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Original Article

Comparative effect of local and foreign commercial feeds on the growth and survival of *Clarias gariepinus* juveniles

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Abstract

Growth and survival of *Clarias gariepinus* juveniles fed with a local feed and coppens commercial feed were observed for 16 weeks at the laboratory of the Department of Zoology, University of Ilorin, Nigeria. The proximate compositions and economics of the feeds and the water quality of the cultured tanks were assessed. Fish fed with coppens showed significant (P<0.05) higher weight increase, specific growth rate, protein efficiency ratio and low food conversion ratio than fish fed with local feed. Significant (P<0.05) higher mortality were recorded in fish fed with the local feed. The growth performance was a reflection of the proximate composition of the feeds with local feed having low crude protein (10.95%), lipid (3.95%) and ash (4.92%) when compared to coppens which had 42% crude protein, 12% lipid and 9.5% ash with protein being most significant. Carbohydrate (69.90%) and crude fiber (2.88%) were higher in the local feed than in coppens with an imbalance in carbohydrate and lipid ratio. Mortality was attributed to stress resulting from the poor quality of the feed. Cost of feeding with local feed to a weight gain of 31.67g was ₦80, while the cost of feeding with coppens to a weight gain of 148.58g was ₦16.

Keywords: *Clarias gariepinus*, African catfish, growth performance, coppens, water quality, survival rate, proximate composition

INTRODUCTION

Clarias gariepinus (Burchell, 1822) is the most commonly cultured fish species in Nigeria being more desirable for culture by the farmers than any other fish species. One of the main constraints in the production of the species is feed, coming from the high cost of imported commercial feed, lack of locally formulated feed which are nutritionally optimal and acceptable to the fish and affordable to the farmers. Fish feed has been projected to account for at least 60% of the total cost of production of the species (Gabriel *et al.* 2007).

In an attempt to find cheaper, affordable, available alternative fish feed to imported commercial fish feeds, various local fish feeds have been formulated from different varieties of sources. This has led to the emergence and proliferation of many fish feed industries in Nigeria manufacturing and selling all sorts of fish feed with bogus and questionable formulation, nutrients composition and production. Most fish farmers opt for this cheaper local feed without knowing the proximate composition, formulation and processing of the feeds.

A good *C. gariepinus* feed should contain essential nutrients such as protein, lipids or fats, ash (minerals), fiber, moisture, NFE (nitrogen free extract or carbohydrates) and vitamins in the right proportion and formulated in a balanced ration which will be acceptable, palatable and durable to the fish for its optimum growth.

According to Ayuba and Iorkohol (2012), there is paucity of information on the nutrient content of fish feed produced by different feed companies in Nigeria and no reliable published information on chemical composition of commercial feed and feed ingredients. Shyong *et al.* (1998) also reported the dearth of information on the evaluation of nutrient contents of commercial feeds. This

makes the farmers to rely only on the proximate composition of feed given by the manufacturers.

The growth of a fish is influenced by its feed utilization and the feed utilization is a function of the balanced nutrient composition of the feed. Studies of the growth response of *C. gariepinus* to feed have mainly concentrated on the replacement of fish meal with suitable alternatives by using different varieties of plants and animal sources as substitute, supplement or total replacement in fish feed and this has led to the development of all sorts of fish meal with varying or total inclusions of the plants or animals in the feed. Such feed are often called local, home or farm-made fish or aqua feed.

Very few studies have actually looked and compared the growth response of fish to these local feeds and the standard commercial feeds. These include Mollah *et al.* (2010) who compared local feeds and commercial feeds on the growth and survival of riverine catfish *Rita rita*, Shapawi *et al.* (2011) who compared the growth performance and body composition of humpback grouper *Cromileptis altivelis* fed on farm made feeds and commercial feeds and Ekanem *et al.* (2012) who compared the growth performance and food utilization of *C. gariepinus* fed on local Unical aquafeed and coppens commercial feed.

The objective of this study was to compare the growth response and survival of African catfish *C. gariepinus* fed with locally produced and a widely sold fish feed and an imported commercial feed of coppens. The proximate compositions of two feeds were also evaluated and compared with each other.

METHODOLOGY

One hundred and twenty juveniles of *C. gariepinus* were sourced from the hatchery of Kwara State Ministry of Agriculture, Ilorin, Nigeria. The fish were acclimatized in six 60- litre experimental plastic tanks (1x1x0.2 m) labelled L_1, L_2 and L_3 for the local feeding trials, C_1, C_2 and C_3 for the commercial feed trials under 12-hour light/dark cycle for 7 days prior to the start of the experiment at the laboratory of the Department of Zoology, University of Ilorin, Ilorin, Nigeria. The experiment was done in triplicates with 3 replicates for each feeding trial. Twenty fish were stocked into each tank.

At the start of the feeding trial, the acclimatized fish were starved for 24 hours, after which the mean initial body weight and total length were measured with mettler weighing balance and measuring board respectively.

Fish in tanks L_1, L_2 and L_3 were fed with local feed, while fish in tanks C_1, C_2 and C_3 were fed with commercial feed of coppens. The two feeds were purchased from a popular fish feed store in Ilorin, Nigeria. The proximate composition of the feeds was carried out according to AOAC (2003) at the Chemistry Department of the University of Ilorin, Ilorin, Nigeria.

Water quality parameters of the tanks such as dissolved oxygen, free carbon dioxide, temperature and pH were measured weekly with the aid of Lamotte Aquaculture Lab Model SCL-08.

All the fish were fed twice daily (8:00 am and 6:00 pm local time) at 3% of their body weight for a period of 16 weeks (112 days) from January, 2013 to April, 2013. The pellet size of the feeds was 2 mm at the start of the experiment and 4 mm towards the end of the experiment. The water in the tanks was changed weekly after sampling.

Sampling of fish was done weekly by randomly selecting 10 fish specimens from each tank at each time. The fish were weighed to the nearest 0.01 g and total length measured to the nearest 0.01 cm and their mean weights and lengths measured. At the end of the experiment, the final mean weight, mean weight gained, percentage mean weight gained, mean total length, mean length gained, percentage mean length gained, specific growth rate, food conversion ratio, protein efficiency ratio, number of survival, percentage survival, number of mortality and percentage mortality were calculated according to Sawhney and Gandotra (2010a), Eyo and Ekanem (2011) and Mustapha *et al.* (2014).

The economics of the feeds in feeding was evaluated through the market prices of the feeds, the quantity of the feeds used for one fish and the average weight gained for an individual fish. The exchange rate of Nigerian Naira to U.S Dollar is ₦160 = $1.

Statistical analysis

One-way analysis of variance, Duncan's new Multiple Range Test and Fishers Least Significant Difference (LSD) test were applied to the growth data, proximate composition of the feeds and water quality parameters to determine significant differences among the treatment means at $P< 0.05$. The statistical analysis was done using SPSS (Windows version 15.0).

RESULTS

The growth data of *C. gariepinus* fed with local and commercial feed of coppens is presented in Table 1, while the weekly growth performance in weight is shown in Figure 1. At the start of feeding trial, the mean initial body

weight and total length of the fish were 11.67±0.2 g and 11.60±0.1 cm respectively. There was significant difference (P<0.05) in the growth data among the fish species fed with two kinds of feeds. Fish in tanks C_1, C_2 and C_3 which were fed with imported commercial feed of coppens showed significantly (P<0.05) higher length and weight increase, specific growth rate (SGR), protein efficiency ratio (PER) and low food conversion ratio (FCR) than fish in tanks L_1, L_2 and L_3 which were fed with local feed. There was also significant difference (P<0.05) in the survival and mortality of the fish species in the tanks with higher percentage mortality and lowest survival rate recorded in L_1, L_2 and L_3 tanks.

Table 1: Growth parameters, survival and morality of *Clarias gariepinus* juveniles fed local and coppens commercial feeds

Parameters	*Local feed*	*Coppens*
Mean initial weight (g)	11.67±0.20	11.67±0.20
Mean final weight (g)	43.30±0.90	160.25±1.2
Weight gained (g)	31.67±0.60	148.58 ±1.1
Percentage weight gained (%)	271.04±0.6	1273.18±1.1
Mean initial length (cm)	11.60±0.10	11.60±0.10
Mean final length (cm)	22.30±0.20	34.50±0.80
Mean final length gained (cm)	10.70±0.50	22.90±1.00
Percentage length gained (%)	92.24±0.50	197.41±1.0
Specific growth rate (%/day)	00.50±0.10	01.01±0.80
Food conversion ratio	02.78±0.60	01.34±0.20
Protein efficiency ratio	01.46±0.40	11.98±0.80
Number of survival	50.0±5.00	58.00±2.00
Percentage number of survival (%)	83.33	96.67
Number of mortality	10.00±5.00	02.00±2.00
Percentage number of mortality (%)	16.67	3.37

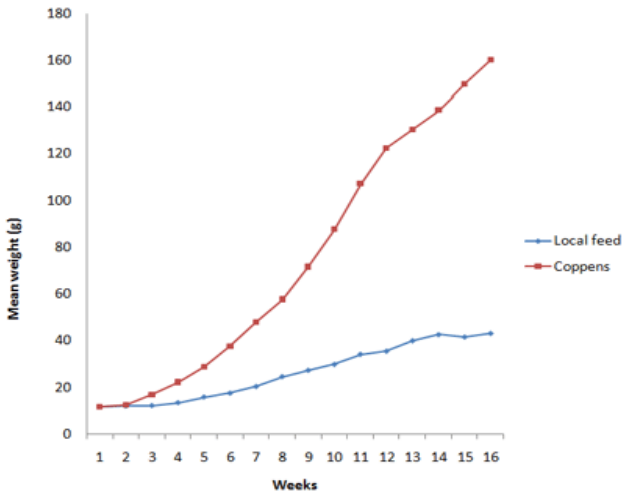

Figure 1: Growth performance of *Clarias gariepinus* fed with local feed and commercial feed of coppens

The proximate composition of the feeds revealed significant (P<0.05) differences in the composition of crude protein, lipid, ash, crude fiber and NFE while moisture content showed no significant differences (P>0.05). The local feed had low crude protein (10.95%), lipid (3.95%), ash (4.92%) when compared with the imported commercial feed of coppens which had crude protein of 42%, lipid 12%, ash 9.5%. The NFE (nitrogen free extract or carbohydrates) (69.90%) and crude fiber (2.88%) were higher in the local feed than in coppens which had NFE of 10% and crude fiber of 1.9% respectively (Table 2).

Table 2: Proximate composition of local and coppens commercial feeds used in feeding of *Clarias gariepinus* juveniles

Proximate composition	*Local feed (%)*	*Coppens (%)*
Crude protein	10.95	42.00
Lipid	03.95	12.00
Ash	04.92	09.50
Crude fiber	02.88	01.90
NFE (Carbohydrates)	69.90	10.00
Moisture	08.40	08.10

There was no significant difference (P>0.05) in the water quality parameters of the tanks. The pH and dissolved oxygen in tanks L_1, L_2 and L_3 were however lower than in tanks C_1, C_2 and C_3, while higher concentration of carbon dioxide was recorded in tanks L_1, L_2 and L_3 than in tanks C_1, C_2 and C_3. The range of temperature in the tanks was 24-30 °C (Table 3).

Table 3: Mean range of water quality parameters in the tanks

Parameters	*Tanks L_1-L_3*	*Tanks C_1-C_3*
Temperature (°C)	24.00-30.00	24.00-30.00
pH	05.50-07.60	06.50-08.00
Dissolved oxygen (mg/l)	04.70-06.80	05.80-07.60
Carbon dioxide (mg/l)	00.01-01.00	00.01-00.05

Table 4 shows the economics of the feeds during the feeding experiment. A kilogram of local feed costs ₦ 80, while a kilogram of coppens costs ₦ 200 (US$ 1.25). The cost of feeding one individual fish with local feed to a weight gain of 31.67 g was ₦ 80 (50 US cents), while the cost of feeding one individual fish with coppens to a weight gain of 148.58 g was ₦ 16.

DISCUSSIONS

Growth data parameters, survival and mortality are great tools for evaluating the effect of feed and its value

composition on fish species. This study showed that local feed used in this research (like most other local feeds sold and used for feeding *C. gariepinus* and other fish species in Nigeria) produced poor growth response in *C. gariepinus* as compared to the imported foreign commercial feed of coppens. The poor growth response as recorded from the length and weight gained, low SGR and PER and high FCR is attributable to the proximate composition of the local feed. According to De Silva and Anderson (1995), the quality of a feed is a function of how well that feed meets the nutrient requirement of a fish. The good growth performance of fish fed with coppens is an indication that the feed contained well balanced nutrients as seen in the proximate composition of the feed as well as its high digestibility and nutrient utilization.

Table 4: Economics and performances of the local and commercial coppens feeds in feeding one *Clarias gariepinus* juveniles

Parameters	***Local feed***	***Coppens***
Cost of 1 Kg ₦	80	200
Average quantity used to feed (g)	1000	80
Weight gained (g)	31.67	148.58
Percentage weight gained (%)	271.04	1273.18
FCR	2.78	0.34
Quantity of feed utilized (g)	88.04	50.51
Quantity of feed unutilized (g)	911.96	24.49
Percentage of feed utilized (%)	8.80	63.14
Percentage of feed unutilized (%)	91.20	36.86
Average cost of feeding ₦	80	16

The very low percentage composition of crude protein, lipid and ash and very high percentage composition of NFE or carbohydrate and crude fiber in the local feed were responsible for the poor growth performance of *C. gariepinus* when fed with the feed with protein being most significant and limiting the growth. It has been shown by various workers that fish growth is significantly influenced by the level of protein in the feed (Degani *et al.* 1989, Buttle *et al.* 1995, Siddiqui *et al.* 1998, Giri *et al.* 2003, Ali and Jauncey 2004a, Goda *et al.* 2007, Keremah and Beregha 2014, Corn'elio *et al.* 2014) with 40% dietary protein promoting maximum growth of *C. gariepinus* (Henken *et al.* 1986, Van Weerd 1995). The crude protein in the local feed was far less than the acceptable range recommended for commercial fish (NRC 2011). The low protein content in the local feed was responsible for the high FCR recorded in the fish. This shows that high amount of cheap local feed will be required to produce the fish to table size, thereby making the production of the fish more expensive as compared to expensive foreign feed which requires less feed to feed fish to table size. Sawhney and Gandotra (2010b) found that food conversion efficiencies in fish increases with increasing protein in the diet.

In addition to protein, the poor growth response in tanks L_1, L_2 and L_3 was due to very low level of lipid in the local feed. High amount of lipid ranging between 10-25% has been certified to produce the best growth performance in fish species (Jantrarotai *et al.* 1994, Erfanullah and Jaffri 1998, Ali and Jauncey 2004b, Agokei *et al.* 2011, Ali *et al.* 2012).

This study showed that *C. gariepinus* does not utilize large amount of carbohydrates for growth, but protein as observed in fish fed with coppens which contained a high percentage of protein. Mollah and Alam (1990) reported negative effect of carbohydrate on growth of *C. batrachus* fry when levels were maintained at more than 15% in the diet. Similarly, Tan *et al.* (2007) reported that carbohydrate in the diet of *Clarias* species should not exceed 20%, if it thus, FCR and PER begins to decrease.

The imbalance in carbohydrate and lipid ratio (CHO:L) in the local feed which was 17.69 was another reason why the fish fed with the local feed showed very poor growth response to the feed. Ali and Jauncey (2004a) observed that CHO:L ratios ranging from 1.70 to 3.40 produced significant improved growth performance and feed utilization in *C. gariepinus*. Erfanullah and Jaffri (1998) showed that imbalance with respect to non-protein energy sources and their inclusion levels may have direct effect on the growth, feed conversion, nutrient retention and body composition, with fish fed lowest or highest CHO:L ratio produced lower growth and feed conversion efficiencies. High FCR on account of reduction in feed intake observed in the tanks gave rise to a lot of uneaten feed thereby deteriorating the water quality with water pH becoming low (acidic) and carbon dioxide increased and dissolved oxygen decreased. Similar scenario has been reported by Tan *et al.* (2007).

Another possible cause of the slow growth performance in fish fed with the local feed is the high percentage composition of fiber in the feed. This could be due to the inability of the fish digesting and utilizing the high fiber content in the feed. High level of fiber content in feed has been observed to slow the growth of *C. gariepinus* fingerlings (Adewolu *et al.* 2010, Agbabiaka *et al.* 2013). In the results of Agokei *et al.* (2011), significant highest growth performance of *C. gariepinus* juveniles was found in the diet that contained <2% fiber content.

The low ash content found in the local feed could also be responsible for the poor growth performance of the fish

in L_1, L_2 and L_3 tanks. This occurred as a result of necessary mineral elements such as calcium and phosphorous that promotes growth in fish lacking in the local feed. Ali and Jauncey (2004b) noted a better growth performance of *C. gariepinus* on diet containing 9.3% ash content, while Alam *et al.* (2012) opined that ash content in the feed of *C. gariepinus* should not be less than 8%. High ash content of >12% in feed has been reported to produce better growth performance in *Clarias* species (Kiriratnikom and Kiriratnikom 2012, Corn´elio *et al.* 2014).

Only the moisture composition of the local feed was good and compared well with the imported feed of coppens. The low moisture content in the local feed was easily achieved than the nutrient composition because of the high abundance of solar energy in the Nigeria to dry the feed.

Anti-nutritive factors in the local feed ingredients which might not have been removed, bad formulation and inadequate processing of the local feed might all have synergistic effects on the growth performance of the fish when fed with the local feed.

The imported commercial feed of coppens used in this work which gave significant better growth performance in *C. gariepinus* than the local feed, and has also been reported to produce better growth performance in various species of fish when compared with local feeds. These include the work of Shapawi *et al.* (2011) who compared growth performance of humpback grouper *Cromileptis altivelis* fed on farm-made feeds and coppens and Ahmed *et al.* (2012) who showed that commercial feeds enhanced better growth performance of the fingerlings of *Labeo rohita*.

The proximate analysis of the coppens feed done in this research agrees with that of Agokei *et al.* (2011), Ekanem *et al.* (2012) and Ayuba and Iorkol (2013).

The high number of mortality recorded in tanks L_1, L_2 and L_3 was attributed to the poor quality of the feed, high FCR, low PER, low pH and DO_2, and high CO_2 concentrations. The lack of balanced ration in the feed gave rise to large amount of uneaten food which subsequently decomposed leading to the deteriorating water quality in the tanks. All these caused stress to the fish leading to their poor growth and mortality. Huntingford *et al.* (2006) stressed that lack of essential and balanced nutrients in feed could lead to poor growth and mortality, while Mustapha *et al.* (2014) observed that stressful conditions in culture tanks of *C. gariepinus* juveniles always lead to their mortality.

The inability of the fish species in L_1, L_2 and L_3 tanks to completely eat the local feed could be linked to the less fishy odor of the feed since *C. gariepinus* uses olfactory senses during feeding. Agokei *et al.* (2011) noted that high growth performance of *C. gariepinus* fed on coppens could be traced to fishy odor emitted by the feed.

The hardy nature and ability of the *C. gariepinus* to tolerate poor water quality made the mortality to be minimal considering the period of the experiment (112 days). The water quality parameters in the six tanks were within the tolerable limits for the culture of the species.

Among the short comings of the local feed when compared to coppens was the inability of the feed to float when dispensed, rather it sinks to the bottom of the tanks. Although, *C. gariepinus* is a bottom feeder, the species prefer floating feeds to sinking ones during experiment. The high CHO content in the local feed might not have been cooked and could be the reason why the feed sinks.

The lack of balanced nutrients and poor proximate composition of the local feed which reflected in the high FCR when fed to fish was also seen in the economics of the feeding and feeding. ₦ 80 was used in feeding one fish to a weight gain of 31.67 g as opposed to ₦ 16 used in feeding a fish with coppens to a weight gain of 148.58 g. This is a case of penny wise pound foolish for the farmer who thinks the local feed was cheaper and did not consider the FCR, PER, SGR and weight gain of the fish fed with local feed as compared to those fed with imported expensive feed like coppens.

CONCLUSION

The present study revealed that most local feeds available in the market are not good enough to enhance growth of fish species. This is due to the unguided use of plants and animal ingredients in formulation, without recourse to the nutrients composition of the ingredients, the fish requirements, lack of balanced ration most especially protein and lipid in the proximate composition of the feed, bad formulation and inadequate processing. The use of this kind of local feed will make culture of species such as *C. gariepinus* to be more expensive at the long run because it will take more time, more feed, more production cost for the fish to attain table or market size thereby making aquaculture un profitable and unattractive to people. Although producing local feed by the use of locally available ingredients is good and helpful to the growing aquaculture industry in Nigeria as it will reduce the cost of production of which feed takes about 60%, it is necessary that each manufactured local feed must be tested and found to have all necessary nutrients in appropriate proximate composition percentage for fish before being certified by the government authority for

sale to the farmers. It is recommended that feeding trial of the local feed on fish should be carried out before the feed is allowed to be sold in the market in order to determine their efficiency and performance which should compared well with the imported feeds, while routine samplings and quality control of the feeds should also be carried out regularly. There should regularly training of fish farmers on how to formulate and produce nutritionally balanced high quality fish feed. Government should help by subsidizing the cost of locally fabricated feed manufacturing machines (especially extruded and pelleting machines used in making floating and appropriate size feeds) thus making it affordable to fish farmers. In formulating such least-cost local feed, linear programming technique could be employed which will establish an optimum replacement level of fish feed with plant and animal ingredients and standard for a nutritionally balanced and palatable diet for the fish. Doing all these will help in increasing aquaculture production and make it attractive to everybody and it will go a long way in providing income as well as cheaper and affordable fish to meet the protein needs of the people.

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