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Effects of Dietary Hormone (Prednisolone) on Growth and Feed Utilization of *Clarias gariepinus* Fingerlings

***Aliu B.S., Okovido O.R.**

Department of Aquaculture and Fisheries Management, Faculty of Agriculture, University of Benin, P.M.B. 1154, Benin City, Nigeria.
*Corresponding author E-mail: bayo.aliu@uniben.edu, +2348055314843

Abstract An experiment was designed and carried out to assess the growth performance and feed utilization (weight gain, feed conversion ratio, protein efficiency ratio, specific growth rate, percentage weight gain, feed intake, and net protein utilization) of *Clarias gariepinus* fingerlings fed graded levels of diets containing prednisolone, with the aim of establishing the best inclusion level of prednisolone. Seventy-five (75) fingerlings with an initial mean weight of 2.5± 0.5g were allotted at random to five treatments in triplicate groups with each treatment tank having five fingerlings and were fed with the compounded diets. The prednisolone was added to the diets in the following proportions: diet I (0mg), diet II (5mg), diet III (10mg), diet IV (15mg) and diet V (20mg). All the fish and feed per replicate were weighed weekly to determine the growth performance and feed utilization.

At the end of the feeding trials that lasted for 70 days, the Percentage Weight Gain (PWG) and Specific Growth Rate (SGR) showed no significant difference (P>0.05) among all the treatments while the Feed Conversion Ratio (FCR) of treatments II(5mg) and V(20mg) was significantly different from treatments I(0mg) and III (10mg) except for treatment IV (15mg) which had the best value of 1.37. The PWG had the highest value in treatment II(5mg) and the lowest value in treatment III(10mg), while the SGR had the highest value in treatment IV (15mg) and the lowest value in treatment III (10mg). The weight gain and feed intake of treatments I(0mg), III(10mg) and IV (15mg) showed no significant difference (P<0.05). Treatment V(20mg) had the lowest Protein Efficiency Ratio (PER) and was closely followed by treatment II(5mg), with a value of 1.55. At the end of the experiment, better growth performance and nutrient utilization were obtained with the fish fed treated diet at 15mg inclusion level of prednisolone. It can therefore be recommended that prednisolone should be included in *Clarias gariepinus* diet at 15mg inclusion, since this will improve growth performance and nutrient utilization.

Keywords feed utilization, prednisolone, dietary hormone and fish nutrition

Introduction

In Africa, the high cost of formulated commercial fish feeds is a major constraint to the expansion and growth of the aquaculture sector [1], and this has prompted a concerted effort, particularly in Nigeria, to seek suitable alternative feed ingredients. Because of the high cost of vitamin and mineral premixes, farmers in Africa often use chicken layers mash, which contains minerals and vitamins, as a one of the primary components of catfish feeds. In fact, pig and poultry feeds are often used as alternate feeds for North African catfish throughout the African subcontinent [2-3]. Alternative sources of minerals used in Nigeria include bone meal and crushed periwinkle shells [4].

Sources and quality of feed ingredients used to formulate striped catfish feeds are very diverse and include both locally produced and imported ingredients. Major feed ingredients are rice bran (different types), fishmeal, meat

bone meal, blood meal, soybean meal, soybean cake, canola meal, cassava, oils, etc. For example, there are many kinds of fishmeal, including local fishmeals with protein levels ranging from 35 to 65 percent, and imported fish meals. The prices of feed ingredients depend on their quality and on seasonal fluctuations. Fishmeal is normally used only in small amounts (less than 10 percent in the diet, depending on fish size) in order to reduce feed cost. Normally, the protein level in formulated feeds is about 30–32 percent for the nursery stage (5–20 g). This value decreases with increasing fish size, the lowest value (22–26 percent) occurring at a size of >500 g. Similarly, the lipid level of the diet changes with fish size appropriate to the requirement, which varies from 4–6 percent. Two essential amino acids which are often supplemented in the feed are methionine and lysine. Different kinds of vitamin C are also used. Furthermore, calcium and phosphorus may be added to the diets [5]. Major problems that result from low quality feeds are poor appetite, slow growth, high feed conversion ratio, and low survival. These usually develop as a result of problems on quality of raw materials, feed formulation, processing technology, storage, and feed management [6]. This study is aimed at determining the effects of dietary hormone on the growth and utilization of Clarid catfish fingerlings (*Clarias gariepinus*).

Materials and Methods

Preparation of Blood Meal

The Prednisolone tablets were purchased from a reputable pharmacy in Benin and kept in a cool and dry place to maintain a good condition. The tablet is small, round and whitish in colour. A total of 10 tablets were bought and they were added to the feed at different concentrations of 0mg 5mg, 10mg, 15mg and 20mg. They were crushed into powder and added to the feed during the manufacturing process at the above respective concentrations.

Preparation of the Experimental Diets

Fishmeal, soybeans cake, maize, palm oil as fatty acid, vitamin premix, palm oil and bone meal used in the production of the feed were purchased from a feedmill in town. Five iso-nitrogenous and iso-caloric diets were formulated. Diets 1 (control), 2, 3, 4, 5, had the growth hormone at 0mg, 5mg, 10mg, 15mg, 20mg respectively. The composition of the experimental diets is shown in Table 1.

Table 1: Composition of the Experimental Diets

Ingredients	**Treatments**				
Composition of Prednisolone hormone (mg)	0mg	5mg	10mg	15mg	20mg
Fishmeal (65.5% CP)	20.00%	20.00%	20.00%	20.00%	20.00%
Soya bean (46% CP)	19.50%	19.50%	19.50%	19.50%	19.50%
Prednisolone hormone	0.00mg	5.00mg	10.00mg	15.00mg	20.00mg
Maize (9.5% CP)	17.00%	17.00%	17.00%	17.00%	17.00%
Bone meal	5.00%	5.00%	5.00%	5.00%	5.00%
Palm oil	7.00%	7.00%	7.00%	7.00%	7.00%
Vitamin premix	0.40%	0.40%	0.40%	0.40%	0.40%

The various ingredients were measured accurately to their required quantity, after which they were homogenously mixed, finely pelleted and dried at the departmental fish farm. The pelleted feed was stored in sealed containers throughout the duration of the experiment.

Experimental Units

The study was conducted in the wet laboratory, Department of Fisheries, University of Benin, Benin city, Nigeria. Fifteen (15) rectangular plastic tanks, (five (5) treatment in three (3) replicates) measuring (30cm×36cm×52cm) was used. Each tank was filled up to 2/3 of its volume with bore-hole water attached to the laboratory.

Experimental Procedure

After the period of acclimatization (2 weeks), the fingerlings were weighed in batches of 5 into each of the experimental units replicated thrice for each treatment. They were fed twice daily to satiation to ensure maximum growth between 9:00 - 10:00hrs and 17:00 - 18:00hrs. Feeding was monitored for each unit to ensure

that fishes were not underfed or overfed. The experimental units were cleaned by total changing of the water daily. All the fish per replicate were weighed and counted weekly to determine growth and survival, also the weekly weighing of feed was carried out.

Parameters Monitored: Data on feed consumed and weight gain were collected weekly for each unit from which the following performance parameters were evaluated.

1. Weight gain (WG) = $W_2 - W_{1\,(g)}$ Where; W_1 = initial weight, W_2 = final weight
2. Feed intake = Initial weight of feed – Final weight of feed
3. Specific growth rate per day (SGR) % = $\frac{\text{Loge W2} - \text{loge W1}}{\text{T2} - \text{T1}}$ X 100

   Where: T_1 and T_2 are time of experiment in days.

   W_2 = final weight at T_2, W_1 = initial weight at T_1

   Loge = natural logarithm.
4. Relative weight gain (PWG) % = $\frac{\text{Weight Gain}}{\text{Initial Weight}}$ X 100
5. Food conversion ratio (FCR) = $\frac{\text{Feed Intake (g)}}{\text{Wet Weight Gain (g)}}$ X 100
6. Protein efficiency ratio (PER) = $\frac{\text{Weight Gain (g)}}{\text{Protein Intake}}$ X 100
7. Survival rate % = $\frac{\text{Initial stocked} - \text{mortality}}{\text{Initial stocked}}$ X 100

Statistical Analysis

The data obtained from the feeding trials was tested for significant differences using Analysis of Variance (ANOVA) test and the means were separated using Duncan's Multiple Range Test, all at 5% level of significance.

Results

Table 2: Proximate Composition (%) of Experimental Diets

Parameter	T1	T2	T3	T4	T5
Moisture Content	10.10	10.50	10.45	10.60	11.80
Crude Protein	39.28	36.75	37.25	38.04	35.65
Ether Extract	27.40	28.70	27.40	28.20	27.60
Crude Fibre	5.30	5.71	5.20	4.86	5.30
Ash	8.10	8.00	8.90	9.00	8.40
N.F.E	9.82	10.34	10.80	9.30	11.25

N.F.E = Nitrogen free extract; T = Treatment

The proximate composition of experimental diet was shown in Table 2with highest moisture content in T5 (11.80%) at 20mg inclusion level of prednisolone and lowest moisture content in control diet T1 (10.10%). Crude protein content was highest in T1 (39.28%) and lowest in T5 (35.65%) at 20mg inclusion level of prednisolone. The ether extract (crude fat) content of experimental diet ranged from the lowest value of 27.40% in T1 (control) and T3 (10mg inclusion level of prednisolone) to the highest value of 28.70% in T2 (5mg inclusion level of prednisolone). The crude fibre content ranged from 4.86% to 5.71% with lowest value in T4 and highest value in T2 respectively. Contrarily, T4 (9.00%) had the highest ash content and T2 (8.00%) had the lowest ash content. N.F.E was highest in T5 (11.25%) and lowest in T4 (9.30%).

Table 3 Carcass composition (%) of *C. gariepinus* fingerlings fed diet with varying levels of prednisolone

Parameter	Initial	T1	T2	T3	T4	T5
Moisture	11.72	7.27	5.90	6.94	7.12	5.35
Crude Protein	61.02	66.88	68.13	67.13	66.38	69.63
Crude Lipid	9.63	7.61	8.21	7.86	7.62	7.66
Ash	10.34	7.40	6.62	6.94	7.50	6.31
Crude Fibre	0.17	3.21	3.09	3.15	3.34	2.87
N.F.E	7.12	7.62	8.05	7.97	8.03	8.19

N.F.E = Nitrogen free extract; T = Treatment (Source: Field survey, 2018)

Proximate composition of *C. gariepinus* fed prednisolone treated diet in Table 3 revealed that moisture content ranged from the lowest value of 5.35% in T5 to the highest value of 7.27% in T1 (control). Crude protein level was irregular with highest value (69.63%) in T5 and lowest value (66.38%) in T4. Fat content of experimental fish had a range of 7.61% to 8.21% with lowest value in T1 and highest value in T2 respectively. The ash content had highest value (7.50%) in T4 and lowest value (6.31%) in T5. Crude fibre level was highest at 3.34% in T4 and lowest at 2.87%) in T5. NFE content of the fish had highest value of 8.19% in T5 and lowest value of 7.62% in T1.

Table 4: Growth performance of *C. gariepinus* fingerlings fed diet with varying levels of prednisolone

Parameter	T1	T2	T3	T4	T5	S.E.D
Feed Intake(g)	15.69^{bc}	17.52^{b}	15.65^{bc}	14.71^{c}	19.32^{a}	1.14
Weight Gain(g)	10.15	9.69	9.97	10.91	9.44^{NS}	0.80
Percentage Weight Gain (%)	37.08^{a}	38.34^{a}	28.93^{c}	37.79^{a}	31.23^{b}	3.77
Specific GrowthRate (%)	4.37^{a}	4.32^{a}	3.49^{b}	4.39^{a}	3.71^{b}	0.34
Feed Conversion Ratio	1.58^{ab}	1.93^{c}	1.63^{b}	1.37^{a}	2.15^{c}	0.12
Protein Efficiency Ratio	2.12^{b}	1.55^{c}	1.95^{bc}	2.55^{a}	1.51^{c}	0.22
Net Protein Utilization (%)	15.28	21.53	14.65	17.78	13.40	0.00

Note: different superscript within the same row indicates significant difference ($p<0.05$) in means.
(Source: Field survey, 2018) SED = Standard Error of Deviation, NS: no significant difference

The growth response and nutrient utilization of *C. gariepinus* fingerlings fed diet with different levels of the steroids prednisolone was as shown in Table 4The mean weight gain was highest in T4 (10.91g) at 15mg prednisolone inclusion followed by the control, T1 (10.15g) and lowest in T5 (9.44g) at 20mg prednisolone inclusion. Mean weight gain increased with increased level of prednisolone inclusion in fish diet with exception of T5 and no significant difference ($p>0.05$) was recorded between all the treatments. The feed intake values ranged from the lowest value of 14.71g in T4 at 15mg prednisolone inclusion to the highest value of 19.32g in T5 at 20mg prednisolone inclusion. Feed intake decreased significantly with increasing levels of prednisolone inclusion with exception of T1 and T5. The highest percentage weight gain (PWG) was recorded in T2 (38.34%) followed by T4 (37.79%). PWG was irregular across the treatments with increasing level of inclusion of prednisolone in fish diet and the lowest value of 28.93% was observed in T3. Similarly, T3 (3.49g/day) had the lowest specific growth rate (SGR). Specific growth rate followed a similar trend with PWG, but the highest value was recorded in T4 (4.39g/day). According to Analysis of variance (ANOVA), there was significant difference ($p<0.05$) in specific growth rate and percentage weight gain between the different treatments. However, further separation of mean using Duncan Multiple Range Test (DMRT) revealed no significant in SGR and PWG between T1, T2, T4 and T5. Feed conversion ratio (FCR) had the lowest value in T4 (1.37) followed by T1 (1.58) and with the exception of T5 (2.15) with the highest FCR, FCR decreased significantly with increasing level of prednisolone inclusion in experimental diet across treatments from T2 to T4. However, DMRT showed no significance difference ($p>0.05$) in FCR between T1, T3 and T4 as well as between T2 and T5.

The highest protein efficiency ratio (PER) was recorded in T4 (2.55%) followed by T1 (2.12%) and PER differed significantly ($P<0.05$) across the various treatments. With the exception of T5 (1.51%) with the lowest PER, there was a steady increase in PER with increasing inclusion level of prednisolone from T2 to T4. Net protein utilization (NPU) of *C. gariepinus* fingerlings in this study showed no significant difference ($p>0.05$) between the different treatments, with lowest NPU in T5 (13.40) and highest NPU in T2 (21.53).

Discussion

Growth

In this study, the results of the growth parameters indicated acceptance of prednisolone included in the diets. However, mean weight gain in this study were significantly lower than the values of 162.67 – 193.55g recorded by Chandra *et al*. [7] in monosex tilapia fed diet supplemented with growth promoter; 23.93 – 47.02g observed by Adewole [8] in *C. gariepinus* fed amoxicillin supplemented diet and 17.45 – 35.80g obtained by Nwanna *et al*. [9] in *C. gariepinus* juvenile fed probiotic-supplemented diets. Adewole [8] stated that fish fed the control

diet had significantly lower ($p < 0.05$) mean weight gain compared to other diets supplemented with amoxicillin. This was contrary to the result of this study where with exception of T4, fish fed control diet (T1) had higher weight gain than those fed diets supplemented with prednisolone. Similar to the findings of Adewole [8], there was increased weight gain across treatments with increasing level of prednisolone inclusion in the experimental diet, but no significant difference between the different treatments. *C. gariepinus* responded to all the diets irrespective of the inclusion levels of prednisolone in the diets. According to Fattahi *et al*. [10], body weight gain and daily weight gain are important parameters to evaluate kinds of diet and protein value in it. The mean weight gain had a range of 9.44g in T5 at 20mg inclusion level of prednisolone inclusion to 10.91g in T4 at 15mg inclusion level of prednisolone in diet. At the end of the feeding trial, fish fed diet supplemented with prednisolone at 15mg (T4) were the fastest grower.

The evaluation of growth performance on fish is more accurate by use of percentage weight gain (PWG) and specific growth rate (SGR) criteria than the body weight gain (BWG) and daily weight gain (DWG) criteria, because the RGR and SGR criteria reduce the effects of variant in the initial weight between fish [10]. The highest percentage weight gain (PWG) was recorded in T2 (38.34%) at 5mg prednisolone inclusion in feed followed by T4 (37.79%) at 15mg prednisolone inclusion and the least value was in T3 (28.93%) at 10mg prednisolone inclusion. The values were significantly lower than 405 – 483.8% observed by Chandra *et al* [7], 382.9–808.2% obtained by Adewole [8], and 50.53–92.22% recorded by Ali *et al* [11]. With exception of T2 and T4, the control (T1) had higher percentage weight gain than the treated groups. However, it appeared that 5mg prednisolone inclusion in fish feed is an optimum dose for growth in *C. gariepinus* on the basis of percentage growth over control.

Specific growth rate (SGR) of *C. gariepinus* fed prednisolone supplemented diets followed the same trends as percentage weight gain. The values ranged from 3.49%/day in T3 at 10mg prednisolone inclusion in diet to 4.39%/day in T4 at 15mg prednisolone inclusion level. Dada and Olugbemi [12] recorded higher SGR of 8.01 – 9.13 in *C. gariepinus* fed diets containing commercial additives. However, the result of this study was higher than 1.26 – 1.48 recorded by George *et al*. (2016), 1.55 – 2.27 reported by Nwanna *et al*. [9], and 0.73 – 1.15 observed by Ali *et al* [11]. No significant difference was recorded in specific growth rate and percentage weight gain between fish fed the control diet (T1) and those fed prednisolone supplemented diet, except in T3. This agreed with the results of George *et al* [13] and Dada and Olugbemi [12], who observed no significant difference across the different treatments.

Nutrient Utilization

Feed intake by fish consequently has direct effect on feed conversion ratio, protein efficiency ratio and specific growth rate [14]. Feed intake ranged from 14.71 – 19.31g with the highest value from the fish fed diet at 20mg inclusion level of prednisolone (T5) and the least value from the fish fed diet at 15mg inclusion level of prednisolone (T4). These values were below the 26.17 – 45.11g reported by Nwanna *et al*. [9] in *C. gariepinus* juvenile fed probiotic-supplemented diets. *C. gariepinus* was able to accept and adapt to the diets/drugs even at higher level of inclusions and stimulate growth during the course of the trial. However, the feed intake decreased with increasing levels of prednisolone among the treated groups and peaked at T5 (20mg prednisolone concentration in diets). This observation was contrary to the reported increase/higher feed intake and enhanced digestibility of the dietary components by the fish fed both tetracycline and furasol as dietary additives by Lawal *et al* [15]. There was significant difference ($p<0.05$) in feed intake across the various treatments and this was in agreement with findings of Adewole [8] who observed significantly different feed intake among the treated diets. Adewole [8] also recorded same trend in feed intake and protein intake which was contrary to the result of this study as no significant difference ($p>0.05$) was observed in protein intake between T1, T3 and T4 as well as between T2 and T5.

There was no significant difference in FCR between *C. gariepinus* fed control diet and those fed prednisolone treated diet at 10mg and 15mg inclusion levels of prednisolone. Dada and Olugbemi [12] recorded significant differences ($p<0.05$) in FCR between treatments, but George *et al* [13] observed no significant difference in FCR within treatments of *C. gariepinus* fed diet with commercial probiotics. The capability of any fish species to convert diet to body weight gain without compromise to fish health is referred to as feed conversion ratio

(FCR). FCR had a range of 1.34 in T4 to 2.15 in T5 which was relatively higher than values of 0.73–1.35 obtained by Lawal *et al* [15] and 0.26 – 0.32 recorded by George *et al* [13]. The best FCR was recorded in T4 which means that the use of prednisolone at 15mg inclusion level can decrease the amount of feed necessary for fish growth which could result in reductions of production cost.

Protein efficiency ratio (PER) is a quality indicator for fish diet and amino acid balance that has direct link with feed intake [16-17]. PER increased with increasing level of inclusion of prednisolone in treated diets except in T5 with the least PER value. The PER values from this study was similar to the reported increased PER in *O. niloticus* fed varying levels of chloramphenicol as observed by Shalaby *et al* [16] and in *C. gariepinus* fed amoxicillin as dietary additive as observed by Adewole [8]. Therefore, *C. gariepinus* was able to utilize efficiently the protein in the diet adequately or the diet provided the needed quality and quantity of protein for growth and health of the fish. The highest PER recorded in T4 (2.55%) indicated that diet supplementation with prednisolone at 15mg inclusion level improved protein utilization in *C. gariepinus* juveniles, this contributes to optimizing protein used for growth which is the most expensive feed nutrient.

In this study, chemical analysis of *C. gariepinus* showed significant variations ($P < 0.05$) in their body composition. Thus, prednisolone supplementation in experimental diet significantly affected the whole fish body composition as reflected in increased protein level in *C. gariepinus*. The crude protein content of the fish ranged from 66.38% in T4 to 69.63% in T5. This agreed with the findings of Degani [18] who reported that proteins are the major material in fish tissue and could make up to 65-75% of the total organic materials on a dry matter basis. Abdel-Tawwab *et al* [19] added that changes in protein and lipid contents in the fish body could be linked with changes in their synthesis, deposition rate in muscle and/or different growth rate. The body composition values obtained in this study were similar to those reported by Diab *et al* [20], Lara-Flores *et al.* [14], Abdelhamid and Mohamed [21] and Dada and Olugbemi [12] using commercial feed additives. The fat content of the fish was not high which is good for human consumption because fatty fish are known to deteriorate due to oxidation of fat (lipid) content of the flesh resulting in rancidity [9]. Variation in the ash value and other parameters could be due to variation in the environment, inclusion level of prednisolone and ingested metabolic rate.

Conclusion

It may be concluded that prednisolone could act as growth promoter in *C. gariepinus* juveniles. However, prednisolone inclusion in *C. gariepinus* diet at 15mg followed by the control performed better than the other treated diets, and it is therefore recommended. The information generated from present investigation might contribute to the incorporation of prednisolone at 15mg inclusion level in commercial aquaculture as supplement in formulated fish feed to achieve better growth performance and nutrient utilization.

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