International Journal of scientific research and management
(IJSRM) ||Volume||1||Issue||9||Pages|| 471-475 ||2013||
Website: www.ijsrm.in ISSN (e): 2321-3418

Effect of Different Feed Application Rates on Growth Performance and Body Composition of African catfish, *Clarias gariepinus* fingerlings

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Abstract: *This Study was carried out in the Institute of Oceanography Fish Farm which is geographically located in the historic peninsula of the Great Kwa River. This study lasted for ten weeks and was carried out in 3 hapas (A_1, A_2, and A_3) measuring 1.5 x 1.0 x 1.0 m^3 in earthen pond. A total of sixty (60) fingerlings of Clarias gariepinus, mean bulk weight 0.20 ± 0.02 kg (10 g for each fingerling) were collected from the University of Calabar fish farm and stocked in each of the three experimental units (20 in each unit). The fishes were fed twice daily at 3%, 8% and 12% of their body weight. Some physicochemical parameters (Dissolved oxygen, pH, Ammonia and Temperature) of the water were measured weekly with a calibrated electronic meter. Mean temperature, pH and ammonium were found not to be affected by feed application rates during the ten weeks feeding trial. However, dissolved oxygen levels increased significantly with increasing feed application rate. The food values analyzed showed varied values of their presence in the body tissue of the fish analyzed; with the mean moisture, carbohydrate and protein recording higher value in that order; followed by ash, fat and fibre. The fish samples presented a relatively higher and lower amount of proximate concentrations. Growth performance and proximate composition of Clarias gariepinus show no significant differences among different feed application rates. The results suggest that, although a feeding rate of 12% gave the highest growth performance, Clarias gariepinus should be fed at the rate of 8% body weight per day, considering feed conversion efficiency, survival rate and growth response.*

Keywords: Growth performance, Fingerlings, Body Composition, African catfish.

1. Introduction

Clarias gariepinus occupies a unique and prominent position in the commercial fisheries in Nigeria because it is tasty, hardy, tolerating poor water quality conditions [1]. It is also capable of reproducing in captivity and growing to a size of 7.0 kg [1], has an efficient feed conversion especially in the males [2] and so attracts high market price. Feeding rates vary across species and at each developmental stage and this has driven research to be focused on these areas. Overfeeding and waste food disrupts the water quality [3] while inadequate food supply has direct impact on production cost [4]. Several factors influence the feeding rate in culture system. These include fish size, species and rearing systems [5]. Feeding rate is also influenced by the presence of the nutrients in the feed [4]. By controlling the feeding rates, farmers can successfully reduce cost; maximize growth whilst managing other factors such as individual size variation and water quality which are deemed important in rearing of fish in culture conditions [6].The African catfish inhabits in a wide range of water bodies like swamps, lakes and rivers. It is a native fish species in African countries and it has been introduced and commercially cultured in several countries in Europe (Netherlands, Germany, Belgium), Asian countries (Indonesia, Thailand, Malaysia), South America (Brazil) and West African (Nigeria and Cameroun). It is one among the highly demanded freshwater food fish and cultivable species in Nigeria and elsewhere because of its resistance to diseases, ability to tolerate a wide range of environmental parameters and high stocking densities under culture conditions, relative fast growth rate, and good quality meat [7]. In Nigeria, however its full aquaculture potential has not yet been realized. Effective management of any fishery requires considerable knowledge regarding population parameters such as length-weight, age and growth, mortality and recruitment of the exploited stock. In this process, some fish species even feed on others. When fish are removed from their natural environment, to an artificial environment, enough food must be supplied to enable them grow. This could be in the form of complete diets, where the artificial diet furnishes all the nutrients required by the fish or supplementary diets, where part of the nutritional needs of the fish are obtained from the natural environment [8]. The objective of the study was to evaluate the effects of different feeding rates on growth performance, food conversion, survival and body composition of African catfish of *Clarias gariepinus* fingerlings.

2. Materials and Methods

2.1 Description of study area

This Study was carried out in the Institute of Oceanography Fish Farm which is geographically located in the historic peninsula of the Great Kwa River with elevation of 41 meters

above sea level. This area has Latitude of 04°55.9′N and longitude 08°26′E respectively with a total surface area of three hectares.

2.2 Experimental Design

This Study lasted for ten weeks and was carried out in 3 hapas (A_1, A_2, and A_3) measuring 1.5 x 1.0 x 1.0 m^3 in earthen pond. A total of 60 fingerlings of *Clarias gariepinus*, mean bulk weight 0.20 ± 0.02 kg (10 g for each fingerling) were collected from the University of Calabar fish farm and stocked in each of the three experimental units (20 in each unit). The stocked fish were acclimated for seven days prior to the start of the feeding trial. The average initial body weight of the fish in each experimental unit was measured using a METLAR MT-5000D electronic balance to the nearest gram. Fish samples were fed with Coppens feed. The fishes were fed twice daily at 3%, 8% and 12% of their body weight. Some physicochemical parameters (Dissolved oxygen, pH, Ammonia and Temperature) of the water were measured weekly with a calibrated electronic meter. At the end of seven weeks feeding trials, fish were deprived of feed for 24 hr., captured and bulk weighed individually in all the treatments. Five fishes were sampled from each group for the determination of whole body composition. The sampled fish were frozen at (−20°C) until analysis. The moisture, protein, lipid (lipid), Fibre, ash contents and carbohydrate of experimental fishes were determined by standard methods [9]. Mean wet weight gain, specific growth rate (SGR) [(ln final weight)-(ln initial weight)/Number of days] X100; and feed conversion ratio (FCR) [dry feed fed (g)/wet weight gain (g)] were estimated followed by [10].

2.3 Statistical analysis

Data obtained from this study were subjected to descriptive statistic among different feed application rate, also simple T-test analysis were used to determine the significant difference among the growth performance and proximate composition among different feed application rate. Effects with a probability of ($P< 0.05$) were considered significant [10].

3. Results

3.1 Water Quality Parameters

Water quality parameters such as pH, dissolved oxygen, temperature and ammonium (NH_3) were given in Table 1. Mean temperature, pH and ammonium were found not to be affected by feed application rates during the ten weeks feeding trial. However, dissolved oxygen levels increased significantly with increasing feed application rate (Table 1).

Table 1: Water Quality Parameters at Different Feed Application Rates

	FEED APPLICATION RATES		
PARAMETERS	**3%**	**8%**	**12%**
pH	6.54±0.28	6.51±0.28	6.64±0.35
Dissolved Oxygen (mg/L)	4.20±1.12	3.76±1.12	4.21±0.88
Temperature (^{0}C)	27.64±2.82	26.75±2.82	27.53±1.60
NH_3 (mg/L)	0.04±0.016	0.03±0.02	0.04±0.02

3.2 Growth performance of African Catfish, *Clarias gariepinus* fingerlings on different feed application rates

Growth performance of African catfish fingerlings fed with different feed application rate was presented in Table 2. Initially *C. gariepinus* fingerlings, had similar weight, and exhibited no significant difference among the treatment (p>0.05, Table 4). After, seven (7) days of feeding trial, final fish weight and growth generally showed a linear increase with increasing feeding rate. Daily specific fish growth rates for feeding rate at 3%, 8% and 12 % of body weight were 3.60±0.32, 4.36±0.31 and 4.14±0.28 respectively. Highest specific growth rate was observed in 8% feeding rate fed groups and no significant difference was observed among the treatment (P>0.05, Table 4). The best feed conversion ratio (FCR) (0.27 ±0.01) was observed in the 12% feed application rate fed groups, follow by 0.18±0.01 observed in 8% and 0.1±0.01 observed in 3% feed application rate fed groups whereas there was no significant difference noticed in all the treatments (P>0.05, Table 4). The highest survival was recorded in 8% and 12% feed application rate fed groups. There was no significant difference in survival rate among the fish fed at different feed application rate (P>0.05, Table 4). The highest mortality was recorded in 3%, 12% and 8% feed application rate fed groups. There was no significant difference in survival rate among the fish fed at different feed application rate (P>0.05, Table 4). Size variation in fish length was observed in all the treatments except 3% feed application rate fed groups.

Table 2: Effect of different feed application rates on growth performance of African Catfish, *Clarias gariepinus* fingerlings

	FEED APLICATION RATES		
PARAMETERS	**3%**	**8%**	**12%**
Initial weight (g)	39.9 ± 5.05	45.6 ± 4.03	47.53 ± 0.55
Final weight (g)	512.8 ± 147.35	1109.31 ± 67.63	806.93 ± 28.72
Initial Mean Length (Cm)	8.5 ± 0.43	8.51 ± 0.11	8.65 ± 0.12
Final Mean Length (Cm)	21.5 ± 1.09	26.19 ± 0.35	26.52 ± 0.13
Weight gain (g)	481.9 ± 144.79	1063.71 ± 63.86	759.37 ± 65.29
Specific growth rate (%day)	3.6 ± 0.32	4.36 ± 0.31	4.14 ± 0.28
Percentage weight gain	1203.7 ± 306.4	2337.23 ± 96.45	1594.3± 548.35
Feed Conversion Ratio	0.1 0.01	0.18 ± 0.01	0.27 ± 0.01
Survival (%)	66.7 ± 8.50	91.67 ± 8.50	77.78 ± 4.81
Mortality (%)	33.2 ± 8.35	8.22 ± 8.34	22.23 ± 4.79
Initial Condition Factor (K)	6.60 ± 1.59	7.39 ± 0.45	7.35 ± 0.27
Final Condition (K)	5.4 ± 1.99	6.10 ± 0.63	4.32 ± 1.40

3.3 Body Composition of African catfish *Clarias gariepinus* fingerlings fed with different feed application rates

Summary of the mean body composition of the analysized samples of African Catfish, *Clarias garipinus* is shown in Table 3. The food values analyzed showed varied values of their presence in the body tissue of the fish analyzed; with the mean moisture, carbohydrate and protein recording higher value in that order; followed by ash, fat and fibre. The fish samples presented a relatively higher and lower amount of proximate concentrations. The fish had the moisture with mean and standard deviation values of 82.5 ± 0.1, 84.8 ± 0.01, 79.5 ± 0.01 and no significant difference was observed among the treatment (P>0.05, Table 4), Ash with mean and standard deviation values of 4.56 ± 0.01, 4.86 ± 0.01, 6.60 ± 0.1 and no

significant difference was observed among the treatment (P>0.05, Table 4), protein with mean and standard deviation values of 35.44 ± 0.01, 38.44 ± 0.01, 41. 29 ± 0.016 no significant difference was observed among the treatment (P>0.05, Table 4), fat with mean and standard deviation value of 3.84 ± 0.01, 4.29 ± 0.01, 5.19 ± 0.01 and no significant difference was observed among the treatment (P>0.05, Table 4), Fibre with mean and standard deviation of 0.39 ± 0.01, 0.50 ± 0.01, 0.48 ± 0.01 and no significant difference was observed among the treatment (P>0.05, Table 4), carbohydrate with mean and standard deviation of 52.71 ± 0.02, 52.85 ± 0.02, 46.28 ± 0.02 and no significant difference was observed among the treatment (P>0.05, Table 4).

Table 3: Body composition of African catfish *Clarias gariepinus* fingerlings fed with different feed application rates (mean ±SD) mean with three replicates

	FEED APPLICATION RATES		
PARAMETERS	**3%**	**8%**	**12%**
Moisture	82.50 ± 0.1	84.75 ± 0.01	79.45 ± 0.01
Ash	4.56 ± 0.01	4.86 ± 0.01	6.60 ± 0.1
Protein	35.44 ± 0.01	38.44 ± 0.01	41.29 ± 0.01
Fat	3.84 ± 0.01	4.29 ± 0.01	0.50 ± 0.01
Fibre	0.39 ± 0.01	0.50 ± 0.01	0.48 ± 0.02
Carbohydrate	52.71 ± 0.02	52.85 ± 0.02	46.28 ± 0.02

Table 4: T-test analysis for growth performance and body composition of *Clarias garipinus*

GROWTH INDICES	**Sig. (2 – tailed) value**	**Inference**
Initial weight (g)	0.049	P>0.05 (H_0 accepted)
Final weight (g)	0.039	P>0.05 (H_0 accepted)
Initial Mean Length (Cm)	0.061	P>0.05 (H_0 accepted)
Final Mean Length (Cm)	0.051	P>0.05 (H_0 accepted)
Weight gain (g)	0.058	P>0.05 (H_0 accepted)
Specific growth rate (%day)	0.042	P>0.05 (H_0 accepted)
Percentage weight gain	0.043	P>0.05 (H_0 accepted)
Feed Conversion Ratio	0.035	P>0.05 (H_0 accepted)
Survival (%)	0.039	P>0.05 (H_0 accepted)
Mortality (%)	0.055	P>0.05 (H_0 accepted)
Initial Condition Factor (K)	0.043	P>0.05 (H_0 accepted)
Final Condition (K)	0.056	P>0.05 (H_0 accepted)
BODY INDICES	**Sig. (2 – tailed) value**	**Inference**
Moisture	0.00	P>0.05 (H_0 accepted)
Ash	0.37	P>0.05 (H_0 accepted)
Protein	0.04	P>0.05 (H_0 accepted)
Fat	0.001	P>0.05 (H_0 accepted)
Fibre	0.01	P>0.05 (H_0 accepted)
Carbohydrate	0.05	P>0.05 (H_0 accepted)

4. Discussion

In the present study the increased rate of feed application associated with increased amount of feed offered to fishes influenced the decreased water quality with respect to dissolved oxygen. It has been report earlier that the amount of oxygen in water is not as constant as in air but fluctuates markedly depending on depth [11]. However the parameters like temperature, pH, dissolved oxygen and Ammonium were within the appropriate ranges for catfish culture and no apparent influence of these parameters on catfish growth was recorded. In the present study the feeding rate do not present a significant effect on all the growth performance and body composition indices. It is obvious that the feeding rate is one of the main limitation factors for growth of fishes. Similar results were observed for cobia (*Rachycentron canadum*) juvenile, which presented a greater SGR when fed with 8% body weight/day, rather than with 12% body weight/day [12]. The fish fed at 12% body weight per day exhibited the best FCR among the feed application rate fed groups (P>0.05), while there were no significant differences in FCR among the fish fed at all treatment of body weight per day (P>0.05). In the present study, different feed application rate did not significantly affect body composition of the moisture, ash, protein, fat, fibre and carbohydrate of African catfish fingerlings, whereas body moisture and carbohydrate content of the fish fed at 3% and 8% body weight per day was higher than that of the fish fed at 12% body weight per day fed groups. Ash, protein and fat content of the fish fed at 12% body weight per day was higher than that of the fish fed at 3% and 8% , fibre content of the fish fed at 8% body weight per day was also higher than that of the fish fed at 3% and 12%. It has been demonstrated that, low body fat (lipid) content of fish resulted from fish fed with less than optimum feed application rate [13] and declined feeding frequency [14]. Daily feed application rate of 12% body weight may be optimum rate for the fingerlings of African catfish *Clarias gariepinus*, since with our investigation below this level of feeding rate reduced the growth and feed efficiency indices. In general, food conversion ratio increases with increased feed application rates above the optimal rate. Earlier authors have also reported different optimal feeding rate in different fish species. Optimum feed application rate of other fish species *Clarias fuscus* (8% body weight) [15]. [16] reported that a daily ratio of 10% body weight was optimum for 0.5 g juvenile *Clarias gariepinus.* [17] found that feed application rate greater than 3% per day with juvenile snakehead could even reduce growth, apparently due to increased surfacing and swimming activities. In the present study our initial assumption was that increased feed application rate could increase the survival rate of fishes. Contrast we found that, increase the feed application rate did not increase the survival rate. The substantial size differences in fish existed in all the feeding rate fed groups except 3% feed application rate fed groups. According to [18] a considerable growth variation has been exhibited in African catfish both in aquaculture and in nature. The differential growth pattern recorded for the fishes notwithstanding, it was observed that the total biomass fish as revealed by their mean weight were not significantly different (P> 0.05) from each other. Thus these fish can be successfully used in stocking a fish pond as revealed from the result of this study. The condition factors (Kf) higher than one (1) were recorded; the study revealed the fish generally have condition factors (Kf) of less than 1. This result should however not portray the fish as being in bad state. This is due to their allometric growth pattern, where the length increased more than the weight. This view is supported with the work of [19] in their work on the growth patterns of four dominant fish species in Ona Lake. They opined that fishes with allometric growth patterns often have condition factor (Kf) values of less than 1. The heterogeneity in size often leads to social dominance, which results in aggressive behaviour and

cannibalistic responses [20]. Size variation in fishes caused by either genotype differences or inadequate food supply has already been found to be a major cause of growth for survival [20]. Further, [21] reported that minimizing the size variation could be more important than the availability of food for controlling growth.

5. Conclusion

In the present study, it appears that the daily feed application rate of 8% body weight was near to optimum when the fish grows. The results suggest that, although a feeding rate of 12% gave the highest growth performance, *Clarias gariepinus* should be fed at the rate of 8% body weight per day, considering feed conversion efficiency, survival rate and growth response.

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