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Growth performance of two strains of *Clarias gariepinus* in indoor and outdoor concrete tanks

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Abstract

Six indoor concrete tanks (1.5m x 2.0m x 1m) were stocked with 120 C. gariepinus fingerlings (9.52 ±1.52g). Six outdoor concrete tanks (2m x 2m x 1m) were stocked with 240 fingerlings (9.66 ± 1.52g). The fish samples were collected from Osi Ekiti, Ekiti State and from the National Institute for Freshwater Fisheries Research hatchery, New Bussa, Niger State, both in Nigeria. The fish were acclimatized for three days and were fed with coppens feed. The experimental feed had crude protein level of 40.5% and was fed to the fish for 51 days in two treatments indoor and outdoor. There was no significant variation ($p > 0.05$) in the mean initial weight, mean final weight, mean weight gain, food conversion ratio, protein intake, specific growth rate and percentage survival of fish stocked indoors. There was significant difference ($p < 0.05$) in the protein efficiency ratio of fish fed indoor. There was significant difference ($p < 0.05$) in the mean weight gain, mean final weight, food conversion ratio, protein intake and protein efficiency ratio of two strains of fish fed the diet outdoor. There was no significant difference ($p > 0.05$) in the specific growth rate and percentage survival of the two strains of fish fed outdoor. The highest weight gain was observed in the outdoor fish from Osi and the lowest weight gain was recorded in the indoor from New Bussa.

Keywords: Growth, C. gariepinus, indoor, outdoor.

Introduction

Clarias gariepinus is the most cultured fish in Nigeria and indeed in Africa, and third in the world (FAO, 1997; Adeogun et al., 2007; Cowx, 1992; Ayinla and Nwadukwe, 2003; Sogbeson and Ugwumba, 2008; Ayoola, 2009). It can be inferred that Nigeria is the highest producer of this Clariid catfish in the world (Williams et al., 2007) and about 90% of farmed fish is *Cl. gariepinus* and it is now a major attraction to private sector investors in the country (Kemthorn and Miller, 2006). *C. gariepinus* is widely cultured because of its high growth rate, ability to withstand stress, ability to withstand disease, ability to spawn easily, ability to adapt ambient climate, high density culture and good feed conversion ability. The presence of arborescence air- breathing organ, omnivorous and high fecundity and mass artificial seed technique (Haylor, 1992) also ease its culture.

Growth is affected by several factors as feeding rates and frequency, nutrient composition of feed (Mihelakakis et al., 2002), water quality (FAO, 1999) and source of seed, species of fish (Cho et al., 2003). The desire of farmers is to produce table - sized fish within the shortest possible time. Madu *et. al.* (1988) noted that interest in fish culture is growing very rapidly in Nigeria but the scarcity of fingerlings of widely acceptable species or strains of catfish such as *Heterobranchus* sp. and *Clarias* sp. tend to constitute a major constraint to rapid development of fish farming in Nigeria. Another challenge in the production of fingerling is the sourcing of fast growing strains. Ekelemu (2010) observed differential growth with the hybrids and also in ponds *Heteroclarias* displayed differential growth pattern while their parents grow uniformly (Ekelemu and Ogba, 2005). Percentage weight gain was highest in pure breed *C. gariepinus* induced with ovaprim and lowest among hybrid using male *Heterobranchus* (Ndimele and Owodeinde, 2012). This study sets out to compare the growth performance of two strains of *C. gariepinus* in indoor and outdoor concrete tanks.

Materials and Methods

Six indoor concrete tanks (1.5m x 2.0m x 1m) were stocked with 120 *C. gariepinus* fingerlings (9.52 ±1.52g). Six outdoor concrete tanks (2m x 2m x 1m) were stocked with 240 fingerlings (9.66 ± 1.52g). The samples of fingerlings *C. gariepinus* were collected from Osi Ekiti in Ekiti State Nigeria and National Institute for Freshwater Fisheries Research hatchery in New

Bussa Niger State. The fish were acclimatized for three days and were fed with coppens feed. Table 1 shows the composition of the experimental feed which had crude protein level of 40.5%. Table 2 shows the proximate composition of the diet fed to the fish for 51 days in two treatments indoor and outdoor.

Table 1: Percentage composition of feed fed *C. gariepinus* for 51 days.

	Fishmeal	Soybean	Groundnut cake	Wheat offal	Premix	Starch	Yeast	Vitamin C	Vitamin BCO	Oil
D1	35.00	10.00	15.00	26.44	0.50	2.00	7.00	0.03	0.03	4.00

Table 2: Proximate composition of feed fed *C. gariepinus* for 51 days.

	Moisture	Protein	Crude fat	Crude fibre	Ash	NFE
D1	9.95 ± 0.36	40.5±60.0	13.49± 0.14	4.75 ±0.21	6.85± 0.28	26.41± 0.66

The indoor tanks were cleaned every other day by opening the outlet pipe to release remnant of feed and faecal materials from the bottom. Water was replaced with borehole water from the supply tap. The outdoors tanks were not cleaned daily and it was observed that phytoplankton and zooplankton developed after about three days of feeding. Partial exchange of water was carried out weekly while complete exchange of water was done fortnightly on sampling days. Sampling was carried out fortnightly by bulk weighing samples in each tank. Throughout the period of the experiment aeration was done with air-pumps.

The growth parameters were measured as follows:

Mean weight gain (MWG) = Wt – Wo where Wo is initial weight and Wt is final weight

Specific growth rate (SGR) (%/day) = 100 x (ln Wt – ln Wo)/t (Brown 1957)

Feed conversion ratio (FCR) = dry food intake/Weight gain (g) (Halver, 1972)

Protein efficiency ratio (PER) = (weight gain per fish x 100)/ N x 6.25 given per fish (Halver 1972)

Protein intake = feed intake (g) x % protein in diet

The proximate analysis of the experimental fish before the experiment and after the experiment was carried out using two samples for fingerlings indoor and outdoor from each treatment. The proximate composition of the experimental feed was also done according to AOAC (2000) (Table 2). Statistical analysis was done using the computer package SPSS version 13. Data collected for MWG, SGR, FCR, PER and percentage survival were subjected to one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test for the significance of their means. Dissolved oxygen, pH, temperature and conductivity of the water in the indoor and outdoor tanks were measured using standard methods (APHA 1989).

Results

The water quality parameters showed that temperature ranged from 26–29.2°C, dissolved oxygen ranged from 2.2–4.8 mg/L, pH ranged from 6.6–7 while conductivity ranged from 110–200 µ/cm in the indoor tanks. In the outdoor tanks the temperature ranged from 28–29.4°C, dissolved oxygen ranged from 4.0–7.6 mg/L, pH ranged from 6.2–7.5, and conductivity 100–200 µ/cm.

Table 3: Growth of Osi and New Bussa strains of *C. gariepinus* in indoor and outdoor concrete tanks for 51 days.

	MIW	MFW	MWG	FCR	PER	Protein Intake	SGR	PS
Indoor								
NB1	9.64± 1.02a	54.53± 17.73a	44.89± 16.71a	1.71± 0.09a	2.63± 0.0c	17.06± 6.35a	3.05± 0.36a	80.00± 17.32a
OS1	9.79± 0.50a	60.63± 9.12a	50.74± 9.11a	2.1± 0.41a	2.20± 0.10a	23.00± 3.46a	3.24± 0.38a	65.00± 25.98a
Outdoor								
NB2	9.17± 0.1a	92.5±) 0.01b	83.33± 0.02b	3.69± 0.1c	2.37± 0.11b	35.15± 0.02b	4.13± 0.11b	92.00± 0.50a
OS2	9.66± 0.0a	120.62± 0.20c	110.96± 0.15c	3.29± 0.0b	2.63± 0.02c	42.17± 0.14c	4.50± 0.30b	93.00± 2.00a

Table 3 shows the growth of the two strains of fish indoor and outdoor tanks for 51 days. There was no significant variation ($p > 0.05$) in the mean initial weight, mean final weight, mean weight gain, food conversion ratio, protein intake, specific growth rate and percentage survival of fish stocked indoors. There was significant difference ($p < 0.05$) in the protein efficiency ratio of fish fed indoor. There was significant difference ($p < 0.05$) in the mean weight gain, mean final weight, food conversion ratio, protein intake and protein efficiency ratio of two strains of fish fed the diet outdoor. There was no significant difference ($p > 0.05$) in the specific growth rate and percentage survival of the two strains of fish fed outdoor. The highest weight gain was observed in the outdoor fish from Osi and the lowest weight gain was recorded in the indoor fish from New Bussa. Figure 1 shows the growth of the experimental fish indoors and outdoors. Table 4 shows the proximate carcass composition of the New Bussa and Osi fish reared indoor and outdoor.

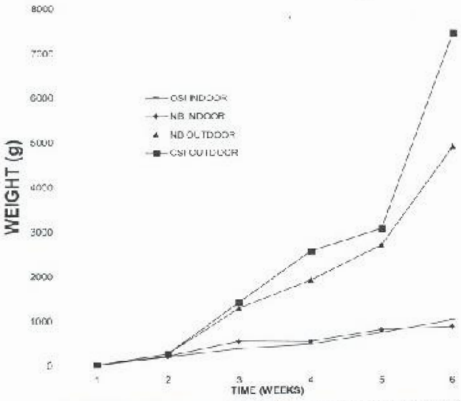

FIG 1: GROWTH OF OSI AND NEW BUSSA STRAINS OF *Clarias gariepinus* IN INDOOR AND OUTDOOR CONCRETE TANKS

Table 4: Proximate composition of *C. gariepinus* of New Bussa and Osi at stocking and at harvest in indoor and outdoor concrete tanks.

	Moisture	Protein	Crude Fat	Crude Fibre	Ash	NFE
New Bussa						
Initial	78.55	14.70	2.20	0.53	1.25	0.27
NB1	74.84	17.65	2.80	0.65	3.14	0.91
NB2	74.12	18.38	2.96	0.70	3.02	0.82
Osi						
Initial	80.17	14.50	2.56	0.53	1.58	0.66
OS1	72.98	19.48	3.11	0.80	2.85	0.78
OS2	73.92	18.38	3.05	0.85	2.94	0.86

Keys: NB1 – New Bussa (indoor), NB2 = New Bussa (outdoor), OS1 = Osi (indoor), OS2 – Osi (outdoor).

Discussion

The growth parameters such as mean weight gain and specific growth rate of Osi fish fed indoors showed higher growth than New Bussa strain. There was no significant difference in the fish growth ($p > 0.05$) fed indoors. The food conversion ratio and protein efficiency ratio were better in New Bussa fish indoors. All the food utilization and growth parameters were better in Osi fish than New Bussa fish in the outdoor tanks. There was significant difference ($p < 0.05$) in the growth of the fish fed in outdoor tanks. Environmental conditions play an important role that cause *C. gariepinus* to have different growth rates in different locations (Yalcin et al., 2002), this may have come into play in these two strains of fish. Also variation in sizes may be due to variation in the sizes of the eggs. It has been observed that even fingerlings from the same clariid broodstock produced the same time vary from one another in sizes (Ayinla and Nwadukwe, 1989). In this study, although, the sizes of the broodstock are not known, this may be a contributory factor to the growth observed in these two strains. As reported in Odedeyi (2007) fingerlings from bigger broodstock had higher mean weight gain.

In using specific growth rate of the fish grown indoor and outdoor, Osi strain is a better candidate in terms of seed selection. Ndimele and Owodeinde (2012) observed that pure breed of *C. gariepinus* (8.8g mean weight gain) had superior growth than other hybrids. In this study the weight gain (50.74–110.96g) observed after 51 days were however, better than that of the pure breed in Ndimele and Owodeinde (2012) reared for 56 days. However, the weight gain (129.96g) and specific growth rate (5.05) observed by Adewolu et al. (2008) in monoculture of *C. gariepinus* was better than that observed in this study. Also Ataguba et al. (2010) reported superior growth of pure breed in terms of specific growth rate (8.8). The sharp increase in growth (Fig. 1) of the fish stocked outdoor from the second week to the end of the study may be attributed to additional nutrients from phytoplankton and zooplankton available to it. The better survival experienced in the outdoor fish is also contributory to the increase in the mean final weight.

The carcass composition of the fish followed the same trend for all parameters in that the experimental fish at harvest had higher composition of protein, crude fat, ash and crude fibre than at stocking for both Osi and New Bussa fish. This is similar to the result of Fagbenro (1992) for *C. isheriensis* when fed cocoa-pod husks. There was slight variation in the trend for *C. gariepinus* for crude fibre and Nitrogen Free Extract (NFE) (Ibiyo et al., 2011) and for *H. longifilis* (Fagbenro et al., 1992; Ovie et al., 2005; Ovie et al., 2007 and Ovie et. al., 2012).

The survival of the fish reared outdoor was higher than those reared indoor in both strains; however, in the indoor experiment survival was higher in New Bussa strain. The percentage survival of the fish followed the same trend as Ibiyo et al. (2011) and Sotolu (2010) however, it was higher than that recorded by Ndimele and Owodeinde (2012). The higher dissolved oxygen observed in the outdoor tanks was due to the photosynthetic activities of phytoplankton. The constant aeration indoors also kept the dissolved oxygen level within conducive ranges although, slightly low on some days which may have contributed to the lower survival.

Conclusion

The two strains of *C. gariepinus* have good growth. New Bussa fish showed superior utilization of nutrients in terms of protein efficiency ratio in the indoor trial. The Osi fish was outstanding in all growth parameters in the outdoor trial.

REFERENCES

Adeogun, O.A., Ogunbadejo, H.K., Ayinla, O.A., Oresegun, A., Oguntade, O.R., Tanko, A. and William, S.B. (2007). Urban aquaculture producers: perception and practices in Lagos State, Nigeria. *Journal of Scientific Research* 2/1: 21–27.

AOAC (2000). *Official Methods of Analysis* (22nd Ed.). Association of Official Analytical Chemists, Arlington Virginia.

APHA (1989). *American Water Works Association and Water Pollution Control Federation. Standard Methods for the Examination of Water and Waste Water* (17th Ed.). New York: American Public Health Association.

Ataguba, G. A., Annune, P. A. and Ogbe, F. G. (2010). Growth performance of two African catfishes—*Clarias gariepinus* and *Heterobranchus longifilis*—and their hybrids in plastic aquaria. *Livestock Research for Development.*

Adewolu, M. A., Ogunsanmi, A. O. and Yunusa, A. (2008). Studies on growth performance and feed utilization of two Clariid catfish and their hybrid reared under different culture systems. *European Journal of Scientific Research* 23/2: 252–260.

Ayinla, O. A. and Nwadukwe, F. O. (1989). Fingerling size variation among freshwater catfish: Effect of broodstock sizes. Onyia, A. O. and G. N. Ajana (eds.) *Proceedings* of FISON Annual Conference, November 13–17. 43–47.

______ (2003) Review of the development of hybrid (*Heteroclarias*) of *Clarias gariepinus* and *Heterobranchus bidorsalis*. *Nig. J. Fish.* 1: 85–95.

Ayoola, S. O. (2009b). Relationships of chemical composition, quantity of milt to fertility and hatchability of *Clarias gariepinus*. *African Journal for Food Agriculture, Nutrition and Development* 9/4: 1031–1045.

Cho, S. H., Lim, Y. S., Lee, J. H. and Park, S. (2003) Effect of feeding rate and feeding frequency on survival, growth and body composition of ayu post-larvae. *Plecoglossus altivelis. J. World Aquaculture Society*. 34: 85–91.

Cowx, I. G. (1992). *Aquaculture Development in Africa, Training and Reference Manual for Aquaculture Extensionists*. Food Production and Rural Development Division, Commonwealth Secretariat, London: 246–295.

Ekelemu, J. K. (2012). Differential growth pattern of *Clarias gariepinus*, *Heterobranchus bidorsalis*, and hybrid Heteroclarias fed commercially prepared diets. *Agriculture and Biology Journal of North America*. 1/4:658–661.

______. and Ogba, O. (2005). Growth performance of *Clarias gariepinus* fed rations of maggot meal as replacement for fishmeal. *Proceedings, 20th FISON Annual Conference*, Port Harcourt, November 14–18, 159–163.

Fagbenro, O. A. (1992). Utilization of cocoa-pod husks in low-cost diets by the Clariid, *Clarias isheriensis*. *Aquaculture and Fisheries Management*. 23: 175–182.

______, Balogun, A. M. and Anyanwu, C. N. (1992). Optimal dietary protein level for *Heterobranchus bidorsalis* fingerlings fed compound diets. *The Israeli Journal of Aquaculture—Bamidgeh*. 44/3: 8–92.

FAO (1997). *Database on Introduced Aquatic Species*, FAO, Rome, Italy. 46pp.

______ (1999). *African Regional Aquaculture Review*. Rome.

Haylor, G. S. (1992). Controlled hatchery production of *Clarias gariepinus* (Burchell, 1822): An investigation of tank design and flow rate appropriate for *C. gariepinus* in hatcheries. *Aquaculture and Fisheries management*. 23: 649–659.

Ibiyo, L.M.O., Ovie, S. O., Babalola, T. O. O. and Eze, S. S. (2011). Growth response of Clarias gariepinus (Teugels, 1984) fed NIFFR floating feed and coppens feed. *Biological and Environmental Sciences Journal for the Tropics*. 8 (4): 33–36.

Kemthorn, P. and Miller, J. (2006). Manual on catfish hatchery production. A guide to small to medium Hatchery and farm producers in Nigeria. *Aquaculture and Inland Fisheries Project (AIFP). National Program. for Food Security.* 29pp.

Madu, C. T., Okoye, F. C. and Ita, E. O. (1988). A review of hatchery management procedures for the production of mudfish fingerlings. KLRI, New Bussa. 115 pp.

Mihelakakis, A., Tsolkas, C. and Yoshimatsu, T. (2002). Optimization of feeding rates for hatchery produced juvenile gilt-head sea bream Sparus aurata. *J. World Aquaculture Society*. 33:169–175.

Ndimele, P. E. and Owodeinde, F. G. (2012). Comparative reproductive and growth performance of *C. gariepinus* and its hybrid induced with synthetic hormone and pituitary gland of *C. gariepinus*. *Turk. J. of Fisheries and Aq. Sciences*. 12: 619–626.

Odedeyi, D. O. (2007). Survival and growth of hybrid (female *Clarias gariepinus* (B) and male *Heterobranchus longifilis* (Val.) fingerlings: effect of broodstock sizes. *American–Eurasian Journal of Scientific Research*. 2/1: 19–23.

Ovie, S.O., Sadiku, S.O.E. and Ovie, S.I. (2005) Protein/energy ratio requirement of the giant African mudfish (*Heterobranchus longifilis*). *Journal of Sustainable Tropical Agricultural Research*. 15:16–23.

Ovie, S. I. and Adejayan, C. (2007). Effect of quantity of zooplankton on the growth of Heterobranchus longifilis. Journal of Sustainable Tropical Agricultural Research. 23: 7–11.

Ovie, S. I. (2007). Protein-sparing activity of lipid and carbohydrates in the giant African mudfish diets. *J. Appl. Sci. Environ. Mgt.* 9(3):109–113.

Ovie, S. I., Ibiyo, L. M. O., Babalola, T. O. O. and Eze, S. S. (2012). The effects of varying levels of yeast (*Saccharomyces cerevisiae*) on the growth and body composition of *Heterobranchus longifilis*. *The Zoologist*. 10: 34–39.

Sogbeson, A. O. and Ugwumba, A. A. A. (2008) Nutritive evaluation of termite (*Macrotermis subhyalinus*) as animal protein supplement in the diet of *H. longifilis* fingerlings. *Turkish Journal of Fisheries and Aquatic Science*. 8: 149–157.

Sotolu, A. O. (2010) Growth performance of *Clarias gariepinus* fed varying inclusions of *Leucaena leucocephala* seed meal. *Tropicultura*. 28/3: 168–172.

Williams, B. B., Olaosebikan, B. D., Adeleke, A. and Fagbenro, O. A. (2007). Status of African catfish farming in Nigeria. Proceedings of workshop on the Development of Genetic Improvement Program for African Catfish, Nov. 5–9.

Yalcin, S., Solak, K. and Akyurt, I. (2002). Growth of the catfish *Clarias gariepinus* (Clariidae) in the river Asi (Orontes), Turkey, Cybium. 26/3: 163–172.