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# GROWTH PERFORMANCE OF AFRICAN CATFISH FED VARYING DIETARY PHOSPHORUS

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## ABSTRACT

One hundred and twenty (120) juveniles of African catfish *Clarias gariepinus* were obtained in May 2015 from a reputable Fish Farm in Enugu to the University Research Farm (latitude 074° North and 082° South, longitude 068° East and 076° West with annual mean temperature of 30°C). The fish were fed for 49 days from June – July 2015 with diets containing 4 different inclusion levels of phosphorus $T_1$ [0.6% P], $T_2$ [0.8% P], $T_3$ [1.00% P], $T_4$ [1.2% P] and $T_5$ [0% P] which served as control diet, to determine optimum P requirement for fish growth at probability level of $P < 0.05$ between various treatments and control. Each diet was formulated to contain 40% crude protein composed of yellow maize, soybean cake, palm kernel cake and fish meal. Fish fed with graded levels of phosphorus were significantly higher ($P < 0.05$) than control in FW and MDWG. There was however no significant difference ($P > 0.05$) in FCR and PER between $T_1$, $T_2$, $T_4$ and control but $T_3$ was significantly ($P < 0.05$) better in FCR (0.33) than control (0.39). Similarly, T3 was significantly ($P < 0.05$) higher in PER than control. Fish in $T_3$ had the best growth performance indicative that 1% P is the optimum requirement for the growth of *C. gariepinus.*

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## INTRODUCTION

Nutrition is the process by which organism obtain food and use it for metabolic processes including, growth and repair of worn out tissues. It is highly important in animal agriculture as it accounts for about 60-70% of the total cost of production Ayinla and Ajayi, 2011). Fish needs food to grow, irrespective of the good health, quality or condition of their environment and if this is not adequately supplied a malnourished condition may occur (Fagbenro, 2010). Mineral elements are inorganic substances, needed in animal body including fish and are necessary for the maintenance of certain physio-chemical processes in the tissues and body fluids. They may be broadly classified as macro elements which include calcium, phosphorus, sodium and chloride and micro elements which include iron, copper, cobalt, potassium, iodine, zinc, chloride, chromium, selenium and sulfur (Soetan et al., 2010).

According to Nwanna et al. (2011) calcium and phosphorus make up 70% of the total mineral elements in the body and are essential for the formation of bone, energy transfer through Adenosine triphoshate (ATP) and are essential components of buffer systems in the blood. McDowell (2011) noted that phosphorus is involved in the control of appetite, weight and feed efficiency while Waldroup (2011) asserted that inadequate supply of phosphorus may lead to severe consequences in terms of reduced performance, excessive mortality, and reduction in carcass quality. Phosphorus is a growth promoter when supplied at optional concentration in animal feeds and this could probably account for better results in animal growth when used optimally. Coloso et al. (2003) stated that increase in the concentration of available dietary phosphorus from 0.24 to 0.88% modestly enhanced the growth of rainbow trout. Dietary requirement of phosphorus in channel catfish is less than 10 g P $kg^{-1}$ (Eya and Lovell, 2011); while McDowell (2011) reported that the requirement of African catfish is about 10 g P kg-1 diet. The problem of actual amount of phosphorus availability for the fish physiological demand can be a factor in the utilization index of this mineral. Coloso *et al.* (2003) reported that soluble phosphorus production per kg fish is a liner function of dietary phosphorus and is independent of the type of diet used and apparently on the size of fish. Increasing faecal phosphorus levels due to increase in dietary phosphorus levels has been reported by Siguira et al. (2010) who described that faecal phosphorus content significantly increased when diet fed to rainbow trout was supplemented with calcium phosphate. phosphorous is very essential in fish nutrition and is the second most abundant mineral after calcium in the body of the fish, which helps to build healthy bones and makes every cell functioning (Lovell, 2011). Phosphorous is essential but care should be taken not to feed fish with high amount because too much phosphate is present in the water which will cause algae and weeds to grow rapidly (Robenette, 2011).

The effect of high phosphorous in fish causes low dissolved oxygen in the water because an increase in algae bloom and weeds due of the high amount of phosphorous in water which lead to fish death and other aquatic organisms (Delvin, 2009).The response of African catfish (C*larias gariepinus)* to different sources of dietary phosphorus in terms of growth, weight gain and utilization is important for measuring optimum level needed by the fish. As the interest in fish culture increases, there is need for the fish farmer to know the effect and importance of dietary phosphorus on the growth and food efficiency of C*larias gariepinus* in order to get the best economic returns from his fish. This study was carried out to guide fish farmers and those aspiring to go into fish venture on effects of phosphorus levels in diet on the growth performance of African catfish (C*larias gariepinus).*

## MATERIALS AND METHODS

### Experimental Site

The experimental site was the Research Laboratory of the Department of Animal/Fisheries Science and Management, Enugu State University of Science and Technology (ESUT) Enugu Nigeria. Enugu is located within latitude 074º North and 082º South and longitude 068º East and 076º West with annual mean temperature at 30ºC

### Experimental Fish/Design

One hundred and twenty *Clarias gariepinus* fingerlings were obtained from Luis farm Warri, Delta state. Average weight of the fingerlings at procurement was 0.25g. They were stocked inside plastic basins for acclimation after which they were fed a locally formulated diet of 40% crude protein. Before the experiment commenced, the fish were not fed for one day to increase their appetite for the feed. The fish were stocked into ten different bowls with its replicate with each bowl containing ten fingerlings.

### Water Quality Monitoring

The water quality of the experiment basin was monitored. These include the temperature, hydrogen ion concentration (pH) and dissolved oxygen concentration (DO). The monitoring was on a daily basis. The volume of the water was maintained at ¾ of the container depth.

### Experimental Diets

The raw materials were obtained from New Market in Enugu metropolis and were subjected to Pearson's square method at 40% crude protein. The ingredients were weighed out, grinded to powder form and mixed according to the composition formula, The feed were pelletized using a pelleting machine with appropriate pelleting diameter. The pelletized feeds were sun dried properly to avoid spoilage after which they were packed into different polythene bags to feed the experimental fish.

**Table 1**. Experimental diets

| **Ingredients** | **$T_1$** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_{5\ (control)}$** |
|---|---|---|---|---|---|
| Yellow maize | 10.31 | 10.31 | 10.31 | 10.31 | 10.31 |
| Palm kernel Cake | 10.31 | 10.31 | 10.31 | 10.31 | 10.31 |
| Soybean | 33.70 | 33.70 | 33.70 | 33.70 | 33.70 |
| Fish meal | 33.70 | 33.70 | 33.70 | 33.70 | 33.70 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Vitamin Premix | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Oil | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Phosphoric acid | 0.60 | 0.80 | 1.00 | 1.2 | 0.00 |

### Feeding Schedule

The fishes were fed twice a day (8.00 hours and 18.00 hours) at 5% body weight throughout the experiment. Uneaten feed and faecal matter in each bowl were siphoned out each week. The water in the bowl was also changed with pre-conditioned pipe borne water every week.

### Data Collection

The following measurement and record were carried out: IW initial weight, FW final weight, MDWG: mean daily weight gain, FCR: food conversion ratio, PER: protein efficiency ratio.

### Food Conversion Efficiency

The Feed Conversion Efficiency was calculated as

$$\frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

### Weight Gain

This was calculated as the difference between the initial and final mean weight values in each treatment.

### Protein Efficiency Ratio

This was calculates as

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

Where protein intake (g) = $\frac{\text{Total feed intake}}{\text{Protein content of feed}}$

### Water Quality Assessment

Rain water was collected and stored in an open tank before the trial began. At the beginning of the experiment, water in the bowl was renewed twice a week for the first two weeks after which water renewal was done weekly to reduce pollution of the experimental fish environment.

### Statistical Analysis

All data collected were subjected to 1 way analysis of variance (ANOVA) using SPSS version 20. Comparisons among means were carried out using Duncan Multiple Range Tests (DMRT) at significance level of ($P < 0.05$).

## RESULTS

### Growth Parameters

The result obtained from the 49 days (7 weeks) experimental period with juveniles of *Clarias gariepinus* were fed with locally formulated diet at different levels of phosphoric acid.

**Table 2.** Mean growth ± SEM of *Clarias gariepinus* fed dietary phosphorus

| Parameters | $T_1$ [0.6%P] | $T_2$ [0.8%P] | $T_3$ [1% P] | $T_4$ [1.2% P] | $T_5$ [0% P] control |
|---|---|---|---|---|---|
| IW(g) | 200 | 200 | 200 | 200 | 200 |
| FW (g) | $400^b$ | $500^b$ | $800^c$ | $523^b$ | $328^a$ |
| MDWG (g) | $4.08 \pm 0.01^b$ | $6.12 \pm 0.02^b$ | $12.24 \pm 0.02^c$ | $6.59 \pm 0.02^b$ | $2.61 \pm 0.03^a$ |
| FCR | $0.50 \pm 0.01^b$ | $0.38 \pm 0.01^b$ | $0.33 \pm 0.01^a$ | $0.35 \pm 0.01^b$ | $0.39 \pm 0.01^b$ |
| PER | $0.40 \pm 0.04^a$ | $0.4 \pm 0.04^a$ | $0.6 \pm 0.03^b$ | $0.39 \pm 0.05^a$ | $0.36 \pm 0.04^a$ |

IW initial weight, FW final weight, MDWG: mean daily weight gain, FCR: food conversion ratio, PER: protein efficiency ratio. Same letter super scripts are equal at $P < 0.05$.

Fish fed with graded levels of phosphorus were significantly higher ($P < 0.05$) than control in FW and MDWG. There was however no significant difference ($P > 0.05$) in FCR and PER between $T_1$, $T_2$, $T_4$ and control but $T_3$ was significantly ($P < 0.05$) better in FCR (0.33) than control (0.39). Similarly, $T_3$ (0.6 ±0.03) was significantly ($P < 0.05$) higher in PER than control (0.36 ±0.04). Fish in $T_3$ had the best growth performance indicative that 1% P is the optimum requirement for the growth of *C. gariepinus* (Table 2).

**Table 3.** Physico-chemical parameters of water

| Wks No. | Temperature ($^0$C) | pH | DO $mgL^{-1}$ |
|---|---|---|---|
| 1 | 25.0 | 7.0 | 6.8 |
| 2 | 26.6 | 6.8 | 6.0 |
| 3 | 26.3 | 6.0 | 5.6 |
| 4 | 26.1 | 7.5 | 5.4 |
| 5 | 25.4 | 6.2 | 6.8 |
| 6 | 28.0 | 7.2 | 8.4 |
| 7 | 26.6 | 7.5 | 6.0 |

Table 3 presents the result of water quality parameters. The mean temperature ranged from 25°C - 28°C, the dissolved oxygen (DO) was found to vary between5.0 - 6.8mg/L. The pH of the water varied between 6.0 - 7.8 however, the water quality parameters were found to be within the range tolerable to fish.

## DISCUSSION

The present study indicated that 1% dietary Phosphorus level led to better Phosphorus utilization in juveniles of African catfish. Similar results were observed in rainbow trout and black sea bream (Shao and Ma, 2008). Effects of dietary phosphorus level on growth performance have been reported in many fish species. However, other studies reported that dietary phosphorus level did not change the growth of sea bass (Shoa and Ma, 2008. Animal growth depends on several factors, including the age, stage of development, diet composition, and duration of experiment, health and rearing condition. Young animals were more sensitive to nutrient deficiency than those at a later stage of development. In the current study, African Catfish was sensitive to dietary phosphorus content and showed different growth performance under different dietary phosphorus treatments. However, the improved growth performance was only observed until the dietary available phosphorus level reached 1.0%, indicating that African Catfish fingerlings needed about 1.0% dietary available phosphorus to obtain maximum growth. There were several reports about catfish dietary available phosphorus requirements based on channel catfish (*Ictalurus punctatus*). Andrews et al. (1997) reported that phosphorus requirement of catfish is 1.0 percent of available phosphorus in practical diets. However, Lovell et al. (2011) reevaluated the phosphorus requirement using chemically defined diets and estimated it to be approximately 0.5 percent available phosphorus. NRC recommended the appropriate dietary available phosphorus to be 0.45 percent for channel catfish. However in the present study, African catfish gained highest growth at 1.0% dietary available phosphorus.

## CONCLUSION

This study should guide the fish culturists on the use of dietary phosphorus which recorded optimal performance in growth rate and nutrient utilization at 1% inclusion level in the diet of *Clarias gariepinus* (African Catfish).

## RECOMMENDATION

The result obtained from the study indicated that sub-optimal or sub toxic levels (1.2%) of dietary phosphorous can negatively affect the growth performance of the fish and knowing this would help to reduce the high rate of mortality presently experienced in fingerling culture. It is therefore recommended that phosphorus requirement for African catfish fingerlings be 1.0g P/kg.

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