GROWTH PERFORMANCE, FEED UTILIZATION AND BODY COMPOSITION OF AFRICAN CATFISH (*Clarias gariepinus*) FINGERLINGS FED AT DIFFERENT FREQUENCIES

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ABSTRACT
Experiment was carried out to evaluate the effect of feeding frequency on growth performance, feed utilization and body composition of *Clarias gariepinus* fingerlings and also establish the appropriate feeding frequency for optimal culture of *Clarias gariepinus*. *Clarias gariepinus* fingerlings with initial mean weight (12.90g) were stocked on same density and placed on a daily feeding frequency of once, twice, thrice and four times/day feeding, replicated three times for 18 weeks. The fish were fed at 5% body weight with commercial feed. Experimental data collected were analyzed using one-way analysis of variance (ANOVA) and Duncan's multi-range test was used to separate the means and determine the level of significance among treatments and also compare differences among means. The result of the study indicates that mean weight gain (MWG) were significantly different ($P<0.05$) across feeding levels except at thrice and four times feeding levels. Significantly, ($P<0.05$) best specific growth rate (SGR) and relative growth rate (RGR) were recorded in four and three feeding frequencies (3.02 ± 0.03, 2.99 ± 0.02 and 43.85 ± 1.56, 42.42 ± 1.00), respectively. The best feed conversion ratio (2.06 ± 0.04) was observed in twice feeding frequency, while survival not affected. Body composition was affected by feeding frequency. Feeding four times per day had the best performance, without significant differences from three times frequency. It was recommended that *Clarias gariepinus* could be fed four times per day, but three times per day could be adopted since both achieve optimal growth when compared to other feeding frequencies.

Keywords: *Clarias gariepinus*, Feed Frequencies, Performance, Utilization

INTRODUCTION

Fish is very important to humans because it contains protein of very high quality and also has sufficient amounts of all the essential amino acids required by the body for growth and maintenance (Teshima *et al*., 1984). The protein in fish, as well as similar foods of animal origin, makes up complete protein sources in many people's diets around the world (Madu, 2016). High quality protein, such as the protein in most fresh fish, can be used to maintain an active metabolism (Madu, 2016). Beside its use as good source of protein because of high quality protein in it, it has other non-food and nutritional values, such as medicinal value, for cosmetics, perfume and lubricant, varnishes and soap and margarine production (Ayoola, 2011). The demand for this important product is high while the supply is inadequate. The challenge therefore is to bridge the wide gap between fish demand and supply (Ayoola, 2011). But unfortunately, the high cost of production of this important product through aquaculture is the main challenge faced by Nigerian farmers (Fagbenro and Adeparusi, 2003). This could be attributed to high cost of nutritive feed (40-60%) used in production (Aderolu *et al*., 2009. Davies *et al*., 2006 Derya *et al*., 2005). The challenge therefore is to device means of using the fish feed that is insufficient in supply to achieve optimum growth at shortest possible time. This therefore necessitates the need to develop appropriate feeding strategy to make efficient use of the insufficient feed. Attempts have been made to reduce the feed cost by employing suitable feeding strategies in order to maximize utilization of supplied nutrients to culture fish. Feed management as regards optimization of feeding frequency is essential in aquaculture; hence overfeeding and waste food disrupt water quality (Ng *et al*., 2000, Marimuthu *et al*., 2010, Kasi *et al.*, 2011) while inadequate food supply has direct impact on production (Mihelakakis *et al.*, 2002). By controlling the optimum feeding frequency farmers can successfully reduce the cost and maximize growth and also be able to manage other factors such as individual size variation, food wastage and water qualities which are deemed important in rearing of fish (Marimuthu, *et al*., 2010., FAO, 1999). Previous research reveal that the optimum feeding frequency for maximum growth of fish varies depending on certain factors, fish species , fish size, culture conditions, environmental factors, dietary nutrients (i.e., protein and energy levels) and feed allowance in the previous feeding (De silva, and Anderson 1995, Dwyer *et al*, 2002, Goos, and Richter, 1996 Lee, 2000). Also various examination have shown that effects of feeding frequency on the growth and food conversion efficiency varies among several species, hence different fish species have different optimum frequency. The African catfish has its native in African countries, but in the recent past has been introduce and culture in other parts of the world (Europe, America and Asia). *Clarias gariepinus* has an almost pan-African distribution, from Nile to West Africa and Algeria to Southern Africa (De Graaf, and Janssen, 1996). It lives in most river basins with *Clarias anguillarias*. The African catfish inhabit calm waters from lakes, streams and rivers to swamp, some of which are subject to seasonal drying, but have been known to prefer swamps Reed *et al*. (1967).The African catfish belongs to the family of *Clariidae*. Their unique feature such as high disease tolerance, good meat quality, and hardy nature, tolerance to harsh environmental condition, relative fast growth, and omnivorous nature makes it a good culture species (De Graaf, and Janssen, 1996). The aim of this study is to know the feeding frequency that is optimum for fish culture, hence establish a feeding schedule for African catfish.

MATERIALS AND METHODS

The experiment was carried out in teaching and research fish farm of Department of Fisheries and Aquatic Resources Management of Michael Okpara University of Agriculture Umudike with out –door concrete tanks measuring (2.03×1.02×1.02)M. The experiment was designed as a complete randomized design (CRD) with four treatments and three replicates and total of 30 fingerlings of *Clarias gariepinus* were used in each treatment, with each replicate having 10 fingerlings. *Clarias gariepinus* fingerlings used for the experiment were procured through artificial induced breeding according to the method of De Graaf, and Janssen (1996), and selected at random for the experiment. Prior to the commencement of the feeding trials, fingerlings of *Clarias gariepinus* with average weight of 12.90g were randomly selected and transferred to the experimental tanks. At the beginning of the feeding trial the fish were deprived of feed for 24 hours according to the method of (Kotaro *et al*., 2006 Aderolu *et al.*, 2009 Marimuthu *et al*., 2010 Ajani *et al*., 2010 Kasi *et al.*, 2011). The various treatments were fed at daily feeding frequency of 1,2,3,4 times daily according to the design of the experiment. Popular commercial catfish feed (Coppens, Holland) was used to feed the fish at designated frequency based on the design of the experiment. Hence, treatment one, once daily (at 7:00hr), treatment two, twice daily (at 7:00hr and 18:00hr), treatment three, thrice daily (at 7:00hr, 14:00hr, and 18:00hr) treatment four, four times daily (at 7:00hr, 11:00hr, 14:00hr, and 18:00hr). The treatments were later designated T_1, T_2 T_3, T_4 respectively based on feeding frequency (1-4) accordingly. Fish in all the treatments were fed at 5% body weight per day and feeding allowance was made in accordance with increase in body weight (Edward *et al*., 2010) and diet allotments was increased every two weeks after length-weight (growth) determination. The daily ration was divided according to the feeding frequency of each treatment. Weighing and length determination of fish was carried out prior to commencement of feeding trial and fortnightly throughout the period of the experiment and fish were not fed but feeding rate was recalculated to accommodate weight changes. At the end of the feeding trial, fish were starved of feed for 24 hours captured and weighed individually in all the treatments. Water quality parameters (temperature, hydrogen ion concentration (pH) and dissolved oxygen concentration (DO) were carefully monitored fortnightly throughout the experiment in order to know, manage and to ensure good and appropriate water quality conditions at all time during the study period as recommended by Boyd and Tucker (1998).

Table 1: Proximate composition of experimental diet

Parameter	Composition (%)
Crude protein	42
Crude fat	13
Crude fibre	2.5
Ash	6.7
Phosphorous	0.9
Calcium	1.0
Sodium	0.2

Table 2: Ingredient composition of experimental feed

Ingredient	Composition (%)
Fish meal	45.00
Soyabean	18.30
Blood meal	4.60
Corn grain	30.60
Vegetable oil	1.00
Vitamin premix	0.50

At the end of the feeding trial fish were sampled randomly from each replicate of the various treatments for determination of body composition. The moisture content, crude protein, ether extract, crude fibre, ash and lipid contents of the experimental fish were determined by standard method of A.O.A.C. (1990). The fish were also analyzed before commencement of experiment for initial body composition. The feed utilization and growth parameters such as: Mean weight gain

(MWG), specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), survival, daily weight gain (DWG) and relative growth rate (RGR) were evaluated using the collected growth data. The growth parameters were computed as follows: Mean weight gain (MWG), MWG = Final mean weight – Initial mean weight,

Specific Growth Rate (SGR), SGR = $\frac{Log_eW_1 - Log_eW_o}{T} X\ 100$

Where, Log_e = Natural log, W_1 = Final mean weight, W_o = Initial mean weight, T = Trial duration (days),

Feed Conversion Ratio (FCR), FCR = $\frac{Weight\ of\ feed\ fed\ (g)}{Weight\ gain\ of\ fish\ (g)}$

Protein Efficiency Ratio (PER), PER = $\frac{Weight\ gain\ of\ fish}{protein\ fed}$,

Survival (%) = S1/S2 X 100

S_1 = No. of fish at the end of experiment, S_2 = No. of fish at the beginning of the experiment, Daily Weight Gain (DWG), DWG = $\frac{Final\ weight - Initial\ weight}{No\ of\ days.}$

Relative Growth Rate (RGR %), RGR (%) = $\frac{W_2 - W_1}{W_1}$

Where; W_2 = Final average weight at the end of the experiment, W_1 = Initial average weight at the beginning of the experiment, Mean Length Gain (MLG) = Mean final length - Mean initial length.

The data collected were analyzed using statistical package for social sciences (SPSS, 2000, system for windows, version 10.0). All experimental data were analyzed using one-way analysis of variance (ANOVA) and Duncan's multi-range test was used to separate the means and determine the level of significance among treatments and also compare differences among means. Effects with a probability of (P<0.05) were considered significant.

RESULTS

The water quality parameters monitored did not vary significantly (P>0.05) amongst the feeding frequency. The range of values of the water quality parameters during the experimental period for, pH (6.99±0.03 - 7.11±0.01), dissolved oxygen (7.03+0.04 - 7.21±0.03) and temperature (26.20±0.07 - 27.59±0.10) fall within the range recommended by Boyd and Tucker (1998), for freshwater fish production. All fish irrespective of the feeding frequency fed actively and appeared healthy. Initially, *Clarias gariepinus* fingerlings had similar weight (12.60±0.64 -13.93±1.01) and exhibited no significant difference (P>0.05) among the feeding frequency. At the end of the experiment the final mean weight of fingerlings fed four times recorded highest value (545.87±16.96) when compared to once (407.27±13.33) and twice (494.53±18.26) feeding frequency respectively and also showed significant difference (P<0.05). No significant difference (P>0.05) were observed in the mean initial length of the fish with various feeding frequency before the commencement of the experiment, but at the end of the experiment a significant different (P<0.05) was observed in the group fed once per day when compared with other feeding frequency. The mean weight gain (MWG) observed in fish fed four times per day recorded high values (533.27±16.34) compared to twice (483.20±17.98) and once (393.33±12.37) daily feeding frequency and is also significantly difference (P<0.05). The mean daily weight gain of fish fed at once per day showed a significant difference (P<0.05) from other feeding frequency, with four and three times feeding frequency showing the highest values (4.04±0.02, 4.22±0.12) respectively while the once per day group exhibited the least value (3.12 ± 0.00). The mean length gain was generally improved by increasing the feeding frequency during the experimental period and significantly differs (P<0.05) between once per day feeding frequency and other feeding frequencies. The specific growth rate (SGR) of fish fed once per day frequency showed significant difference (P<0.05) compared to other feeding frequencies, but fish fed twice, thrice and four times feeding frequencies did not differ significantly (P>0.05). The relative growth rate (RGR) followed the same significant trend with specific growth rate (SGR), but recorded values which exhibited clear fluctuations. The growth data clearly indicate that the final mean weight and mean weight gain of fish fed three times were not significantly different from those fed four times. The best food conversion ratio (FCR) was observed in twice per day group, the least recorded with four times per day group, whereas no significant differences (P>0.05) were noticed in all the feeding frequencies. There were no significant differences (P>0.05) observed on the protein efficiency rate. Despite the high survival rate, mortalities were recorded; but no external clinical symptoms occurred in any treatment in this study. Survival of the fish during the experiment was not affected significantly (P>0.05) by the feeding frequency. Size variation in fish length was observed in all the treatments. In all the feeding frequencies, small fingerlings were not cannibalized unlike the report of Marimuthu *et al.* (2010) and despite cannibalistic characteristics nature of catfish, yet all treatments had a few large individuals at the end of the experiment. The proximate composition (moisture, protein, lipid, ether extract, fibre, and ash) of *Clarias gariepinus* fingerlings fed with different feeding frequency are presented in Table 5. The highest (78.11 ±0.00) moisture content was observed in fish samples analyzed before the commencement of the experiment. Fish fed at once and twice feeding frequency recorded high (70.50±0.96, 70.19±0.49) moisture content when compared with three and four (65.03±0.77, 66.21±1.76) times feeding frequency respectively. A significant difference (P<0.05) in crude protein level was obtained when twice, thrice and four times feeding frequency were compared to once fed feeding frequency. The highest crude protein level was observed in three times (53.24±1.01) feeding frequency closely followed by four times (53.01±2.50) while the once a day feeding frequency recorded the least (48.77±0.32) crude protein among the experimental fish. The highest (8.85±0.71) lipid content was observed in fish fed four times daily closely followed by three times (8.82±0.43) daily feeding frequency with significant difference (P<0.05) when compared to other feeding frequency while once per day frequency had the least (5.11±0.00) lipid content.

Table 3: Water quality parameters of African catfish (*C. gariepinus*) fingerlings fed at different feeding frequencies during the experimental period.

Feeding Frequency	pH	Dissolved oxygen (mg/L)	Temperature (^{o}C)
Once a day	6.99±0.03^a	7.20±0.08^a	26.20±0.07^a
Twice a day	7.11±0.01^a	7.03+0.04^a	27.15±0.04^a
Thrice a day	7.19±0.02^a	7.04±0.01^a	27.59±0.10^a
Four times a day	7.16±0.00^a	7.21±0.03^a	26.48±0.29^a

Data are mean values of three replicates of different feeding frequency ± standard error.
Mean values with the same superscript letters in the same column are not significantly different at P>0.05.

Table 4: Growth performance and feed utilization of *Clarias gariepinus* fingerlings fed at different feeding frequencies during the experiment.

Parameters	Once a day	Twice a day	Thrice a day	Four times a day
MIW (g)	13.93±1.01^a	12.73±0.29^a	12.73±0.37^a	12.60±0.64^a
MFW (g)	407.27±13.33^a	494.53±18.26^b	525.13±1.27^{bc}	545.87±16.96^c
MIL (cm)	9.54±0.29^a	9.04±0.12^a	9.03±0.19^a	9.27±0.14^a
MFL (cm)	35.11±0.22^a	36.41±0.59^b	36.91±0.10^b	37.40±0.31^b
MWG (g)	393.33±12.37^a	483.20±17.98^b	513.40±1.59^{bc}	533.27±16.34^c
MDWG (g)	3.12±0.00^a	3.83±0.14^b	4.04±0.02^{bc}	4.22±0.12^c
MLG (cm)	25.57±0.09^a	27.87±0.53^b	27.37±0.10^b	28.13±0.19^b
MDLG (cm)	0.20±0.00^a	0.22±0.01^b	0.22±0.00^b	0.22±0.00^b
SGR %	2.68±0.04^a	2.90±0.01^b	2.99±0.02^b	3.02±0.03^b
RGR%	28.42±1.35^a	42.61±0.62^b	42.42±1.00^b	43.85±1.56^b
FCR	2.28±0.11^a	2.06±0.04^a	2.16±0.45^a	2.30±0.26^a
PER	1.03±0.04^a	1.12±0.01^a	1.12±0.03^a	1.13±0.07^a
Survival %	96.67±5.77^a	100.0±0.00	100.0±0.00	100.0±0.00^a

Data are mean values of three replicates of different feeding frequency. Data are expressed as mean ± standard error. Values with same superscript in the same row are not significantly different at (P>0.05).
Key: MIW; mean initial weight, **MFW;** mean final Weight, **MIL;** mean initial length, **MFL;** mean final length, **MWG**; mean weight gain, **MDWG**; mean daily weight gain **MLG;** mean length gain, **MDLG**; mean daily length gain, **SGR;** specific growth rate, **RGR;** relative growth rate, **FCR;** feed conversion ratio, **PER;** protein efficiency ratio.

Table 5: Proximate composition of *Clarias gariepinus* fed at different frequencies.

Parameters	Initial	Once a day	Twice a day	Thrice a day	Four times a day
Moisture	78.11 ± 0.00^{c}	70.50 ± 0.96^{b}	70.19 ± 0.49^{b}	65.03 ± 0.77^{a}	66.21 ± 1.76^{a}
Crude protein	44.61 ± 0.16^{a}	48.77 ± 0.32^{a}	50.47 ± 2.04^{b}	53.24 ± 1.01^{b}	53.01 ± 2.50^{b}
Ether extract	24.06 ± 0.03^{a}	28.47 ± 0.73^{b}	29.11 ± 2.14^{b}	28.38 ± 2.00^{b}	28.50 ± 0.60^{b}
Crude fibre	2.05 ± 0.03^{b}	2.89 ± 0.11^{c}	3.03 ± 0.22^{c}	1.08 ± 0.12^{a}	0.98 ± 0.23^{a}
Ash	2.33 ± 0.06^{a}	3.70 ± 0.35^{b}	3.37 ± 0.32^{b}	3.01 ± 0.77^{b}	3.10 ± 0.33^{b}
Lipid	7.19 ± 0.01^{b}	5.11 ± 0.00^{a}	5.75 ± 0.39^{a}	8.82 ± 0.43^{c}	8.85 ± 0.71^{c}

Data are mean values of different feeding frequency ± standard error. Mean values with different superscript along each row are significantly different from each other ($P<0.05$).

DISCUSSION

The result of this study shows that the water quality parameters monitored during the study period were found to be more or less similar and had no significant effect on growth performance of *Clarias gariepinus* fed at different feeding frequencies, this is attributed to bi-weekly water replacement of the various feeding frequencies during the experimental period and also because of the fact that the various fish group fed actively at all time during the experimental period, hence little or no feed was left unconsumed after each feeding. Generally, good dissolved oxygen in fish culture are attained and maintained by ensuring proper feeding rate and frequency, and also avoidance of decomposable material that are not edible to fish from entering the pond. Optimum supply of dissolved oxygen in ponds enhances the physiological activities of the fish and ensures proper growth and reproduction.

Feeding frequency is one important consideration as it has been proved to affect growth, survival and body composition as well as water quality. Feeding also at the optimum frequency can result in tremendous savings in feed cost (Davie *et al*., 2006). The amount of daily feed intake, frequency and timing of the feedings and presentation of the predetermined ration are the key factors of feed management strategies influencing the growth and feed conversion (Goddard, 1995). Optimal feeding frequency may vary depending on species, age, size, environmental factor and husbandry, and feed quality (Goddard, 1995). Studies on the effect of feeding frequency on growth of fish revealed different results for different species. Optimum feeding frequency was reported as once on alternate days for *Chrysichythys nigrodigitatus* (Ekanem, 1996) eight times per day for milk fish, *Chanos chanos* (Chiu *et al*., 1987) , once in two days for estuary grouper *Epinephelus tauvina* (Chua and Teng 1978), once a day for stinging catfish *Heteropneustes fossilis* (Marian *et al.*, 1981), twice per day for channel catfish *Ictalurus puntatus* (Andrew and Page 1975, Webster *et al.*, 1992a), rainbow trout *Oncorhynchus mykiss* (Crayton and Bleamish 1977), three times per day for fry of common carp *Cyprinus carpio* (Charles and Sebastian 1975), six times per day for hybrids of Nile tilapia *Oreochromis niloticus* X blue tilapia *O.aureus* (Tung and Shiau 1991), continuous feeding 24 hours per day for white sturgeon *Acipencer transmontanus* (Cui,1997) and continuous feeding for *Clarias gariepinus* (Dada and Olarewaju 2002).

Fish fed at higher feeding frequencies gained significantly more weight and added more length than those fed less often (Khan *et al.*, 2009). This is similar with the findings of this study that length and weight of fish increase with increase feeding frequency. The reason could be that fish fed at higher frequencies consume more food since they are available at different intervals and utilized them for growth. It could also be attributed to the fact that fish fed at higher frequencies consumed larger quantities of food than those fed less often, but with smaller individual meal size. The fish that are fed less frequently during the experiment devised means of adapting to such condition by consuming larger amounts of feed during each meal and when this condition is applied for a longer period, this lead to increased gut capacity and hyperphagia. Size variation in fish length was observed in all the treatments, however, the inter-individual size variation of fish in the treatment fed highest feeding frequency (four times) daily were much lower than in the other treatment groups. This supports the hypothesis that more frequent feeding yields fish of more uniform sizes (Bascinar *et al*., 2011), this could arise because dominant individuals are less aggressive under such circumstances, or because more food is distributed to locations occupied by subordinates. The uniform size of fish could also be due to minimal individual variation in food consumption and growth of cultured fish; hence this contributes to maximum production efficiency, reduce food wastage, and improve water quality. The high inter-individual size variation recorded with the low feeding frequency could be due to the popular hypothesis that social interactions and dominance hierarchy formation can lead to suppression of food intake and growth in subordinate individuals (McCarthy *et al*, 1992). It is assumed that dominant fish eat large quantity of food whereas subordinate fish eat little or nothing (McCarthy *et al*, 1992 Damsqard *et al.,* 1997, Nadir *et al.,* 2007).

The mean weight gain and mean daily weight gain recorded in this experiment were similar to that for *Heterobranchus* and *Clarias* species in low input homestead concrete tanks and brackish water pond environment (Legendre, 1983 Egui, 1986) and also differs widely with the mean weight gain and mean daily weight gain of *Heterobranchus longifilis, Clarias gariepinus X Heterobranchus longifilis* hybrids, and *Clarias gariepinus* obtain by (Davies *et al.,* 2006, Ndom *et al.,* 2011, *Marimuthu et al.,* 2010) respectively in the laboratory. Mean weight gain, mean final weight, mean daily weight gain, increased and differ significantly with increase in feeding frequency. The increased trend in weight result of the experiment could be attributed to the fact that more feed were available, hence consumed and utilized by high frequently fed fish.

In specific growth rate (SGR), the group fed once daily had less significant difference than twice, thrice and four times feeding frequencies; consequently the same trend was observed in relative growth rate (RGR). The highest mean weight gain, specific growth rate, and relative growth rate recorded in this experiment in increasing order of feeding frequency (Table 4) were in agreement with those reported for sunshine bass when grown indoors, (Webster *et al*., 2001 Gabriel *et al*., 2000 Milad *et al*., 2011). Also different authors have reported similar result when *Heterobranchus longifilis, Clarias gariepinus* and their hybrids (*Clarias gariepinus X Heterobranchus longifilis*) were grown in the laboratory. This is because feed intake and utilization increased with increase frequency. No significant differences ($P>0.05$) were found in feed conversion ratio (FCR) and protein efficiency ratio (PER) among the different feeding frequencies. The lack of difference in feed conversion rate among the treatments was consistent with the argument that the effect of feeding frequency on feed conversion is usually small (Aderolu *et al*., 2009). This indicates that fish which were fed more frequently and consumed more food, utilized that food as efficiently as the fish that were fed less frequently, and that food consumption and not food conversion efficiency was the growth-limiting factor (Wang *et al*., 1998). This is also a clear indication that efficiency of feed utilization and feed conversion was not influenced by the feeding frequency. This might indicate that African catfish fed more frequently might utilize diet less efficiently than fish fed less frequently. The result of this study is similar to that of (Webster *et al.,* 2001 Webster *et al.,* 1992a Webster *et al.,* 1992b) who reported similar result in channel catfish, Wang *et al*. (1998) with hybrids sunfish fed once through four times/day, (Marimuthu *et al.,* 2010 Aderolu *et al*., 2009 Dada and Akinwande, 2005). As reported in other fish species (Hashim, 1994 Teshima *et al.,* 1984 Lee *et al*., 2000 Fatan *et al.,* 2005) the greater the feed intake, the greater the growth response. This was the expected result since a higher amount of nutrients become available to the fish when they are fed more often. Survival in the present study was higher than the range reported by Webster *et al.*, 2001, in juvenile sunshine bass (45%-62%). Survival rate range of 96%-100% was reported in the present study which is more or less similar to survival rate range of (68%-90%) recorded in catfish *Heterobranchus longifilis*. The high survival rate is due to good water quality management, good feed utilization and good aquaculture management practice during the experimental period. The result of the present study is completely consistent with initial assumption that increased feeding frequency could reduce cannibalism and increase survival rate of the fish. The size variations in different feeding frequencies are in agreement with the report of Grobler *et al.* (1992) and Van der Waal (1998) that a considerable growth variation has been exhibited in African catfish both in aquaculture and in nature. Absence of cannibalism could be due to food availability; this is in accordance with the report of (Hecht and Pienaar 1993) that a decrease in cannibalism has been reported with increased food availability. Though size variation occur, no cannibalism was recorded; instead, fish at the once/day feeding frequency enlarge their gut and store food (hyperphagia), but utilization of this feed did not compensate for high growth recorded at high feeding frequency. All mortalities may be attributed to handling stress after bi-weekly measurement.

The body compositions of African catfish, *Clarias gariepinus* fingerlings were affected by frequency of feeding. This result is in contrast with that of Webster *et al*., 1992a who reported no significant differences in body composition (percentage moisture, protein, and lipid) in channel catfish fed either once or twice daily. Sveier and Lied (1998) had similar result that body composition was not influenced when Atlantic salmon were fed once a day, also Dada and Akinwande (2005) and Kasi *et al.* (2011) reported no significant effect on body composition of *Clarias gariepinus* fed at different feeding rate. The proximate composition of fish in the experiment shows an increase in values of crude protein, lipid, ether extract, and ash at the end of the experiment over the initial fish samples. The result follows this trend because the experimental fish convert and utilized the nutrient in the diet into their body nutrient. The higher protein content of the experimental fish means that, they converted and utilized the protein from the feed into their body protein. This result is similar with that of Marimuthu *et al.* (2010), Saeed *et al*. (2011) and Ali and Onder (2011). The moisture content of the fish sample before the commencement of the experiment varied significantly with experimental fish after the experiment with the four times/day group having the least value. This result is supported by Ali, and Onder (2011) who reported that, as the feeding frequency decrease, the moisture content of the body increase. This could be due to the fact that less feed become available to the fish, hence utilization of stored lipid for energy during starvation period leading to decrease in lipid content and a rise in water level. The high crude protein content of fish samples fed at thrice and four times per day feeding frequency is similar with the findings of (Kasi *et al*., 2011 Saeed *et al*., 2011 Marimuthu *et al.*, 2010 and, Ali and Onder 2011). The lipid content of the experimental fish follow similar trend with the protein content, as the feeding frequency increases, the lipid content of the body increases significantly ($P<0.05$). This could be due to the fact that more feed were available, hence the fish stored excess nutrient in form of lipid for use during starvation period. This report agrees with the findings of Marimuthu *et al.* (2010) and, Ali and Onder (2011) when rainbow trout were fed at different frequencies. Also lipid level of channel catfish fed twice daily increased when compared to fish fed once daily Noeske-Hallin *et al*. (1985). These results support the findings of many researchers that, low lipid content of fish result from declined feeding frequency (Alanara 1992, Chua and Teng 1978, Andrew and Page 1975, Kanayo *et al.*, 1993, Ruohonen *et al.,* 1998, Wang *et al*., 1998, Lee *et al.*, 2000, Dwyer *et al.*, 2002, Liu and Liao 1999, and Fatan *et al.,* 2005).

CONCLUSION

The growth parameters showed no significant difference between three and four times feeding frequency. It is therefore stated that there is no benefit in feeding *Clarias gariepinus* fingerlings more than four times a day. Hence; it is recommended that *Clarias gariepinus* should be fed four times a day in terms of growth performance, but three times feeding may be adopted if labour cost is to be reduced since both achieved optimum growth when compared to other feeding frequencies. This shows that several feeding frequencies are better than few feeding frequencies for optimum growth and better feed utilization.

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