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# Effects of Different Feeding Regimes and Rates on Fingerlings of *Clariasgariepinus* Fed Commercial and Formulated Diets in Semi-Flow Through System.

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## ABSTRACT

*Two hundred and thirty (230) fingerlings of Clarias geriepinus were sourced from reputable fish farm in Yola. The fish were randomly stocked at 10 fish per tank of 50litres volume. The first set was on feeding frequency regime while other on the feeding rates. The feeding diets were formulated and commercial diets. While the regimes considered were ones, twice and thrice and feeding rates were 3%, 6% and 9% respectively and weekly weights and lengths were recorded. Dead fish were removed for mortality rate. Data generated were analyzed using t-test, ANOVA and graphical representations. The results of the experiment shows that the crude protein was 44.6% and 45.0% for Formulated feed and Coppen respectively, there was no significant difference (p>0.05) between the nutrients values of formulated feed and Coppen rather there was between the gross energy value for the two diets. The ranges of values of the physicochemical parameters during the experimental period for different feeding regimes were as follows: pH 7.07 -7.39; dissolved oxygen 4.37 – 5.12 mg/L, Ammonia 0.0317 – 0.047 mg/L and temperature 28.68--28.87°C while for Feeding rates were pH 7.17 -7.69; dissolved oxygen 4.67 – 5.38 mg/L, Ammonia 0.0327 – 0.0463 mg/L and temperature 28.68--28.87°C. There were significant differences (p<0.05) in the mean weight gain and specific growth rate of fish as the feeding frequencies and regimes varied most especially between ones and thrice. The growth performances and feed utilizations also varied significantly (p<0.05) as the feeding rate increases between the formulated and commercial diets. The best Benefit Cost Ratio of 1.89 was recorded in Clariasgariepinus fed commercial feed thrice followed by twice and ones while highest of 1.98 in fish 9% Commercial Feed.*

## INTRODUCTION

Over the last decades, spectacular growth has taken place in aquaculture. Most of the production in developing countries is realized from pond-based or open-water extensive, improved extensive and semi-intensive practices using polyculture farming techniques (Pantazi and Neififou, 2013). It is unequivocally agreed that global aquaculture production will continue to increase and much of the increased production in developing countries of Asia and Africa is likely to be achieved through the expansion of semi-intensive small scale pond aquaculture. Nutrition and Feeding will play an essential role in the sustained development of this aquaculture (Hassan, 2001).

Due to rapid increase in population of the world especially in the developing countries, there is high demand for fish and fish products as the cheapest source of animal protein in human diet (FAO, 2000). Growth, Health and Reproduction of fish and other aquatic animals are primarily dependent on an adequate supply of nutrients both in terms of quantity and quality, irrespective of the culture system in which they are grown (Hassan, 2001).

Fish need protein, minerals, vitamins, growth factors and energy sources. These nutrients could be available in the natural aquatic environment or applied as prepared feeds (Eyo, 2003). Nutrient is one of the most important factors influencing the ability of cultured fish to exhibit its genetic potential for growth and reproduction. Factors such as quality of feed, daily ration, size, feed intake or water quality also greatly influence growth and reproduction of cultured fish (Nadir *et al.*, 2007).

Fish has become an important source of animal protein in most parts of the world because some of the competing protein sources of animal origin such as beef have been implicated with heart diseases (Owodeinde *et al*., 2013). The prices of others like poultry products are out of reach of the low-income earners, which account for larger percentage of the population (Owodeinde and Ndimele, 2011).

Fish is an essential part of most meals in Nigeria and accounts for about 37% of Nigeria's total protein requirement (Ndimele *et al.*, 2011). Fish production in Nigeria is dominated by the captured sector especially artisanal coastal and artisanal inland fisheries and employs a lot of the riverine population. Over 80% of total domestic production representing about 510,000 tons per annum is contributed by this sector. Factors such as pollution and over-exploitation of the marine fishery resources have resulted into gradual depletion of the stock from the wild. (Owodeinde *et al*., 2013).

Food and Agriculture Organization (FAO), (2013) reported that Nigeria with an estimated population of over 150 million is one of the largest importers of fish in the developing world. Nigeria imports about 600,000 metric tons of fish annually. In order to narrow the gap therefore, between fish supply and demand, Nigerians must be encouraged to embrace aquaculture.

Live food such as Ceriodephnia reticulate and *Brachinus calyciflorus* are common freshwater zooplankton which can be produced in high population density but is not ascertained that they can compete with shell free Artemia in production of *Clarias gariepinus* fry. The prohibitive cost of importation of shell free Artemia and the fact that unconsumed remains of the feed cause fouling and pollution of water has made this organism less variable economically, as a natural larval feed especially in developing countries (Ovie and Ovie, 2010). This calls for an immediate concern since feed which is the most expensive cost item in intensive fish farming could constitute about 40% to 60% of the total recurrent expenditure cost in aquaculture (Adigun, 2005).

*Clarias gariepinus* is very popular to fish farmers for its high market price, fast growth rate, good for conversion ratio, resistance to diseases and infection and ability to withstand adverse pond conditions especially low oxygen content and high turbidity (Ovie and Eze, 2013). The culture of *Clarias gariepinus* fry as seed for fish production is becoming increasingly essential as the fish is contributing to food abundance and nutritional benefit of farmers' health, income generation and employment opportunities (Omotoyin, 2007).

Adekoya et al (2001) reported that *Clarias gariepinus* is the most cultured and economically desired fish species by Nigeria farmers. They are reared all over the country especially in the south and have very good commercial value in Nigerian markets (Adewolu and Adoti, 2010; Owodeinde and Ndimele, 2011). Methods of artificial seed propagation of African mud fish (*Clarias gariepinus*) are very expensive in Nigeria due to the cost of the first exogenous feed (Artemia) that will be required after breeding exercise. This specie do not readily breed in captivity and productivity in the wild is usually very low, thus making fingerlings collection from the wild not only time consuming and labour intensive but also uncertain.

Since the inception of fish culture technology in Nigeria, imported commercial fish feeds have been promoted as the most favoured feed for fish rearing because they support satisfactory growth in fish, however the prohibitive cost of imported fish feed made catfish feeding economically unattractive for the small-scale fish farmers, therefore the need for locally compounded feed that is nutritionally complete with ingredients less competed for by man nor animals but which would equally bring optimal growth. The expenses incurred in feeding cultured fish may be lower by utilizing locally available materials instead of imported feeds.

De Silva (2001) reported that as aquaculture becomes more intensified, fish feeding will be a significant factor in increasing productivity and profitability. Decades ago, the demand for fish in Nigeria has previously been amply supplied from the wild and via importation of exotic species. Although, recently there has been increased awareness among the nations citizenry to save scant foreign resources which has led to a drive for self-sufficiency. The resultant effect therefore is fish production within the private and government sectors (John, 2010).

African catfish *Clarias gariepinus* is a successful aquaculture specie in Nigeria. The specie is widely accepted by fish farmers and consumers because of some biological characteristics (high food conversion ratio, fast growth rate readily accepting artificial feed, ease of artificial propagation, disease resistance), social factors (good market price, good table food quality) and physical characteristics (tolerant of a wide range of environmental conditions). This catfish is an important contributor to both inland fisheries and aquaculture in Nigeria (Jamabo and Keremah, 2009).

The production cost of African catfish farming tends to be higher in tropical than in temperate countries with feed and fertilizers accounting for 54% of the total production cost especially in per-urban farms (FAO, 2011). The economic viability of the culture operation depends on feed and feeding frequency. Nutritionally well-balanced diets and adequate feeding are the main requirements for successful culture.

This research is aimed at determining the effect of different feeding regimes and rates on fingerlings of *Clarias gariepinus* fed with commercial and formulated diets.

## Materials And Methods

The experiment was carried out at Teaching and Research Fish Farm, Department of Fisheries, Modibbo Adama University of Technology (MAUTECH), Yola, Adamawa State, Nigeria.

MAUTECH is situated in Girei Local Government Area of Adamawa State, previously known as Federal University of Technology, Yola, located about 10km North of Yola City on Yola-Mubi road. Adamawa State is located on latitude 9.14'N, Longitude 12.38'E and an altitude of 185.9m. It has an average annual rainfall of about 759mm with maximum average temperature of 38.70'c. The rainy season runs through May to October, while the dry season commences in November and ends in April. The driest months of the year are January and February when the relative humidity drops to 13% (Adebayo, 1999).

The research farm is located at the outskirt of the school staff quarters, and close to the school orchard. This research farm was established to boost research activities in the Department of Fishery. At the experimental site, the semi-flow through system is stationed beside the hatchery unit of the research farm.

### Source of Fingerlings

Two hundred and thirty (230) fingerlings of *Clarias geriepinus* was sourced from reputable fish farm in Yola.

**Duration of the Study:** The study lasted for 12 weeks (84 days) from February to April 2018.

### Experimental Design

The fish were acclimatized for 24 hours prior to the experiment. Two sets of experiments were set. Twenty plastic bowls of 50L capacity were used for the experiment. The fish were randomly stocked at 10 fish per tank of 50 litres volume. The first set was on feeding frequency regime while other on the feeding rates. The feeding diets were formulated and commercial diets. While the frequencies considered were ones, twice and thrice and feeding rates were 3%, 6% and 9% respectively

### Feeding of the Fish

The fish were fed on Commercial Feeds (Coppens) and Formulated Feed Starter at 5% body weight in the different three feeding frequencies (regimes). Those that were fed once are designated 'A' at 8.00 a.m, twice designated 'B' (8.00 a.m and 6.00 p.m), thrice designated 'C' (8.00a.m, 12.00p.m, 6.00 p.m) daily using scatter feeding method as proposed by Rad *et al*. (2003).

On the feeding rates, feeding twice which is a universal method according to Sogbesan *et al*. (2017) was adopted. They were fed 8.00am and 6.00pm. Uneaten feeds were removed by siphoning to control pollution. Fish weights were measured individually once a week and the quantity of feed adjusted based on the changes in body weight of fish for subsequent feedings using a Labtech Balance Numerique Compacted weighing balance.

### Water Quality Assessment

The water in the bowls was monitored on weekly basis for pH, Temperature, Dissolved Oxygen and Ammonia. Water temperature was monitored daily using Mercury in glass thermometer calibrated in degree centigrade (°C) as outlined by Coche *et al*. 2008). The pH of the water was measured using a digital pH pocket sized pH meter. Dissolved Oxygen was measured using the Winkler's method in the laboratory, where as free carbon (IV) oxide and total alkalinity were determined by methods stated by APHA (2005).

### Growth and Feed Utilization Indices

The following indices were measured using formulae adapted from Peterson and Small (2007).

*3.6.1. Weight Gain ($\Delta W$) = Final weight (Wf) – Initial weight (Wi)*

*3.6.2. Percentage Weight gain (%)*

This is percentage increase in weight. Mathematically stated as PWG ($\Delta W/Wi$) × 100

*3.6.3. Specific Growth Rate (%/day)*

Specific growth rate is the logarithmic exponent of weight gained by the fish per unit time expressed in percentage. The formula is: SGR = Loge {(Wf – Wi)/t2 – t1 (day)} × 100

*3.6.5 Feed Conversion Ratio (FCR)*

FCR is a ratio of dry weight of food eaten to the weight gained by fish. It is given as:

Dry weight of food eaten (g) /Fish weight gain ($\Delta W$)

*3.6.4. Protein Efficiency Ratio (PER)*

Protein efficiency ratio is the ratio of weight gained by the fish to the crude protein consumed

Measured in grams, it is stated as: PER = {Weight gain (g) / Protein Intake} g

### Statistical Analysis

The statistical analyses used are t-test, One-way ANOVA, Regression and Correlation. Line graph was also used to represent data for more clarity while means separation was shown in a tabular form.

## RESULTS

### Proximate, Minerals and Gross Energy Values of Formulated Feed and Coppen

The formulated feed and Coppens proximate analysis, mineral compositions and gross energy values are presented in table 1. The crude protein was 44.6% and 45.0% for Formulated feed and Coppen respectively. There was no significant difference (p>0.05) between the nutrient's values of formulated feed and Coppen rather there was between the gross energy value for the two diets. The gross energy in the Coppen feed is higher than that of formulated feed.

### Weekly Weight of Clarias Gariepinus Fed Formulated Feed and Coppen.

The weekly growth curve shows increase from the beginning of the feeding trials to the end. In Figure 1 the highest points was recorded in fish fed commercial feeds thrice followed by once and the least was in formulated feeds fed once while in Figure II, the highest weight was recorded in fish fed 9% commercial feed followed by 6% commercial feed and the least was from 3% formulated feed.

### Growth and Feed Utilization of Clarias Gariepinus

The growth and feed utilization for each of the experiment is presented in Table 2 and 3.

### Water Quality Parameters

The water quality parameters are presented separately on Figures 3 to 10.

**Table1.** *Proximate, Minerals and Gross Energy values of Formulated feed and Coppens*

| Parameters (%) | Formulated Feed | Coppens |
|---|---|---|
| Crude Protein (%) | $44.6^{a}$ | $45.0^{a}$ |
| Crude Fibre (%) | $1.5^{a}$ | $3.0^{a}$ |
| Crude lipid (%) | $11.5^{a}$ | $14.0^{a}$ |
| Ash | $7.5^{a}$ | $7.0^{a}$ |
| Calcium | $1.3^{a}$ | $1.5^{a}$ |
| Sodium | $0.4^{a}$ | $0.3^{a}$ |
| Phosphorus | $0.85^{a}$ | $0.9^{a}$ |
| Dry Matter | $96.0^{a}$ | $95.80^{a}$ |
| NFE | $30.90^{a}$ | $37.70^{a}$ |
| Moisture | $4.00^{a}$ | $4.20^{a}$ |
| Calculated Gross energy (kcal/100g) | $469.01^{a}$ | $522.97^{b}$ |

*Mean on the same row with different superscripts are significantly different (p<0.05).*

**Figure1.** *Weekly Mean Weight of Clarias gariepinus fed formulated and commercial feeds at different feeding frequencies.*

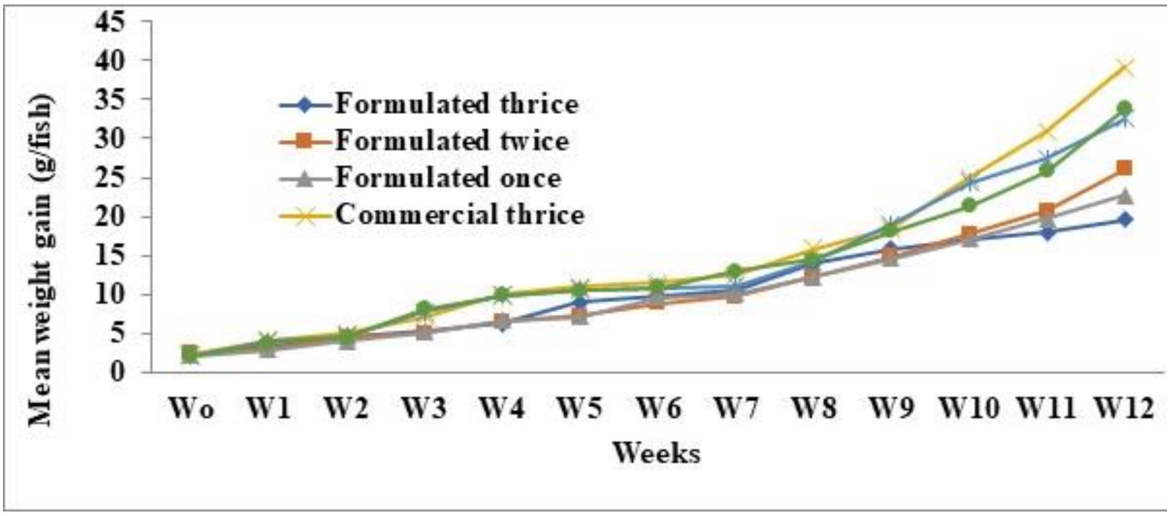



**Table2.** *Growth performances and feed utilization of Clarias gariepinus fed different feeding frequencies.*

| | Feeding frequencies | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **FF thrice** | **FF twice** | **FF ones** | **CF thrice** | **CF twice** | **CF ones** |
| Initial mean weight (g/fish) | 2.25[a] | 2.33[a] | 2.16 [a] | 2.22 [a] | 2.14 [a] | 2.08 [a] |
| Final mean weight (g/fish) | 25.80[c] | 26.70[c] | 22.73[c] | 39.30 [a] | 32.50[b] | 33.83 [ab] |
| Mean weight gain (g/fish) | 23.60[c] | 24.37[c] | 20.57[c] | 37.08[a] | 30.36[b] | 31.75[b] |
| Specific growth rate (%/day) | 1.272 [b] | 1.261 [b] | 1.217[b] | 1.49[a] | 1.41 [a] | 1.44 [a] |
| Relative growth rate (%) | 1070[c] | 1045.9[c] | 952.1[c] | 1670.2[a] | 1418.7[b] | 1526.4[ab] |
| Final length | 13.29[c] | 13.65[b] | 13.11[c] | 14.28[a] | 13.57[b] | 13.82[ab] |
| Condition factor | 1.10[b] | 1.05[b] | 1.01[b] | 1.35[a] | 1.30[a] | 1.28[a] |
| Survival | 98.0[a] | 97.5[a] | 90.5[b] | 99.0[a] | 99.0[a] | 97.0[a] |
| Feed Intake | 39.71[b] | 36.69[b] | 35.06[b] | 47.34[a] | 45.40[a] | 46.67[a] |
| Feed Conversion rate | 1.68[a] | 1.51[b] | 1.71[a] | 1.28[c] | 1.50[b] | 1.47[b] |
| Protein Intake (g/100g of diet) | 17.70[b] | 16.36 [b] | 15.63 [b] | 21.30[a] | 20.43[a] | 21.00[a] |
| Protein Efficiency rate | 1.33[c] | 1.49[b] | 1.32[c] | 1.74[a] | 1.49[b] | 1.51[b] |

*Mean of data with different superscripts are significantly different ($p<0.05$).*

**Figure2.** *Weekly Mean Weight of Clarias gariepinus fed formulated and commercial feeds at different feeding rate.*

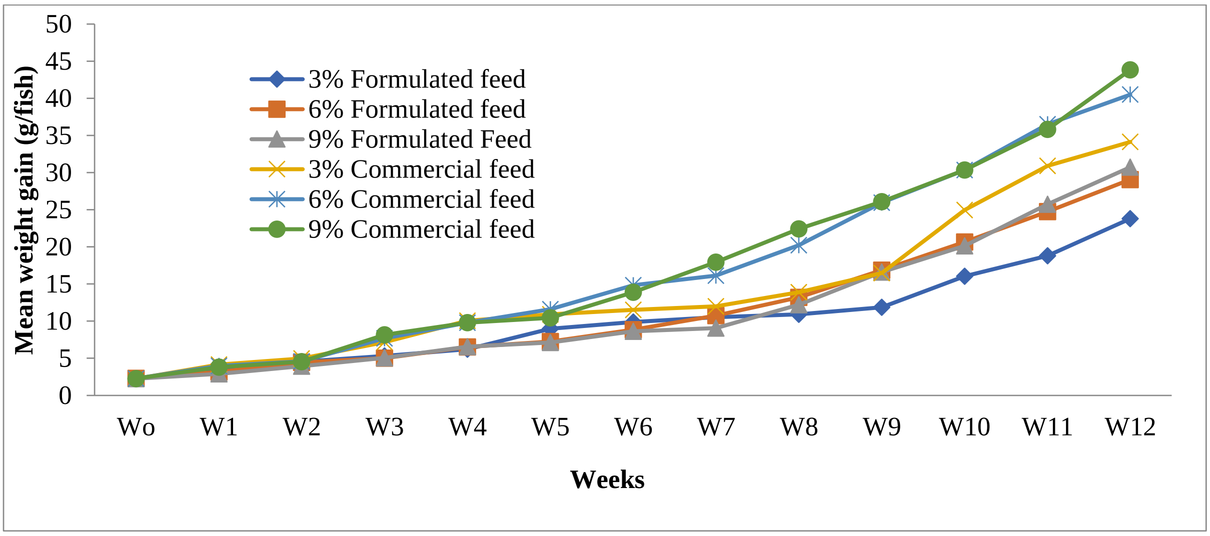


**Table3.** *Growth performances and feed utilization of Clarias gariepinus fed at different feeding Rates*

| | Feeding Rate | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **3% FF** | **6% FF** | **9% FF** | **3%CF** | **6% CF** | **9% CF** |
| Initial mean weight (g/fish) | 2.25[a] | 2.30[a] | 2.26[a] | 2.25[a] | 2.28[a] | 2.28[a] |
| Final mean weight (g/fish) | 23.80[c] | 29.07[b] | 30.73[b] | 34.13[b] | 40.15[a] | 43.83[a] |
| Mean weight gain (g/fish) | 21.55[d] | 26.77[c] | 28.47[bc] | 31.88[b] | 37.87[a] | 41.55[a] |
| Specific growth rate (%/g) | 1.22[c] | 1.31[bc] | 1.35[b] | 1.41[a] | 1.48[a] | 1.53[a] |
| Relative growth rate (%) | 957.78[d] | 1163.91[cd] | 1259.73[c] | 1416.89[b] | 1661.65[a] | 1822.37[a] |
| Final length | 13.31[b] | 13.87[ab] | 14.00[a] | 14.17[a] | 14.79[a] | 14.92[a] |
| Condition factor | 1.01[c] | 1.09[bc] | 1.12[b] | 1.20[a] | 1.24[a] | 1.32[a] |
| Survival (%) | 89.5[b] | 97.0[a] | 90.0[bb] | 93.0[ab] | 96.0[a] | 98.0[a] |
| Feed Intake | 40.69[b] | 39.03[b] | 42.78[b] | 42.53[b] | 49.86[a] | 52.19[a] |
| Feed Conversion rate | 1.89[a] | 1.46[b] | 1.50[b] | 1.33[c] | 1.32[c] | 1.27[c] |
| Protein Intake | 18.14[b] | 17.40[b] | 19.08[b] | 19.14[b] | 22.44[a] | 23.49[a] |
| Protein Efficiency rate (g/100g) | 1.19[c] | 1.54[b] | 1.49[b] | 1.67[a] | 1.69[a] | 1.77[a] |

*Mean of data with different superscripts are significantly different (p<0.05)*

**Figure3.** *Mean water Temperature of Clarias gariepinus fed formulated and commercial diets at different feeding frequencies.*

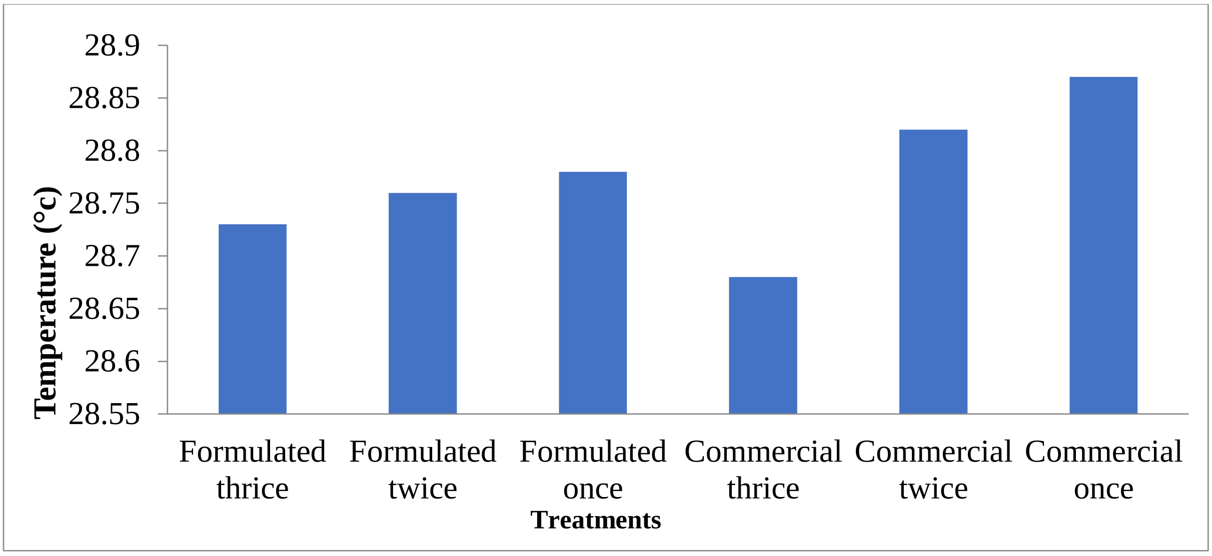



**Figure4.** *Mean water pH of Clarias gariepinus fed formulated and commercial diets at different feeding frequencies*

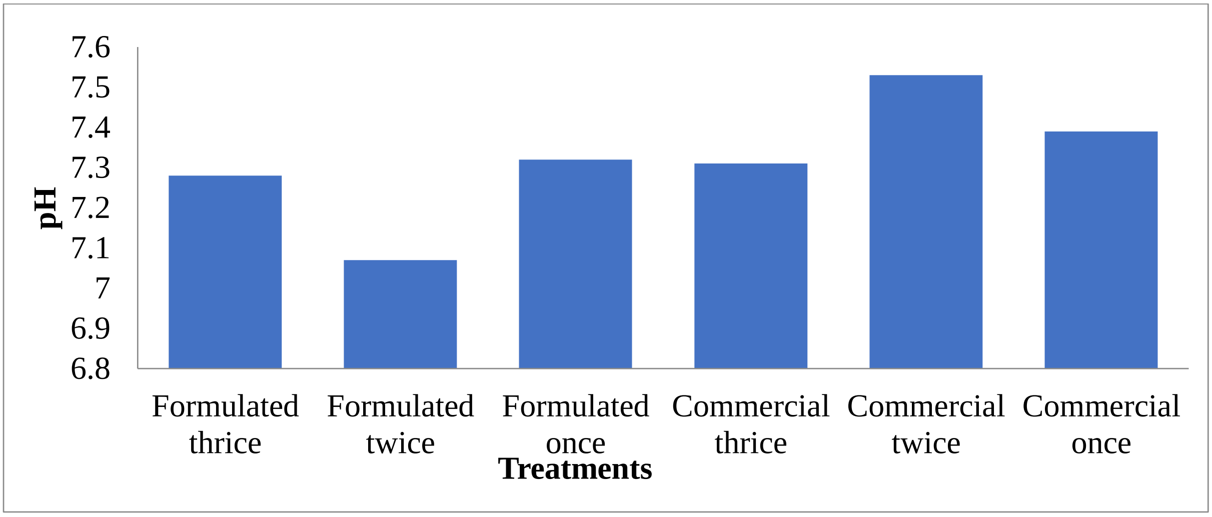


**Figure5.** *Mean water Dissolved Oxygen Clarias gariepinus fed formulated and commercial diets at different feeding frequencies*

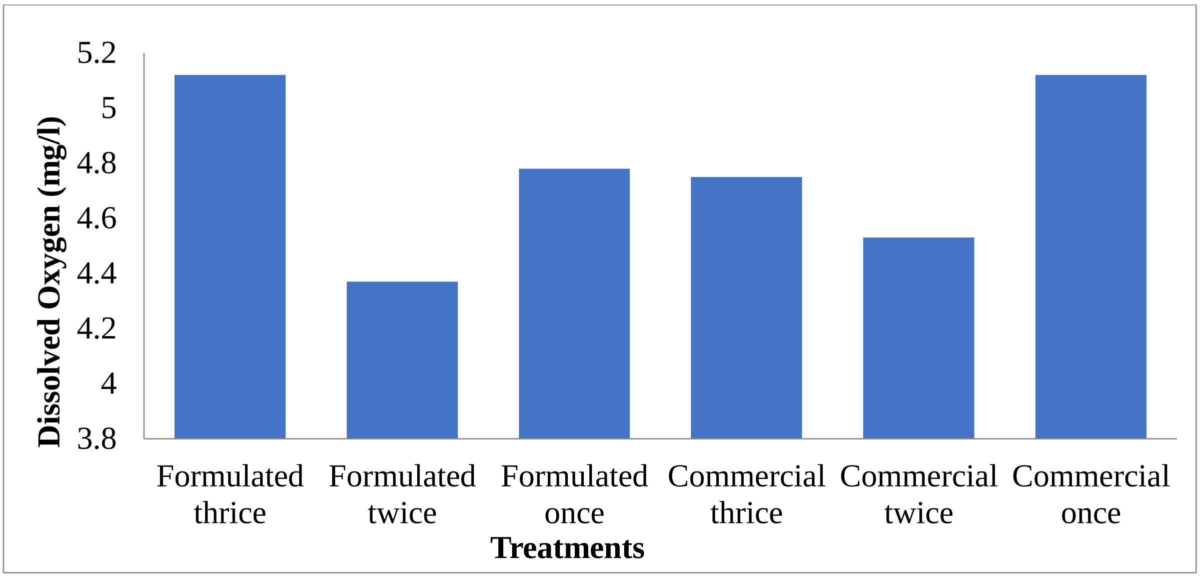



**Figure6.** *Mean water Temperature of Clarias gariepinus fed formulated and commercial diets at different feeding rates*

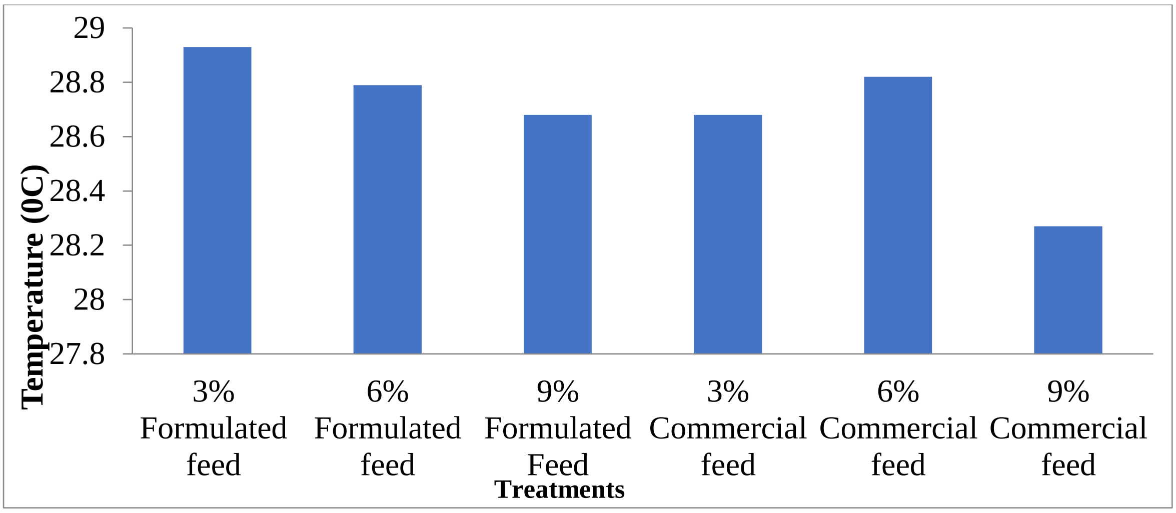



**Figure7.** *Mean water pH of Clarias gariepinus fed formulated and commercial diets at different rates.*

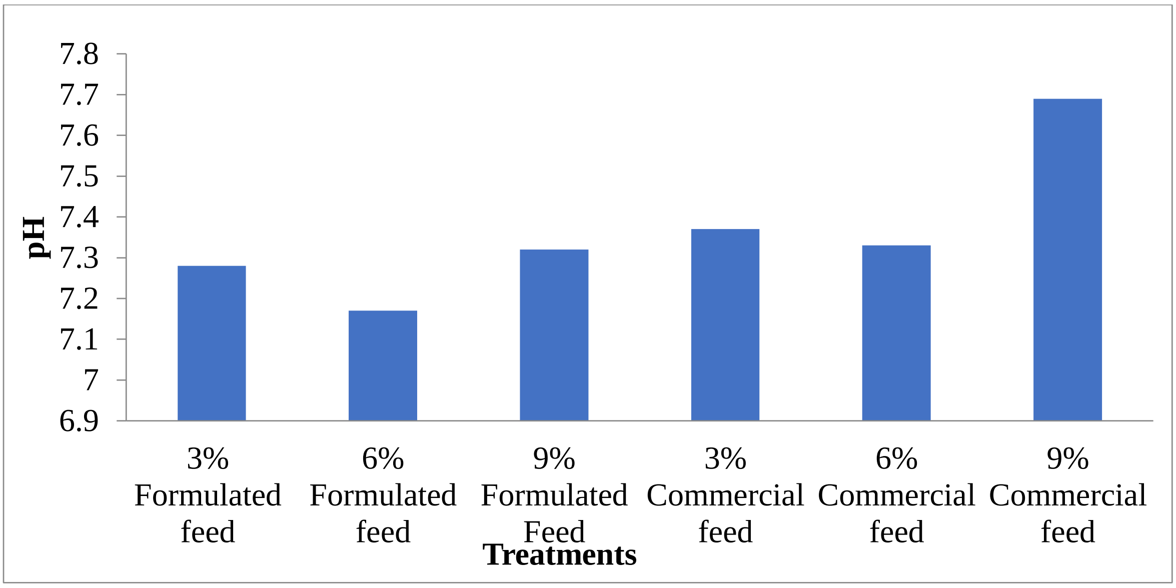


**Figure8.** *Mean water Dissoved Oxygen Clarias gariepinus fed formulated and commercial diets at different feeding rates*

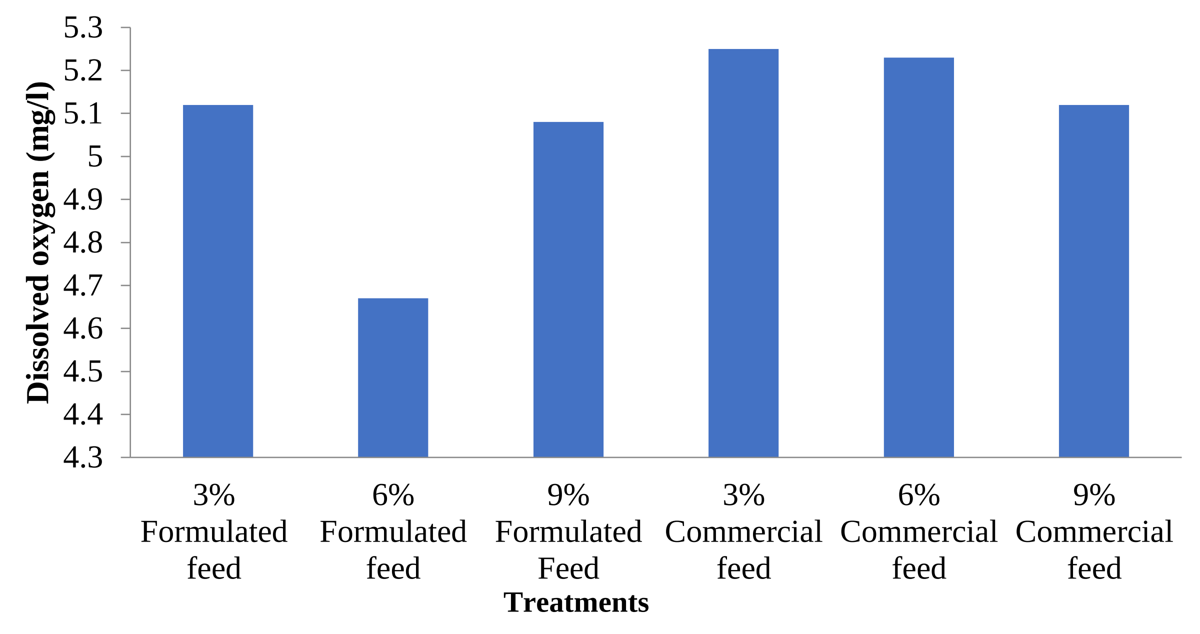
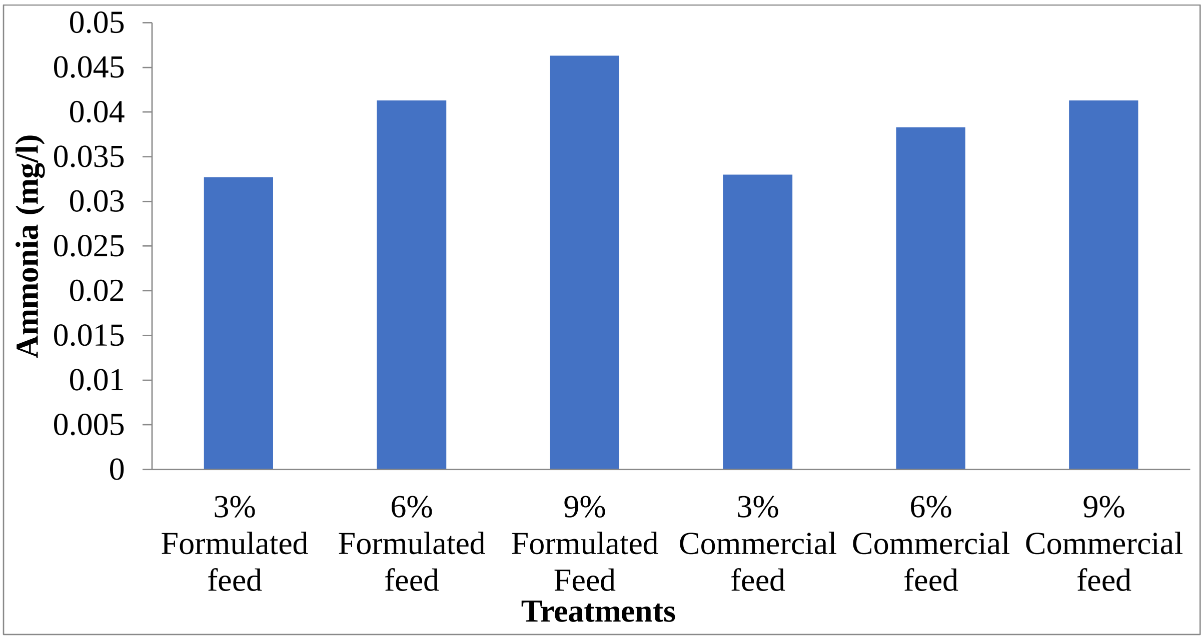



**Figure9.** *Mean water Ammonia of Clarias gariepinus fed formulated and commercial diets at different feeding rate*




## Discussion

Nutrition has been well documented as an important factor affecting fish health (Glencross 2009) fish reproductive performance, (Kaushnik *et al*., 2011; Chong *et al*., 2004) labor and facility operating costs even research outcomes. Yet, as *Clarias gariepinus* increase in popularity, our fundamental understanding of essentiality of nutrients remains elusive, although there is an increase in effort toward this end.

The present study has showed that, growth performance of African catfish fingerlings can be significantly influenced by feeding regimes and feeding rates which strongly affect the feed ingestion and assimilation. The highest growth performance (final mean weight, Relative weight gain in percentage, and specific growth rate and Feed Intake) were recorded in fingerlings fed with twice/day formulated feed and thrice commercial feeds as shown in table 2 and 3. Fish that are fed less frequently can adapt to such conditions by consuming larger amounts of feed during each meal. If such a schedule is applied for a longer period, this can lead to increased gut capacity and to hyperhagia and reduction in the survival as presented in the result. Similar report was made by Sogbesan *et al*. (2010) when they fed Dutch Clarias at different feeding frequencies. Fish that are fed more frequently consume a larger amount of feed; however, when the intervals between meals are short, the food passes through the digestive tract more quickly, resulting in less effective digestion. Hence, determining the optimum feeding frequency is imperative.

Optimum feeding frequency for maximum growth of fish generally depends upon fish size, age and culture conditions including water temperature, food quality and amount of food provided. Sogbesan *et al* (2010) observed that in dutch clarias, best growth performance was recorded in fingerlings fed twice/day than fish fed once/day or thrice per day. In hybrid sunfish, fish fed once/day were smaller than fish fed 2, 3, or 4 times per day; however, there were no differences among the latter three feeding frequencies as documented by Gonzale *et al*. (2013). The present study similar to Dada and Wonah (2003) who reported that Exotic *Clarias gariepinus* fed twice/day had higher percentage weight gains, SGR and average final weight compared to fish fed once/day, once on alternate day and twice on alternate day. Data on Atlantic salmon, *Salmo salar*, has shown that feeding regime has little influence on growth provided that the fish are fed at *ad libitum*. A study by Alanara also confirmed that frequent feeding with an automatic feeder had a negative effect on rainbow trout. Normally fish species exhibits a rapid increase in activity during feeding; this may suggest that frequent feeding is a stress factor that elicits great expenditures of energy thus reducing the fish growth.

With regards to food conversion ratio, low FCR values were recorded in African catfish fed with twice every other day followed by once a day and twice/day respectively whereas significantly no difference in FCR values observed in fingerlings fed with all the feedings regimes except once every other day fed groups. This indicates that the efficiency of feed utilization and feed conversion was not influenced by the feed frequency. This might indicate that African catfish fed more frequently might utilize diet less efficiently than fish fed less frequently. Teng and Chua (1998) reported the same in grouper fed once/day or twice/day had similar FCR values and that there was no difference in FCR Sogbesan *et al*. (2010a) stated that feeding frequency had little effect on FCR. This may indicate that food consumption is the growth limiting factor. As found for other fish species, the greater the feed intake, the greater the growth response and similar was recorded in this study. This was the expected result since a higher amount of nutrients in terms of Protein Intake (PI) become available to the fish when they are fed more often.

The water temperature, pH and dissolved oxygen recorded in this study fall between the acceptable range for fish growth and health. In the present study, survival rate ranged within 90.5% to 99.0% in frequencies feeding while those of feeding rate was 89.5% to 98.0% was observed in fingerlings fed with once every other day groups. However, no significance difference ($p<0.05$) was in the survival difference observed in the other feeding regimes. This could be due to the time interval between the next meal is longer than the other feeding regimes that could have given more appetite, aggressive behavior and cannibalistic behaviour in the once every other day fed groups. Survival in the present study was higher than the range reported by Agnese *et al*. (1995) in juvenile, of *Heterobranchus longifilis* had survival rate between 62-75%. The survival rate range (68-90 %) was recorded in the catfish *H. longifilis* which is more or less similar to the present study.

In fishes, cannibalism is usually associated with heterogeneous size variation, limited food availability, high population densities, limited refuge areas, and light conditions. In the present study size variation and food availability are considered the primary causes of cannibalism. This study suggests that body composition of African catfish fingerlings is affected by the frequency of feeding. African catfish fed once a day and once every other day had less lipid content than fish fed twice/day and twice every other day. The results of the present study based on the growth performance and feed utilization suggests that *C. gariepinus* fingerlings should be fed at twice a day for maximum growth and better survival.

Physicochemical water quality parameters such as temperature, pH, Ammonia and dissolved oxygen were given in Figures 3-10. These indicated variations within each of the treatments. The ranges of values of the physicochemical parameters during the experimental period for different feeding frequencies were as follows: pH 7.07 -7.39;

dissolved oxygen 4.37 – 5.12 mg/L, Ammonia 0.0317 – 0.047 mg/L and temperature 28.68--28.87°C while for Feeding rates were pH 7.17 -7.69; dissolved oxygen 4.67 – 5.38 mg/L, Ammonia 0.0327 – 0.0463 mg/L and temperature 28.68--28.87°C. Mean temperature, pH and dissolved oxygen levels, were found to be not affected by feeding frequency during the four weeks feeding trial. The recorded mean values of all these parameters were within the acceptable limits for fish growth and health (Boyd 1979; Sogbesan *et al*. 2010b). Dissolved oxygen is known as an indicator of water quality, ecological status and pond productivity including the health status of fish. The fact that the Dissolved Oxygen recorded were within the recommended range shown in the condition factor of the fish given each of the treatments as all were above 1.0.

## Conclusion

Two hundred and thirty (230) fingerlings of *Clarias geriepinus* was sourced from reputable fish farm in Yola. The fish were randomly stocked at 10 fish per tank of 50 litres volume. The first set was on feeding frequency regime while other on the feeding rates. The feeding diets were formulated and commercial diets. While the frequencies considered were ones, twice and thrice and feeding rates were 3%, 6% and 9% respectively. The crude protein was 44.6% and 45.0% for Formulated feed and Coppen respectively. There was no significant difference (p>0.05) between the nutrient's values of formulated feed and Coppen rather there was between the gross energy value for the two diets.

The ranges of values of the physicochemical parameters during the experimental period for different feeding frequencies were as follows: pH 7.07 -7.39; dissolved oxygen 4.37 – 5.12 mg/L, Ammonia 0.0317 – 0.047 mg/L and temperature 28.68--28.87°C while for Feeding rates were pH 7.17 -7.69; dissolved oxygen 4.67 – 5.38 mg/L, Ammonia 0.0327 – 0.0463 mg/L and temperature 28.68--28.87°C.

Highest specific growth rate of 1.49%/day was recorded in *C. gariepinus* fed commercial diets thrice.

Highest Specific growth rate of 1.53%/day was also recorded in *C. gariepinus* fed commercial diets at 9% feeding rate

Lowest Feed Conversion rate of 1.28 and 1.27 were recorded from *C. gariepinus* fed commercial feed thrice and those fed commercial feed at 9% feeding rate respectively

The water qualities recorded were within the recommended rate for aquaculture.

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