

# The Growth Performance of African Catfish (*Clarias gariepinus*) Fed Commercially Prepared Imported Fish Feeds

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**Abstract:** The experiment was conducted to investigate the effects of different imported fish feeds on the performance of juvenile African Catfish (*Clarias gariepinus*). A-13 week feeding trial was conducted using 225 juveniles which were randomly assigned to five treatment groups in 15 indoor plastic tanks at a stocking rate of 15 fish per tank and three (3) replicates per treatment. The fish were fed at 5% body weight, twice daily. The five treatments were Coppens (T<sub>1</sub>), Aqua (T<sub>2</sub>), Ranna (T<sub>3</sub>), Pira (T<sub>4</sub>) and Durante (T<sub>5</sub>). Data for each parameter was subjected to one-way analysis of variance (ANOVA) while means of various results were compared at 5% level of significance. There were significant differences ( $P<0.05$ ) in the weight gain among the treatments, with 54.07g and 21.73g for fish fed with Aqua and Rana respectively. Also, there were significant differences in the specific growth rate (SGR) as well as the protein efficiency ratio (PER) among the feed brands with Aqua and Rana having 2.79 and 1.97 as well as 1.49 and 1.12 respectively. In all the treatments, there were significant differences ( $P<0.05$ ) in the survival rates of the fish with the highest percentage in fish fed with Coppens (93.33%). A kilogram of Aqua and Pira feeds each cost \$1.75 while the estimated costs of feeding one individual fish to a weight gain of 1kg using the same feeds were \$2.78 and \$3.73 respectively. Although, from this feeding trial, it is expensive to raise a kilogramme of fish using Pira fish feed, but due to the high survival rate, it is recommended for catfish production. It is assumed that the biomass harvested will make up for the cost incurred.

**Keywords:** African Catfish, Growth Performance, Imported Fish Feed

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## 1. Introduction

Fish is an important source of high quality protein in human diet, providing about 16% of the animal protein consumed by the world's population [1], [2]. It accounts for 20% of animal protein consumed in Africa [3], [4] and is also an important source of other nutrients such as vitamins A, B and D as well as calcium, iron and iodine [5]. Aquaculture, the farming of aquatic organisms [6], [7] including fish, molluscs, crustacean and aquatic plant is necessary in meeting the protein need of Nigerians [8]. Aquaculture has grown by 6.9% per annum since 1970 [9] and now provides half of global fish supply [10]. As global demand continues

to grow, there are opportunities for aquaculture to expand sustainably [9]. In Nigeria, it remains the only option that may ensure the maintenance of the current level of per capita supply of fish of 6.6 kg/year especially with the declining situation of capture fisheries [11]. The African catfish (*Clarias gariepinus*) is the major species cultured in Nigeria because of its high growth rate, good flesh quality, tolerance to poor water quality, ability to withstand high stocking densities, and good taste [12].

In aquaculture, fish requires adequate food supply in the right proportions and with proper nutritional contents needed

for growth, energy, reproduction, movement, and other activities [6], [7]. Fish feeds in sustainable fish culture system, has been reported to account for 40-60% of the total recurrent cost of production [8], [6] which to a large extent determines the viability and profitability of fish farming enterprise [7]. Fish feeds are used in aquaculture to increase production and maximize profit [13]. Fish feed technology is one of the least developed sectors of aquaculture in Africa and other developing countries of the world [14], [7] and for aquaculture to be highly successful in Nigeria, there is need for good quality and affordable feed [15] because [16] opined that the quality of a feed is a function of how well that feed meets the nutrient requirements of a fish. Thus, the need for fish feed importation into the country which gave rise to different brands presently available in Nigeria market. Although, few studies have compared the growth response of fish to local and imported feeds [17], [18], there is a dearth of information on the comparison of growth response of catfish fed with different imported feeds. Therefore, this work compared the growth response of *Clarias gariepinus* fed with five brands of commonly used imported feeds by the fish farmers in Nigeria.

## 2. Material and Method

### 2.1. Experimental Fish, Rearing Conditions and Feeding Trial

300 fingerlings of *Clarias gariepinus* were obtained from a local hatchery in Ibadan, Oyo state. The fish were transported in a 50-litre plastic bowl to Fisheries Laboratory, Department of Fisheries Technology, Federal College of Animal Health and Production Technology; and were acclimatized for two weeks. During the period of acclimatisation, the fish were fed *ad libitum* according to [19] at 5% body weight twice daily at 8am and 4pm (local time) as recommended by [20] with a diet of 45% crude protein. Feed not consumed and faecal matters were siphoned every two days interval.

At the end of the acclimatization period, 225 fish (with average weight of  $3.12 \pm 0.04$ g) were randomly selected and stocked into 15 60-liter experimental plastic aquaria with each aquarium holding 15 fish. To prevent fish from jumping out, the aquaria were covered with a 5mm mesh size net material. Feeding was suspended for 24 hours before the commencement of feeding trials to increase appetite and reception for new diets as recommended by [21]. 5 imported feeds comprising Coppens ( $T_1$ ), Aqua ( $T_2$ ), Ranna ( $T_3$ ), Pira ( $T_4$ ) and Durante ( $T_5$ ) were used for this study. The feeds used contained different levels of components as shown in Table 1. Each test diet was hand-fed to triplicate groups at 5% body weight twice daily at 8am and 4pm (local time) for 13 weeks (91 days).

The water in the tanks was changed bi-weekly while the water quality parameters such as temperature and dissolved oxygen were measured daily with digital YSI DO meter (YSI, Model 57) while pH was measured thrice weekly with electronic pH meter (metter Toledo, Model 320) in each

aquaria throughout the experimental period. All fish were counted and weighed every 7 days for growth sampling during the experimental period and no feed was given to the fish on the day of sampling. At the end of the experiment, the final mean weight, specific growth rate, food conversion ratio, protein efficiency ratio, survival rate and feed cost per kg weight gain were calculated according to [22], [23] and [24]. The exchange rate of Nigerian Naira to U.S Dollar is ₦160 = \$1.

The proximate composition of the five imported feeds given by the manufacturers is presented in Table 1. Coppens had the lowest crude protein of 42% while Aqua, Durante, Pira and Rana contain 45% each. In crude lipid content, Durante had the highest with 14% while Aqua had the lowest with 2%. Other details are shown in Table 1.

**Table 1.** Proximate composition of the experimental feeds.

Parameters	Treatments				
	Aqua	Coppens	Durante	Pira	Rana
Crude protein	45.0	42.0	45.0	45.0	45.0
Crude lipid	2.0	13.0	14.0	8.0	12.0
Crude fibre	3.0	1.8	2.8	2.8	2.5
Ash	0.9	7.4	7.0	17.0	9.5

### 2.2. Growth Parameters

Growth performance of the fish was determined using the following parameters:

#### 2.2.1. Mean Weight Gain (g) (MWG)

$$MWG = wt2 - wt1$$

Where:

wt1 = initial mean weight of fish at time T1

wt2 = final mean weight of fish at time T2

#### 2.2.2. Specific Growth Rate (SGR)

$$SGR = \frac{\log_e wf - \log_e wi}{t} \times 100\%$$

Where:

wf = final average weight at the end of the experiment

wi = initial average weight at the beginning of the experiment

$\log_e$  = the base of Natural Logarithm.

t = number of days for the experiment

#### 2.2.3. Feed Conversion Ratio (FCR)

$$FCR = \frac{\text{weight of feed given (g)}}{\text{fish weight gain (g)}}$$

#### 2.2.4. Protein Efficiency Ratio (PER)

$$PER = \frac{\text{fish Weight Gain (g)}}{\text{protein intake (g)}}$$

### 2.2.5. Survival Rate (%)

$$SR = \frac{\text{number of fish that survived}}{\text{total number of fish stocked}} \times 100\%$$

### 2.3. Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA). Significant difference means ( $P < 0.05$ ) were separated using Duncan's New Multiple Range Test (Duncan). The statistical analysis was done using SPSS (Windows version 15.0).

## 3. Results and Discussion

Growth parameters data are great tools for evaluating the effect of feed on cultured fish. These parameters include: weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, survival rate as well as feed cost per kg weight gain. Mean weight and feed utilization of *Clarias gariepinus* juveniles fed with five commercial imported fish feed brands over a period of 91 days is given in Table 2.

**Table 2.** Feed utilization of *Clarias gariepinus* juveniles fed with five commercial imported fish feed brands.

Growth parameters	Treatments				
	Aqua	Coppens	Durante	Pira	Rana
Initial Weight	3.12±0.2	3.12±0.1	3.10±0.1	3.11±0.2	3.10±0.2
Final Weight	57.18 <sup>a</sup> ±4.05	33.38 <sup>bc</sup> ±3.32	39.28 <sup>b</sup> ±3.64	42.93 <sup>b</sup> ±3.72	24.82 <sup>c</sup> ±2.57
Weight Gain	54.07 <sup>a</sup> ±4.37	30.26 <sup>bc</sup> ±3.46	36.17 <sup>b</sup> ±3.54	39.83 <sup>b</sup> ±3.86	21.73 <sup>c</sup> ±2.30
Percentage Weight Gain	1734.87 <sup>a</sup> ±142.28	969.77 <sup>bc</sup> ±100.32	1165.88 <sup>b</sup> ±106.87	1282.07 <sup>b</sup> ±110.09	704.01 <sup>c</sup> ±80.92
Specific Growth Rate	2.79 <sup>a</sup> ±0.76	2.25 <sup>b</sup> ±0.32	2.41 <sup>b</sup> ±0.43	2.51 <sup>b</sup> ±0.46	1.97 <sup>c</sup> ±0.21
Feed Conversion Ratio	1.59 <sup>a</sup> ±0.06	1.95 <sup>b</sup> ±0.08	1.88 <sup>ab</sup> ±0.06	1.79 <sup>ab</sup> ±0.05	2.13 <sup>b</sup> ±0.09
Protein Efficiency Ratio	1.49 <sup>a</sup> ±0.02	1.22 <sup>b</sup> ±0.02	1.30 <sup>ab</sup> ±0.04	1.33 <sup>ab</sup> ±0.03	1.12 <sup>b</sup> ±0.04
Survival rate	46.67 <sup>c</sup> ±2.46	93.33 <sup>a</sup> ±3.24	57.78 <sup>c</sup> ±3.76	91.11 <sup>ab</sup> ±2.55	62.22 <sup>bc</sup> ±3.65

At the beginning of the feeding trial, the mean initial body weight of the fish was 3.12±0.2g. From Table 2, Aqua had the highest final biomass and percentage weight gain of 57.18g and 1734.87 respectively, while Rana had the lowest with the values of 24.82g and 704.01 for final biomass and percentage weight gain respectively. Although, there were significant differences ( $P < 0.05$ ) in the weight gain among the treatments, no significant difference existed among Coppens, Durante and Pira. Also, Aqua had the highest specific growth rate of 2.79. In the same vein, there were significant differences in the specific growth rate (SGR) among the treatments, though; no difference existed among Coppens, Durante and Pira. The results of the nutrient utilization clearly showed that, the best feed was Aqua with FCR and PER values of 1.69 and 1.49 respectively. There was no significant difference ( $P > 0.05$ ) in FCR among Aqua, Durante and Pira with FCR of 1.59, 1.88 and 1.79 respectively. However, these feeds were significantly different from Rana with FCR of 2.13, though; no difference existed between Coppens and Rana. There existed significant differences ( $P < 0.05$ ) in the survival rate among the treatments with Coppens having the highest survival rate of 93.33%, though; no significant difference ( $P > 0.05$ ) existed between Coppens and Pira.

Water quality parameters recorded during the feeding trials fell within the suitable ranges for *Clarias gariepinus* culture. Water temperature ranged from 21.3°C to 30.2°C, with an average of 27.5 ± 0.2°C; Water pH ranged from 6.70 to 8.20, with an average of 6.5 ± 0.1 while Dissolved oxygen ranged from 4.2 to 7.76 mg/l, with an average of 6.30 ± 0.14 mg/L.

The results of the physico-chemical parameters of the culture medium agrees with the report of [7], where the water temperature ranged from 20.0 to 33.7°C, pH ranged from 6.88 to 8.51 and the Dissolved oxygen ranged from 4.2 to 7.76 mg/l.

These results also compare well with comparative feeding trials of [25], [26] on *Clarias* spp. It was revealed in Table 2 that there were significant differences in the feed conversion ratio (FCR) among the brands with Rana having the highest value of 2.13. According to [27], FCRs should never go above 2. There might be other factors responsible for this high value since [27] opined that feed conversion ratios vary among fish species, sizes and activity levels of fish, environmental parameters and the culture system used. It could therefore be concluded that one or more of these factors were responsible for the results in this feeding trial. Generally, since feed is expensive, [28] reported that feed conversion ratio (FCR) is a predictor in determining the efficiency of the feed used. In all the treatments, there were significant differences ( $P < 0.05$ ) in the survival rates of the fish with the highest percentage in fish fed with Coppens (93.33%) as shown in Table 2. Although, the physico-chemical parameters of the water in the culture medium were favourable, the different survival rates recorded might be due to the culture medium because [29], [30] reported high survival rates ranging from 98.5–99.5% in cage culture system. The proximate composition of the feeds used in this trial might be responsible partly for the results in this experiment. According to [31], significant highest growth performance of *C. gariepinus* juveniles was found in the diet that contained < 2% fiber content. 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 [32], [33]. Also, [34] noted a better growth performance of *C. gariepinus* on diet containing 9.3% ash content while [35] opined that ash content in the feed of *C. gariepinus* should not be less than 8%. The quality and quantity of the protein in the imported feeds in this study

could also be a factor responsible for the results obtained because [36] reported that the African catfish *Clarias gariepinus* and *Heterobranchius bidorsalis* tend to require at least 40% crude protein for normal growth.

Mostly, economic benefits from fish culture operations are based on estimates from gross and net yields. The economic profitability of using the five imported fish feeds for the culture of *Clarias gariepinus* is presented in Table 3.

**Table 3.** Cost-benefit evaluation of the five imported feeds used in feeding trials.

Parameters	Feeds				
	Aqua	Coppens	Durante	Pira	Rana
Cost of 1kg (\$)	1.75	2.19	2.19	1.75	1.75
AFQ	85.97±1.05	59.01±0.95	68.00±0.57	71.30±2.46	46.28±0.44
MWG	54.07±4.37	30.26±2.63	36.17±9.65	39.83±5.21	21.73±2.11
PWG	1734.87±142.28	969.77±84.29	1165.88±312.28	1282.07±168.87	704.01±68.58
FCR	1.59±0.06	1.95±0.13	1.88±0.33	1.79±0.11	2.13±0.15
ACF	0.15	0.13	0.15	0.12	0.08
ECF 1kg fish	2.78	4.27	4.12	3.13	3.73

Note: AFQ-Average feed quantity used; MWG- Weight gained; PWG- Percentage weight gained; FCR- Feed conversion ratio; ACF-Average cost of feeding; ECF: Estimated cost of feed for producing 1kg of fish \$1 (₦160.00); Data = Mean + standard deviation.

For instance, a kilogram of Aqua and Pira feeds each cost \$1.75 while the estimated costs of feeding one individual fish to a weight gain of 1kg using the same feeds were \$2.78 and \$3.73. From Table 3, Aqua and Coppens had the least and highest costs respectively, of feeding one individual fish to a weight gain of 1kg. Sometimes, lower costs could be attributed to good feed quality and acceptance of feed by fish. The total quantity of feed fed and the high price of feed per kilo, can greatly affect the cost of production and the profit index generated from the sale of fish.

The high value of producing 1kg of fish from this study might be due to the culture medium used for this experiment. This value probably might be reduced if produced in a more conventional medium.

## 4. Conclusion

Growth parameters data are great tools for evaluating the effect of feed on cultured fish. It was revealed in this study that there were significant differences in the feed brands with respect to the weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, survival rate as well as feed cost per kg weight gain. The quality and quantity of feed used in fish culture are the major factors in determining profitability because feed represents the largest single expenditure in semi-intensive or intensive culture operations [37]. Although, from this feeding trial, it is expensive to raise a kilogramme of fish using Coppens and Pira fish feeds, but due to the high survival rates, they are recommended for catfish production. It is assumed that the biomass harvested will make up for the cost incurred.

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