 ± 6.0[a]	106.65 ±11.04[b]
Mean growth rate (%/day)	1.42 ±0.0[a]	1.4 ±0.03[b]
Specific growth rate (%/day)	0.04 ± 0.0[a]	0.04 ± 0.03[a]
Survival rate (%)	90 ± 2.89[a]	85 ± 0.0[a]

Means with different superscripts along the row are significantly different (p<0.05)

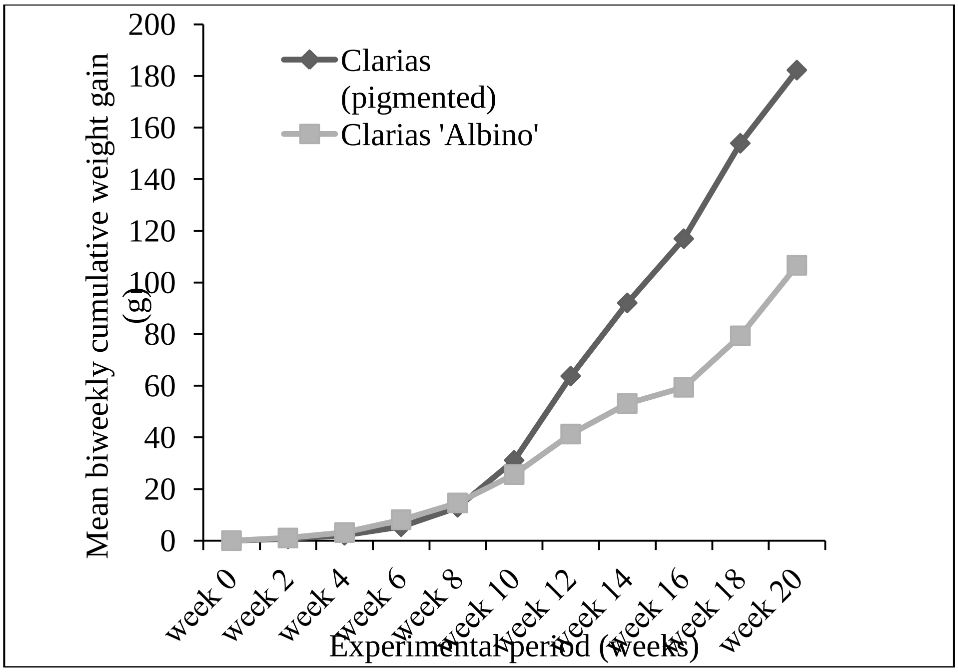

Figure 1: Mean biweekly cumulative weight gain of normally pigmented and albino *C. gariepinus* during the study

Feed Utilisation of normally Pigmented and Albino *C. gariepinus*

Table 4 shows the feed utilization of normally pigmented and albino *C. gariepinus* during the study. The results showed that the pigmented *C. gariepinus* consumed more food and consequently more protein as compared to the albino. The quantity of food and protein consumed were significantly different ($p<0.05$). However, the albino *C. gariepinus* seemed to have utilised the food and protein consumed marginally more efficiently than the normal pigmented strain hence, better nominal values of feed conversion ratio (FCR), feed conversion ratio (FCE), protein efficiency ratio (PER), and protein productive value (PPV). However only the PPV values showed significant difference ($p<0.05$) in the two strains of *C. gariepinus*.

Table 4: Mean feed utilization of normally pigmented and albino *C. gariepinus* during the study

Parameter	Normally pigmented (Mean ± SE)	Albino (Mean ± SE)
Feed consumed	205.76 ± 4.17^{a}	110.11 ± 2.16^{b}
Protein consumed	82.71 ± 1.68^{a}	44.75 ± 0.87^{b}
Feed conversion ratio (FCR)	1.13 ± 1.18^{a}	1.06 ± 0.10^{a}
Feed conversion efficiency (FCE)	88.7 ± 0.02^{a}	97 ± 10.02^{a}
Protein efficiency ratio (PER)	2.2 ± 0.03^{a}	2.38 ± 0.25^{a}
Protein productive value (PPV)	28.43 ± 1.14^{b}	53.46 ± 1.10^{a}

Means with different superscripts along the row are significantly different (p<0.05)

DISCUSSION

The physico-chemical property of water is very essential for the survival and growth performance of the cultured species hence its proper regulation is a key determinant of success in aquacultural enterprise. The mean water quality indices during the conduct of this experiment were within the ambient of safety for warm water fishes.[31] Following the outbreak of harmattan, the water temperatures between December and early January were very low thus affecting feed intake and growth performance of the fish in both treatments. Aksungur *et al;* (2007) reported a similar decline in feed intake and growth performance in turbot, *Psetta maxima.* [32]Mortalities that operated between the normally pigmented and albino *Clarias gariepinus* in this experiment did not differ significantly ($p>0.05$).

Growth performance is an inherent characteristic (a genetic trait) of a species or strain which could be moderated by the environmental variables, farming conditions, and food availability.[32]It is a very desirable trait in aquaculture as noted by Samad *et al.* (2005) that fish size and production determine the price of fish, which in turn depends on the growth.[33] Solomon and Taruwa (2011) also noted that the objective of fish farming is to obtain maximum increase in weight of fish/unit area with specific level of management.[34] The mean weight gain and mean length gain obtained in normal pigmented *C. Gariepinus* were higher than those obtained in the albino *C. gariepinus,* and were significantly different($p<0.05$). The mean weight obtained in this work for normal pigmented *C. Gariepinus* was similar to that obtained in the same species by Adams *et al;* (2014)[35] after 16 weeks culture period. The growth superiority of albino *C. Gariepinus* over normal pigmented *C. gariepinus* reported by Onyia *et al.* (2016) was found to be true till the end of the eight week of this study, after which the pattern of growth reversed (Fig. 1).[21] Onyia *et al.* (2016)[21] however worked on the fry terminating at early fingerling stage. The extraordinary mean growth performance of the normal pigmented strain from the tenth week(i.e. 16thweek of age) was similar to the observations made on rainbow trout, *Oncorhynchus mykiss,*[36][37] and Channel cat fish, *Ictalarus punctatus.*[38] Okumus *et al.* (2001) stated that growth was similar in both albino and normally pigmented Rainbow trout in the first four months but normally pigmented grew better subsequently.[36]Prather (1961) however did not notice any significant difference in growth performance of albino and normally pigmented channel catfish.[39]

The growth disparity between the normally pigmented *C. gariepinus* and the albino *C. Gariepinus* can still be supported by the report of Megbowon *et al.* (2014) that variations in growth performance existed between and within strains of *Clarias gariepinus.*[8] This was in agreement with the findings of Van Der Waal (1998) who observed that the African catfish exhibit considerable growth variation both under aquaculture and in the wild.[40] According to Valente *et al..* (2001), Sundstrom *et al.* (2003), and Martins *et al.* (2005), this observed variation in growth might be as a result of inherent differences in genetic makeup and feeding behaviour.[41][42][43]The normally pigmented strains were observed to be more voracious in feeding as compared to the albino. The poor feeding behaviour of the albino in this experiment could be related to the explanation of Miller (2010) that the poor eye development in the albinos affect their vision making it difficult for the albinos to find food and avoid danger.[44]

Both strains of *Clarias gariepinus* in this experiment exhibited similar food utilization potentials ($p>0.05$). Cremer *et al.* (2000) also did not have any significant difference in FCR between normal pigmented and albino channel catfish.[38] According to Sogbesan and Ugwumba (2008), the ability of an organism to utilize nutrients especially protein will positively influence growth rate.[45] It is likely therefore that if the appetite of the *C. gariepinus* 'Albino' could be enhanced for it to improve its feed intake, its growth rate could be enhanced for better weight gain and economy of production.

CONCLUSION

Growth performance of fish is a matrix of several factors ranging from genetic make up to the environmental variables and food availability. Ample food supply was ensured to the two strains of *Clarias gariepinus* through daily feed ration of 6% biomass. The intervention of temperature was seen during the cold harmattan period which suppressed feed intake and growth rate in both the albino and normally pigmented *Clarias gariepinus.* The growth performance (mean weight gain) of the normally pigmented strain was better compared to that of the albino. The albino strain can still grow to be used as food fish as well as its being a good ornamental choice.

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