Assessment of Some Commercial Feed Brands in Nigeria on Growth Performance of *Clarias gariepinus* Fingerlings

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Abstract: This study assessed three commonly available commercial catfish feed brands on growth, survival and nutrient utilization of Clarias gariepinus fingerlings under controlled conditions; providing information on the integrity and quality of some of the feeds in the market. C. gariepinus fingerlings (3.83± 0.22g) were fed to satiation twice daily at 9.00hr and 18.00hr with 2mm pellet size of three commercial diets scripted TD, TT, and TV in concrete tanks. Growth performance and nutrients utilization parameters were measured and calculated; water quality parameters were controlled using a partial flow-through system. ANOVA showed that there were significant differences (P<0.05) in the mean weight gain, specific growth rate, survival rate, food conversion rate, nitrogen metabolism and protein efficiency ratio. TV had the most significant value for mean weight gain (41.54 ± 4.09g), specific growth rate (1.65 ± 0.04g/day), feed conversion rate (0.7), nitrogen metabolism (951.91), and protein efficiency ratio (2.57) with 90.00 ± 5.0% survival rate; TD had significantly highest survival ration (92.50 ± 4.51%) with mean weight gain 36.77 ± 0.48g. Proximate analysis of TD, TT and TV revealed that macronutrients therein significantly different from the brands' claim, except TD. This study revealed that, for fast fish growth on less expensive feed desired by catfish farmers, commercial catfish feed brand tagged TV, was the best, giving a better growth performance and nutrient utilization, at 48.3% CP, 6.01% Fat, and 3.03% CF.
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1. Introduction

Fisheries occupy a unique position in the agricultural sector of the Nigerian economy. In terms of gross domestic product (GDP), the contribution of the fisheries sub-sector to agriculture GDP was estimated as 4.0% in the year 2007, out of the total estimate of 40% being contributed by agriculture to GDP (FDF, 2008). The Food and Agricultural Organization of the United Nations (FAO, 2006) stated that Nigeria is a protein-deficient country. Protein deficiency in diet can be primarily remedied through the consumption of either protein-rich plant or animal foodstuffs. Protein from animal sources is in short supply in Nigeria due to the annual rapid increase in human population as well as the decrease in livestock population due to several factors including diseases, desertification, drought, climate change, global warming, scarcity and high cost of quality feeds, poor genetic qualities, limited supply of indigenous breeds and avian flu disease (H5N-1) which brought about mass mortality of poultry. These factors have raised the cost of animal protein to a level that is almost beyond the reach of the ordinary citizen. This situation therefore has given rise to a considerable increase in the demand for fish to supplement the needed animal protein intake.

Fish provides 40% of the dietary intake of animal protein to the average Nigerians (FDF, 1997). Fish and fish products constitute more than 60% of the total protein intake in adults especially in rural areas (Adekoya and Miller, 2004). According to FAO (2006), to maintain the present per caput fish consumption level of 13kg per year, 2.0 million metric tons of food fish would be required. It has been noted that the only means of meeting up with this annual fish demand for the country would be through a pragmatic option of intensive fish farming (Ezeri *et al*., 2009). There are various reasons to merit the eating of fish. One is that fish is less tough and more digestible compared to beef, mutton, chicken and bush meat. Fish has a better nutrient profile to all terrestrial meats (beef, pork and chicken etc.), being an excellent source of high quality animal protein and highly digestible energy; a good source of sulphur and essential amino acids such as lysine, methionine, leucine, valine and arginine. Because of its high digestibility, fish is usually recommended to patients with digestive disorders such as ulcers (Eyo, 2001), the young and the elderly. It is therefore suitable for supplementing diets of high carbohydrates contents (Amiengheme, 2005); which is the base of Nigerian and Africans diets.

Despite the abundance fisheries resources and high consumption of fish in Nigeria that is the largest consumer of fish products in Africa (FDF, 2005; 2008); Nigeria's domestic output of 0.62 million metric tonnes still falls short of demand of 2.66 million metric tonnes (FDF, 2008). A supply of deficit of 2.04 million metric tons is required to meet the ever increasing demand for fish in Nigeria. This large deficit at risk as the exploitation of natural fish stocks which is reaching its limits (Mutume, 2002). Although there is a paucity of information on the status of the fisheries industry and the role it plays, it is estimated that Africa produced 7.3 million tons in 2003, and 4.8 million tons was from marine fisheries (FAO, 2005).

Nigeria spends ₦100 billion on fish importation annually and the current fish demand consumption in Nigeria stands at over 2.66 million tonnes per annum, while the present importation rate is over 750,000 metric tonnes (Oota, 2012). With importation of more than 750,000 MT of fish, more than USD 600 million are spent in hard currency and thousands of jobs are exported(USAID, 2010). The species imported are mainly herring, mackerel and stock-fish to offset the deficit of 2.04 million metric tons. However, it has been shown that the country can substitutes fish importation with domestic fish production to create jobs, reduce poverty in rural and peri-urban areas where 70% of the effect on the exchange earnings of the national economy as well as caput consumption 9.68kg/ head/year (FDF, 2008).

According to Atanda (2007) fish farming has been recognized as a viable means of increasing domestic fish production. Most recent investment in aquaculture has been targeted towards catfish farming (Abdullah, 2007). About 90% of farmed fish in Nigeria is catfish which is now a major attraction to private sector investors; catfish attracts premium price with a high ROI (Return on Investment) ranging between 40 – 60% in some very successful enterprise (Atanda, 2007). Investment in cat fish is still growing especially with the renewed awareness being created by the government.

The type of culture medium used and their management have a significant influence on fish farm profitability (Rossand Waten, 1995). According to Hankins *et al.* (1995) fish culture medium and their accessories add up to a large portion of fish farm capital. Therefore, there is need to choose the best production system with good operating strategy to optimize fish farm profitability. There are various ways used by fish farmers to raise fishes for sale or for family consumption. Fishes are raised in big bowls, in unused canoes and in depressions that can hold water as well as in constructed concrete tanks and earthen ponds.

Catfish production is important to the Nigerian economy. It serves as a source of income, reduces the rate of unemployment in the economy and increases the Gross Domestic Product (GDP). In most countries it fetches a higher price than tilapia as it can be sold live at the market as they have a market value two to three times that of tilapia (Emokaro, 2010). According to Olagunju, e*t al.*, (2007), it requires less space, time, and money, and has a higher feed conversion rate.

The importance of catfish itself cannot be overemphasized. According to Anoop *et al.*, (2009), it provides food for the populace, it allows for improved protein nutrition because it has a high biological value in terms of high protein retention in the body, higher protein assimilation as compared to other protein sources, low cholesterol content and one of the safest sources of animal protein. Many species of fish are farm produced all over the world, but catfish is taking the lead because of its uniqueness. The demand for catfish in Nigeria is unprecedented so much that no matter the quantity supplied into the market, it would be consumed by ready buyers. This is so because of its low caloric value, low carbohydrate and high protein content, low fat, quick and easy to prepare, and above all, it tastes good. Feed and feeding of catfishes in ponds and tanks are very important. Various efforts have been made to establish the crude protein and amino acid requirements of *Clarias gariepinus.* Ayinla (1988) recommended 35% and 40% crude protein for raising table size and brood stock respectively. The production cost of catfish in which feed takes over 60% (Nwanna, 2002), has pushed the market price of catfish beyond the reach of poor Nigerians. As such, catfish consumption in Nigeria remains the delicacy of the wealthy. Engaging in catfish farming in Nigeria is a goldmine that can guarantee 100% return on investment with 90 days payback period (Emokaro *et al.*, 2010; Business World, 2011).

Aquaculture production in the developing countries is greatly constrained by undersupply, scarcity and high cost of conventional quality fish feeds. The ever increasing cost and uncertainties about the quality and availability of some of the fish feed ingredients have compelled many fish farmer to patronize any available, conventional catfish feeds in the market. Table 1 shows some of the available catfish feed in Nigeria. It is broadly noted that despite the use of expensive, scarce conventional catfish feeds by farmers, catfish growth performance in terms of weight gain and survival rate varies from one feed brand to the other. The development of formulated feeds that can satisfy the nutritional requirement of the fish is considered to be one of the major tasks in aquaculture.

The high cost of feed is a major factor against the rapid growth of aquaculture in developing countries. The nutrient composition of feed influences feed utilization and ultimately the growth of fish. Given that feed is the highest recurring cost in catfish culture, catfish farmers, who are lured with different catfish feed brand options, hence, this research, which investigated the optimum growth performance of different catfish feed brands on *Clarias gariepinus* fingerlings in concrete tanks, will be of benefit to such farmers.

Table 1: Cost Price of Some Available Fish Feeds in Nigeria

Feed name	Pellet size (mm)	Price/bag (₦)	Price/kg (₦)
Vitafeed	2 – 6	3800 – 4000	253 – 267
Coppens	2 – 6	5150 – 5500	343 – 367
Durante	2 – 6	5100 – 5300	340 – 353
Aquafeed	2 – 6	5000 - 5200	333 - 346
Pira	2 – 6	3900 – 4050	260 – 270
Raanan	2 – 6	4500	300
Multifeed	2 – 8	4500 – 4800	300 – 320
Top feed	2 – 6	3600 - 4200	240 - 280

Source: Adapted from IBAR (2013) and field survey

Therefore, there is need to investigate the integrity and quality of some of the available conventional catfish feeds in the market, and determine the one(s) that is cost effective in terms of fish performance within a notable culture period and culture medium. Feed trials have been carried out on *Clarias gariepinus* to evaluate their growth response to different readily available local plant and animal protein sources (Otubusin *et al* 2009, Sotolu 2009). Studies on the effect of feeding frequency, rates and feed efficacy of *C. gariepinus* fingerlings and juveniles have been carried out by some researchers (Aderolu *et al*, 2010, Gabriel *et al*, 2008). Therefore, objective of this study is to evaluate the effect of three commonly available commercial catfish feed brands on growth and survival of *C. gariepinus* fingerlings under controlled conditions and economics of use.

2. Materials and Method

One thousand healthy fingerlings of *Clarias gariepinus* were procured from a reputable commercial fish farm in Ibadan, Oyo state, Nigeria. Fish were transported in an open 50L container to experimental site at the University of Ibadan and allowed to acclimatize for two weeks. Pellet size 2mm of three commonly available commercial catfish feeds in Ibadan region was procured from Adom Feed Depot, a reputable animal feed store in Ibadan, Oyo state, Nigeria.

Completely Randomized Design (CRD) was adopted for the experiment. A total of three treatments were setup with each treatment representing different catfish feed brand. Each treatment was in triplicate, making a total of nine experimental treatment units. After two weeks of fish acclimatization, fingerlings (3.83± 0.22g) were stocked at 88 fingerlings per cubic meter in 1m x 1m x 1m hapas of 1.6mm mesh size was setup in an 8m x 3m x 1.5m concrete tank. Each hapa representing a treatment was labeled as stated in Table 2.

The fish were fed to satiation twice daily at 9.00hr and 18hr respectively for a period of 90days.

The daily feed intake was measured using the weighing scale (OHAUS MODEL 5000). Feeding response and water quality were monitored. A partial flow-through water system was operated to keep the water quality optimum. Weight of a random sample of fish from all the 9 hapas were weighed biweekly using top load weighing balance (OHAUS MODEL 5000). Growth performances and feed utilization of fish were calculated after the experimental period.

The proximate composition of experimental diets and control diets were also chemically analyzed to determine the crude protein, lipid, ash, fiber and moisture content according to A.O.A.C (1990, 1970) and Hach (1990). Water quality of the culturing tanks was monitored throughout the experiment. Parameters measured were Temperature, pH, dissolved oxygen, nitrate, ammonia, and alkalinity. Temperature was measured by using a mercury-in-glass thermometer of 0^0 c to 50 ^{0}c range and with 0.2^0c least count. The pH of water samples was determined in the laboratory using a pH meter (Inolab pH 720). Nitrate was determined according to Murphy and Riley (1962). Dissolved oxygen was measured using D.O meter. Ammonia and Alkalinity were determined accordingly following APHA *et al.* (2005) and ALPHA (2005).

Table 2: Feeding Trial Treatments

Treatments	Tank No	Composition
TD1	I	Catfish feed brand 1, 2mm
TD2		
TD3		
TT1	II	Catfish feed brand 2, 2mm
TT2		

TT3		
TV1	III	Catfish feed brand 3, 2mm
TV2		
TV3		

Mean Weight Gain (MWG): This was calculated as the difference between initial mean weight of the experimental fish and its final mean weight.

$MWG = (W_2 - W_1)$ g

Where: W_1= initial mean weight (g)

W_2= final mean weight (g)

Specific Growth Rate (SGR)

$$SGR\ (\%) = \frac{LogW2 - LogW1}{T2 - T1} \times 100$$

Where: W_2 = Final weight (g) at time T2 (end of experiment); W_1 = Initial weight (g) at time T1 (beginning of experiment); Log = Natural logarithm

Survival Rate (SR) %

This is calculated as:

$$SR = \frac{(\text{Initial number of fish stocked} - \text{mortality})}{\text{Initial number of fish stocked}} \times 100$$

Food Conversion Ratio (FCR): This is the amount of unit weight of food that specimens were able to convert to unit muscle. It was determined by:

$$FCR = \frac{\text{Feed intake (g)}}{\text{Total weight gain by fish (g)}}$$

Protein Efficiency Ratio (PER)

This was calculated from the relationship between the increments in the weight of fish (i.e. weight gain of fish) and protein consumed.

$$PER = \frac{\text{Mean weight gain (g)}}{\text{Protein intake}}$$

Nitrogen Metabolism (NM)

$$NM = \frac{(0.549)(a + b)h}{2}$$

Where:

a = initial mean weight of fish (g); b= final mean weight of fish (g); h= experimental period in days

Statistical Analysis: This experiment was conducted following a completely randomized design. All data were expressed in terms of mean ± standard deviation (SD). Treatment effects on different parameters were analyzed by one-way analysis of variance (ANOVA). Where significant differences were found, a Duncan's Multiple Range Test was performed to separate treatment means. All statistical analysis was performed using the SPSS version 17 for Windows.

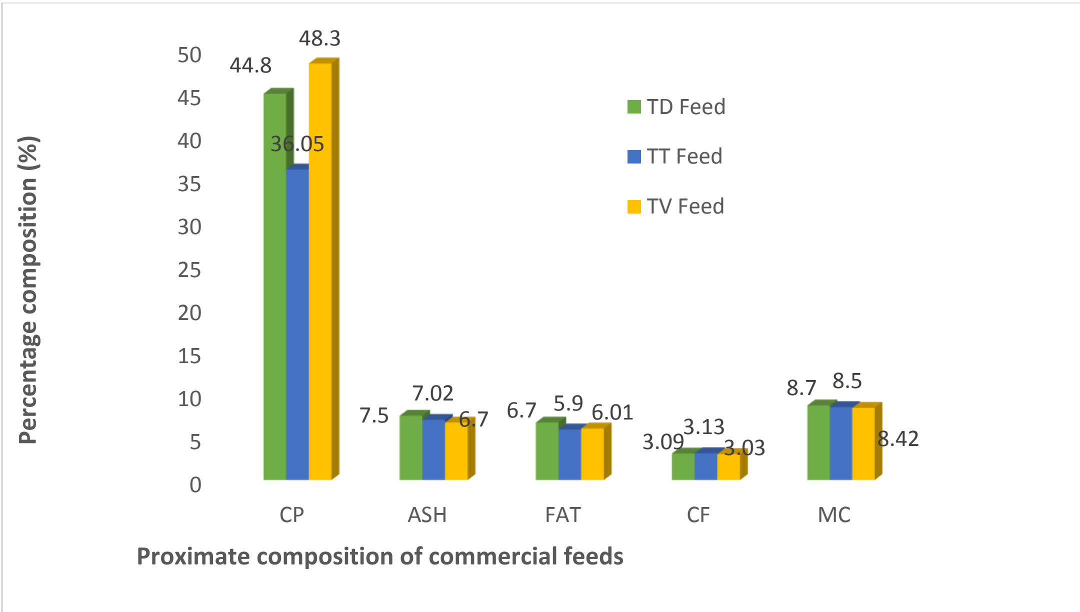
3. Results

The proximate compositions of three selected catfish feed brands diets fed to *Clarias gariepinus* fingerlings are presented in Figure 1. TV feeds had the highest crude protein (48.3%) and TT feeds had the lowest crude protein (36.05%) while TD had 44.8% crude protein. TD, TT feeds and TV feeds had 7.5%, 7.02%, and 6.7% ash respectively. Fat, crude fibre and moisture contents of TD, TT and TV feeds were 6.7%, 5.9%, 6.01%; 3.09%, 3.13%, 3.03%; and 8.7%, 8.5%, and 8.42% respectively.

Figure 2 compares the acclaimed compositions of the three feed brands and the laboratory proximate analytic compositions. TD feeds had approximately same values for crude protein (45%, 44.8%) and ash (8%, 7.5%). While values for fat (14%, 6.7%) and crude fibre (2.6%, 3.09%) differed, and there was no record for moisture content. A huge difference was observed with the values of crude protein (45%, 36.05%) and fat (10%, 5.9%) for TT feeds, while its ash (7%, 7.02%) and crude fibre (3%, 3.13%) contents had approximately same values; there is no moisture content recorded on the brand label. TV feeds also have different composition values. Crude protein (45%, 48.3%), fat (11%, 6.01%), crude fibre (2.8%, 3.03%), and moisture contents (12%, 8.42%) are significantly different. In addition, brand TV did not state the ash content present in it feed.

The mean of all the water quality parameters is presented in Table 3. The temperature recorded ranged from 27.84 ± 1.21ºC to 28. 74 ± 0.45ºC while the DO ranged 5.28 ± 0.68mg/L to 5.75 ± 0.13mg/L. The pH level observed also varied from 7.67 ± 0.42 to 8.23 ± 0.22. Ammonia level is between 0.26 ± 0.02mg/L and 0.33 ± 0.14mg/L. Alkalinity and Nitrate range from 126 ± 18.33mg/L to 135.27 ± 27.58mg/L and 2.14 ± 0.90mg/L to 2.27 ± 0.67mg/L respectively.

The growth parameters of *Clarias gariepinus* fed different feed brands and observed for 10 weeks treatment period, is shown in Table 4, revealed that treatment TV had the highest mean weight gain of 41.54 ± 4.09g while TT had the lowest mean weight gain, 25.02 ± 4.24g. The specific growth rate of TD, TT and TV are 1.60 ± 0.01, 1.45 ± 0.07, and 1.65 ± 0.04 respectively. Treatment TD had the highest survival rate of 92.50 ± 4.51% while TT had the lowest survival rate of 74.17±13.71%.



CP – Crude protein, CF – Crude fibre, MC – Moisture content, FAT – Ether Extract
Figure 1: Proximate composition of commercial feed brands

Analysis of variance revealed that there were significant differences ($p<0.05$) in the growth parameters. Post Hoc test separated means and it was observed that treatment TV had the most significant value for mean weight gain (41.54 ± 4.09^{ab}) and specific growth rate (1.65 ± 0.04^{ab}), with second most significant value for survival rate (90.00 ± 5.00^{ba}), while treatment TD had the most significant.

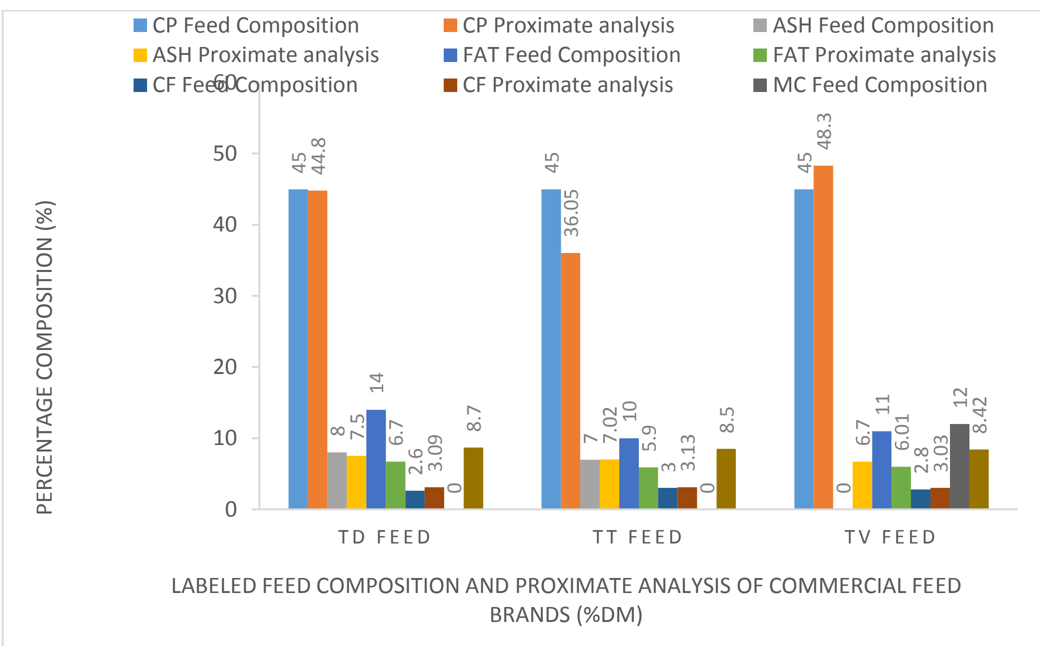


Figure 2: Comparison of labeled composition of commercial feed brands and their proximate analytic composition.

Table 3: Water quality parameters of the treatments

Parameters	TD	TT	TV
Temperature (°C)	28. 74 ± 0.45	28.24 ± 1.02	27.84 ± 1. 21
Dissolve Oxygen (mg/L)	5.28 ± 0.68	5.75 ± 0.13	5.37 ± 0.76

pH	7.58 ± 0.46	7.74 ± 0.25	8.23 ± 0.22
Nitrate (mg/L)	2.25 ± 1.01	2.14 ± 0.90	2.27 ± 0.67
Ammonia (mg/L)	0.33 ± 0.14	0.30 ± 0.09	0.26 ± 0.02
Alkalinity	135.27 ± 27. 58	126 ± 18.33	127.33±16.17

Value for survival rate (92.50 ± 4.51^{ab}), and the second most significant value for mean weight gain (36.77 ± 0.48^{ba}) and specific growth rate (1.60 ± 0.01^{ba}). Worthy of note was treatment TT that had the least significant values for mean weight gain (25.02 ± 4.24^{c}), specific growth rate (1.45 ± 0.07^{c}), and survival rate (74.17 ± 13.71^{c}). Feed utilization of *C. gariepinus* is presented in Table 4.

The feed conversion ratio, nitrogen metabolism, and protein efficiency ratio of treatments TD, TT and TV were as follows: 0.83, 0.81, 0.70; 853.72, 621.80, 951.91; and 1.86, 1.91, 2.57, accordingly. There were significant differences in the feed utilization parameters, as shown in Table 5. Post Hoc test revealed that treatment TD had the most significant value for feed conversion ratio (0.83^{ab}), followed by TT (0.81^{ba}) and TV (0.7^{c}), respectively. Treatment TV had the most significant value for nitrogen metabolism (951.91^{a}), followed by TD (853.72^{b}), and TT (621.80^{c}). Following the same pattern, TV had the most significant value for protein efficiency ratio (2.57^{a}), but TD had the least significant value (1.86^{c}) while TT (1.91^{b}) was second to TV.

Biweekly growth pattern of Clarias gariepinus fed different commercial feed brands is shown in Figure 3. Second week weight gain ranged from 1.87g (TD) to 2.45g (TV) while in 10th week weight gain ranged from 25.02g (TT) to 41.54g (TV). From the growth pattern, it was observed that treatment TT had the lowest growth rate, though it was consistent, while treatment TV had the fastest growth characterized with inconsistent growth pattern (zigzag) as noted in week 8 (slow growth rate). Treatment TD had a consistently fast growth pattern as compared to others.

The proximate composition of *Clarias gariepinus* after the experiment is presented in Figure 4 below. After the 10-week feeding trial, proximate analysis of the fish samples showed that treatment TT had the highest crude protein (64.75%), followed by TD (64.40) and TV (55.50%) with the least crude protein. Ash, fat, crude fibre, and moisture content of fish samples from treatments TD, TT and TV are as follows: ash (6.01%, 6.20%, 7.70%), fat (16.11%, 16.50%, 15.90%), crude fibre (0.03%, 0.05%, 0.01%), and moisture content (69.30%, 70.12%, 69.11%).

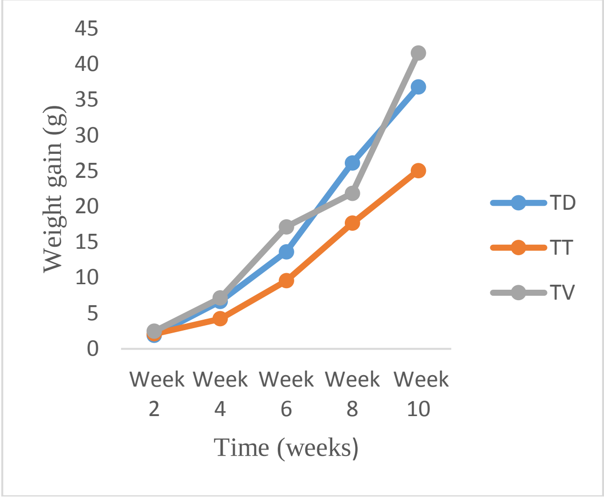
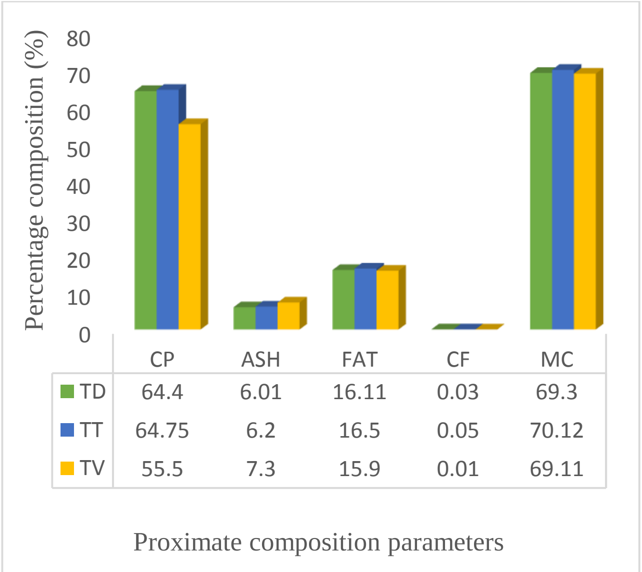


Figure 3: Pattern of biweekly weight gain of Clarias gariepinus



CP – Crude protein, CF – Crude fibre, MC –Moisture content, FAT – Ether Extract

Figure 4: Proximate composition of Clarias gariepinus after the experiment.

Table 4: Growth performance and feed utilization parameters

Parameters	**Treatments**		
	TD	**TT**	**TV**
Growth performance			

Initial Weight (g)	3.83 ± 0.14	3.67 ± 0.14	4.00 ± 0.24
Final Weight (g)	40.60 ± 0.59	28.69 ± 4.38	45.54 ± 3.89
Mean Weight Gain (g)	36.77 ± 0.48[ba]	25.02 ± 4.24[c]	41.54 ± 4.09[ab]
Specific Growth Rate	1.60 ± 0.01[ba]	1.45 ± 0.07[c]	1.65 ± 0.04[ab]
Survival Rate	92.50 ± 4.51[ab]	74.17 ± 13.71[c]	90.00 ± 5.00[ba]
Feed utilization			
Feed Conversion Rate	0.83[ab]	0.81[ba]	0.7[c]
Nitrogen Metabolism	853.72[b]	621.80[c]	951.91[a]
Protein Efficiency Ratio	1.86[c]	1.91[b]	2.57[a]

Mean values in row with the same alphabet are not significantly different (p>0.05)

4. Discussion

Clarias gariepinus fed diet TV, 48.3% CP and 6.01% Fat, had significantly highest weight gain 41.54 ± 4.09g (p<0.05); followed by diet TD, 44.8%CP and 6.7% Fat (36.77 ± 0.48g). Survival for all the treatments was high except for TT with 74.17 ± 13.71% survival rate; TD and TV had highest survival, 92.50 ± 4.51% and 90.00 ± 5.00% respectively.

The growth results indicate that all the diets promoted growth in *C. gariepinus* fingerlings, but fish grew significantly larger on feed containing the higher protein and lipid levels (44 – 48.3% CP, 6.01 – 6.7%Fat respectively). These growth rates compare well with the results of comparative feed trials conducted in the riverine catfish *Rita rita* by Amin *et al,* (2010) who recorded significantly higher growth rates in juveniles fed chicken viscera (47.58% CP) as compared to local prawn (45.75% P) and formulated feed (43.5%). The results also compare well with comparative feed trials of Rahman *et al* (1997) and Henken *et al* (1986) who recorded best growth results for feed containing 40% and 58% CP respectively in *Clarias* spp. The results agree with that of a Giri *et al* (2003) who reported an increase in body weight gain and SGR in post larvae in Clarias hybrid fed increased level of protein in a study conducted using 250, 300, 350, 400g (CP) kg-1 dry matter.

The proximate analysis result of the three experimental diets revealed differences in the macronutrients claimed by manufacturers, according to their labels; though diet TD had approximately same composition levels. These differences most likely accounted for the observed difference in growth rate. In addition, an apparent sensory difference among the three feeds used was in their flavour. Diets TV and TD had stronger fishy odour and they were oily, as compared with diet TT. It is characteristic of *C. gariepinus*, like most catfish, to mostly feed using olfactory senses; this may have made the feeds more noticeable and attractive than the latter; although all the feeds were readily consumed by the fish.

Protein is the main growth promoting factor in feed. The protein requirement of commercial fish are influenced by various factors such as fish size/age, water temperature, feeding rate, availability and quality of natural foods and overall digestible energy content of diet (Satoh, 2000; Wilson, 2000). From proximate analysis of chosen commercial feeds as experimental diets, the crude protein content were within the acceptable range recommended for commercial fish (NRC, 1983). Most of the commercial fish feeds, for example catfish feeds contain 32% CP (Wilson, 2000).

Also, Boonyaratpalin (1988) estimated the protein requirement for tropical catfish to be 35 -40%, 25 – 35%, and 28 – 32% for fry, growth-out and broodstock. In contrast, from this study, catfish fingerlings fed diets of 44 – 48% crude protein had a better growth performance. This is supported by Watanabe *et al* (1990) and Olukunle and Taiwo (2004) who stated that fish production increase through the utilization of diets with high amounts of protein, that is 35% CP and above, in their diet and that phase feeding may be more profitable.

Lipids are primarily included in formulated diet to maximize their protein sparing effect by being source of energy. The observed lipids (fat) 5.9 – 6.7% in all diets were in contrast with the report of Wilson (2000) who stated that the lipid level in catfish feeds should be 5 – 6%, except for diet TT (5.9% Fat) that was within the recommended range. Fibre provides physical bulk to the feeds. Certain amount of fibre in feed allows better binding and moderates the passage of feed through the alimentary canal. High fibre content results in low digestibility of nutrients. The fibre content in all the three diets TD, TT, and TV were similar, 3.09%, 3.13%, and 3.03%; which are lower than the recommended 8 – 12% in diets (De Silva and Anderson, 1995). This suggests that the crude fibre content of the three commercial diets were under safe dietary limit for fish.

Generally, better feed conversion ratio values were obtained in all treatments. These results suggest that diets TD, TT, and TV were better utilized, nevertheless, TV was most utilized by the fish. Nutrient utilization results suggest the presence of some nutrients utilization promoters which is reflected in weight gain, FCR, PER, NM, and SGR, especially in TV and TD. This suggests the presence of growth enhancer and differences in the composition of the diets, as demonstrated by the irregular pattern of biweekly weight gain. This observation is further supported by the proximate composition of fresh fish samples from all the treatment, wherein TV having significantly high growth performance and nutrient utilization had lowest crude protein content, relatively high minerals (ash), and low fat content, as compared with TD and TT under the same culturing environment.

Similar observation was reported by Dada and Olugbemi (2013) who noted that fingerlings of *C.gariepinus* fed commercial feed additives had high FCR (0.74 to 0.86), and suggested that dietary feed additive promoted the growth of *C. gariepinus* fingerlings. EL-Haroun (2007) also reported that African catfish fingerlings fed on diets supplemented by commercial feed additive Biogen® exhibited faster growth than those fed with the control diet. Furthermore, in catfish, *C. gariepinus* (Turan and Akyurt, 2005), tilapia *Oreochromis niloticus* (Khattab *et al.*, 2004; Felicitta *et al.*, 2013), olive flounder *Paralichthys olivaceus* (Cho and Lee, 2012) and shrimp *Peneaus indicus* (Olmedo Sanchez *et al.*, 2009) feed additives in diets promoted growth and feed efficiency.

5. Conclusion and Recommendation

Commercial feeds are important in the growth of African catfish *C. gariepinus* fingerlings. Catfish feed TD, TT and TV are used at various level of successful catfish production. However, the increasing cost is a major constraint to most fish farmers. Examining a cost effective commercial catfish diets is essential to ensuring reduced production cost while at the same time sustaining production of high-quality fishes. This study revealed that, for fast fish growth at low/ cheap feed desired by catfish farmers, commercial catfish feed brand tagged TV, is the best among the three commercial catfish feed brands examined, giving a better growth performance and nutrient utilization, combining 48.3% CP, 6.01% Fat, and 3.03% CF. These findings have practical importance in maximizing the growth and survival of fingerlings by feed managers during fingerlings rearing. As regards fish production, the present findings gave encouraging results which can support fish farmers and can significantly improve the economics of the fish farming/aquaculture sub-sector.

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