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GROWTH PERFORMANCE OF AFRICAN MUDFISH *Clarias gariepinus* FINGERLING FED GRADED POULTRY OFFAL MEAL AS A REPLACEMENT OF FISHMEAL

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ABSTRACT
Twelve week feeding experiment was conducted to evaluate five different mixing ratios of Poultry Offal Meal (POM) and Fishmeal (FM) at a graded level of 0:100%, 25:75%, 50:50%, 75:25%, 100:0% FM: POM and a positive control of commercial diet, Clarias gariepinus fingerlings triplicate groups of 10 fingerlings with mean weight of 5.60g were used in 18 plastic tanks and fed 5% body weight. The SGR ranged from 1.03g/fish/day to 1.08g/fish/day with diet 100% POM having the lowest, 50% poultry offal meal gave the best value for Feed Conversion Ratio (2.07 ± 0.01), protein intake (7.87 ± 0.02), protein efficiency ratio ((1.05 ± 0.01) , nitrogen metabolism (449.58 ± 0.90), GFCE (48.58), and ANPU (44.32) and Showed significant difference (P<0.05) with other diets. This study showed that fishmeal can be successfully replaced by 50% POM in the diets of Clarias gariepinus without any adverse effect on its growth performance and feed utilization.
Keyword: *Clarias gariepinus*, poultry offal, fingerlings, growth, fish meal.

INTRODUCTION

Fish feed is the most expensive component of intensive aquaculture, representing over 50% of the total operating costs (Bob-Manuel and Erondu, 2010). The protein part of fish feed represents almost 60% of the feed cost. Fishmeal is the major protein source in aquaculture feeds. However, the global supply of fishmeal is not growing and fishmeal must be used more sparingly to improve profitability and sustainability of aquaculture. Beside cost considerations, it is important that practical or alternate fish diets contain all the essential amino acids, fatty acids, vitamins, and minerals required by a fish for rapid growth, sound health and economic profitability.

Poultry offal (chicken intestine) is an interesting economic alternative to fishmeal. Chicken offal meal is highly digestible by fish and has a high nutrient composition (Bureau *et al.*, 1999). In Nigeria, aquaculture industry is currently faced with the problem of inadequate supply and prohibitive cost of quality fish feed. Omitoyin, (2005) have reported increasing attempt to develop practical diets for farmed fish in Nigeria. However, most fish farmers particularly those in the rural areas still depend on agricultural wastes including poultry hatchery waste meal for feeding of fish especially catfish.

The aim of the research is to determine the quantity of poultry offal meal that could be used to replace fishmeal in the practical diets of *Clarias gariepinus* fingerlings.

MATERIAL AND METHODS

Collection of poultry offal and diet formulation

Poultry offal was procured from two slaughter house at Waff road Unguwan Rimi and Kawo Kaduna North Local Government Kaduna State. The poultry offal was washed thoroughly in clean water then boiled for 15 minutes at 95° C in order to kill and prevent contamination by disease pathogens. The poultry offal was drained and dried for 2 days then grounded with electrical grinder. The crude protein value of poultry offal derived from the analysis was used to formulate feed at crude protein level of40% using Pearson's Square Method (Mullan, 2006). In preparing each diet, the proportions of the ingredients (Table 2) were weighed separately. Each diet was initially constituted dry then afterwards moulded into a hard dough using hot water. Pelleting was achieved through compressing the ingredients into a larger homogenous particle of 2mm. The finished products were sun dried and stored in appropriately labeled polythene bags. Chemical analysis was conducted to ensure that the final products contained all nutritional and energy requirements needed for optimal growth of fish.

Proximate analysis

The proximate analysis of the experimental diets, fish whole body (initial and final) was carried out according Association of Official Analytical Chemist methods (AOAC, 2000) procedures. The proximate analysis was done in triplicates. Components such as crude protein, crude lipid, moisture content, crude fibre, ash, nitrogen free extract were analyzed.

Experimental feeding

One hundred and eighty (180) fingerlings of *Clarias gariepinus* with average size of 5.60g were purchased at Federal Ministry of Agricultural and Rural Development Live House Mando road, Kaduna State. The fishes of average mean weight of 5.60g were harvested and immediately transported to the experimental site. Upon arrival and on day one, the fish were given vitamin C in order to boost their appetite and reduce stress. They were acclimatized for two week; during the acclimatization they were fed with 2mm sized commercial feed containing CP of 40% devoid of Poultry Offal. They were observed to ensure a healthy state; water was changed at least once every other day. After acclimatization they were randomly stocked in 25 liter squared plastic tanks 10 fishes per tank. Feeding was 5% of their body weight, 2.5% in the morning and 2.5% in the evening for 12 weeks. All the water used for the study was free of chlorine.

Table 1: Proximate Composition of Poultry Offa L

Proximate analysis	Percentage of proximate composition (%)
Dry matter	93.50
Moisture	6.50
Crude protein	47.10
Crude lipid	13.31
Crude fibre	1.77
Total ash	7.70
NFE	23.62
Energy	482.34

Table 2: Compositions of Experimental Diets

	Diet 1 (0:100) %	Diet 2 (25:75) %	Diet 3 (50:50) %	Diet 4 (75:25) %	Diet 5 (100:0) %
Fishmeal	51.40	38.55	25.70	12.85	0.00
Poultry offal	0.00	12.85	25.70	38.55	51.40
Soya beans	24.00	24.00	24.00	24.00	24.00
Yellow maize	23.55	23.55	23.55	23.55	23.55
Bone meal	0.15	0.15	0.15	0.15	0.15
Groundnut oil	0.40	0.40	0.40	0.40	0.40
Vit. Premix	0.15	0.15	0.15	0.15	0.15
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.15	0.15	0.15	0.15	0.15
Nacl	0.10	0.10	0.10	0.10	0.10

Growth performance and feed utilization

Batch weighing (g) and body length (cm) of individual fish of each experimental tank were recorded biweekly during the experimental period using an electrical weighing balance and a ruler respectively. Mortalities were recorded as they occurred. Parameters used in evaluating growth performance include The Weight Gain (g), Percent Weight Gain (PWG)(%), Specific Growth Rate (SGR%day-1), Feed Conversion Ratio (FCR), Feed Intake, Protein Intake, Protein Efficiency Ratio (PER) and Apparent Net Protein Utilization (ANPU) and Survival Rate were also calculated. Water quality parameters such as Temperature, Dissolved Oxygen and pH were monitored weekly using Hanna device temperature and pH was monitored using HANNA-HI 9145 device.

$$SGR = \frac{\text{Final weight (g) - initial weight (g)}}{\text{Experimental days}} \times 100$$

$$PWG = \frac{\text{Final weight – initial weight}}{\text{Initial weight}} \times 100$$

$$FCR = \frac{\text{Feed fed}}{\text{Gain in weight of fish (g)}} \times 100 \quad \text{(Balfour, 1988)}$$

$$PER = \frac{\text{Increment in body weight (g)}}{\text{Protein intake (g)}} \times 100 \quad \text{(Balfour, 1988)}$$

$$ANPU = \frac{\text{Protein retained in grams}}{\text{Protein consumed in grams}} \times 100$$

$$\text{Survival Rate} = \frac{\text{number survived}}{\text{Initial number stocked}} \times 100 \quad \text{(Odedeyi, 2007)}$$

Statistical analysis

Experimental data was collected and statistically analyzed by ANOVA (analysis of variance) to test for significant differences between the 5 experimental means treatment using a General Linear Model procedure for Statistical Analysis System (SAS), ANOVA (analysis of variance) was used to test for significant differences between the treatments. The LSD (Least Significant Difference) was used to determine the difference among the treatment means. $P<0.05$ was considered significant.

RESULTS

The proximate composition of the experimental diets fed to *C. gariepinus* is shown in Table 3 the crude protein ranged from 42.95% to 46.11% statistical analysis clearly shows no significant difference in crude protein of the experimental diets because they are isonitrogenous and isocaloric. The lipid ranged from 4.40% to 10.20%, total ash from 6.11% to 8.37% while nitrogen free extract ranged from 19.69% to 31.40%. The energy ranged 413.85kcal/kg to 425.06kcal/kg.

Growth performance

The results of the mean weight gain of *Clarias gariepinus* fed experimental diets are presented in Table 4 the mean weight gain ranged from 72.72g to 92.82g. Diet 50% POM has the highest mean body weight and was significantly different ($P<0.05$) with the control and all the other experimental diets. Similarly, the same diet gave the best SGR (1.08) and also FCR (2.06). The survival of the 25-50% POM inclusion level was similar to that of the two controls

Table 3: Proximate Composition of Experimental Diet

	Diet 1 0:100%	Diet 2 25:75%	Diet 3 50:50%	Diet 4 75:25%	Diet 5 100:0%
Crude protein	46.11 ± 0.10^{a}	46.06 ± 0.10^{a}	46.03 ± 0.10^{a}	46.01 ± 0.10^{a}	45.99 ± 0.10^{a}
Crude lipid	5.06 ± 0.03^{d}	5.17 ± 0.03^{c}	4.40 ± 0.03^{f}	5.63 ± 0.03^{b}	4.81 ± 0.03^{e}
Crude fibre	1.87 ± 0.02^{c}	2.28 ± 0.02^{b}	1.52 ± 0.02^{e}	1.62 ± 0.02^{d}	1.48 ± 0.02^{e}
Total ash	7.86 ± 0.02^{c}	7.93 ± 0.02^{b}	6.11 ± 0.02^{d}	7.58 ± 0.02^{d}	8.37 ± 0.02^{a}
NFE	28.81 ± 0.17^{bc}	28.34 ± 0.17^{c}	31.40 ± 0.17^{a}	29.07 ± 0.17^{b}	29.24 ± 0.17^{b}

Means with same letter for a given parameter in same horizontal row are not significantly different ($P>0.05$)

Table 4: Growth Parameters and Nutrient Utilization Parameters of *Clarias Gariepinus* Fed Poultry Offal Meal For 12 Weeks.

Parameter	Control	Diet1 0:100%	Diet 2 25:75%	Diet 3 50:50%	Diet 4 75:25%	Diet 5 100:0%
Mean initial weight (g)	55.60 ± 0.31^{b}	55.78 ± 0.31^{ab}	56.10 ± 0.31^{ab}	56.0 ± 0.31^{ab}	56.18 ± 0.31^{ab}	56.56 ± 0.31^{a}
Mean final weight (g)	135.7 ± 0.17^{c}	135.5 ± 0.17^{cd}	136.93 ± 0.17^{b}	148.9 ± 0.17^{a}	132.2 ± 0.17^{d}	129.2 ± 0.17^{e}
Weight gain(g)	80.16 ± 0.34^{bc}	79.74 ± 0.34^{dc}	81.16 ± 0.34^{b}	92.82 ± 0.34^{a}	76.02 ± 0.34^{d}	72.72 ± 0.34^{e}
PWG (%)	144.17	142.94	144.19	165.51	135.32	128.57
SGR	1.07 ± 0.01^{cab}	1.05 ± 0.01^{cb}	1.07 ± 0.01^{ab}	1.08 ± 0.01^{a}	1.05 ± 0.01^{cd}	1.03 ± 0.01^{d}
Feed Intake	16.82 ± 0.03^{c}	16.81 ± 0.03^{c}	16.84 ± 0.03^{bc}	17.05 ± 0.03^{a}	16.92 ± 0.03^{b}	16.81 ± 0.03^{c}
FCR	2.10 ± 0.01^{cd}	2.11 ± 0.01^{cb}	2.07 ± 0.01^{ed}	2.06 ± 0.01^{e}	2.14 ± 0.01^{ab}	2.16 ± 0.01^{a}
Protein Intake	7.22 ± 0.02^{e}	7.73 ± 0.02^{cd}	7.76 ± 0.02^{c}	7.87 ± 0.02^{a}	7.81 ± 0.02^{b}	7.71 ± 0.02^{d}
PER	1.11 ± 0.01^{a}	1.03 ± 0.01^{dc}	1.04 ± 0.01^{bc}	1.05 ± 0.01^{b}	1.01 ± 0.01^{de}	1.01 ± 0.01^{e}
ANPU	27.53 ± 0.10^{e}	26.71 ± 0.10^{f}	41.75 ± 0.10^{b}	44.32 ± 0.10^{a}	39.16 ± 0.10^{c}	28.77 ± 0.10^{d}
Survival rate %	90.0 ± 0.00^{a}	90.00 ± 0.00^{a}	90.0 ± 0.00^{a}	90.0 ± 0.00^{a}	80.0 ± 0.00^{b}	80.0 ± 0.00^{b}
Temperature	25.67 ± 0.15	26.23 ± 0.15	27.01 ± 0.15	27.54 ± 0.15	25.89 ± 0.15	26.17 ± 0.15
pH	7.74 ± 0.12	7.53 ± 0.12	6.78 ± 0.12	7.32 ± 0.12	6.99 ± 0.12	7.23 ± 0.12
DO	3.9 ± 0.7	3.8 ± 0.7	3.9 ± 0.7	4.1 ± 0.7	4.0 ± 0.7	3.7 ± 0.7

Means with same letter for a given parameter in same horizontal row are not significantly different ($P>0.05$)

KEY: SGR= specific growth rate, FCR= Feed Conversion Ratio, PER= Protein Efficiency Ratio, ANPU= Apparent Net Protein Utilization.

Carcass composition

Fish body proximate composition analyzed before and after 12 weeks feeding with experimental diets is presented in Table 5, all experimental group exhibited higher percentage of crude protein with 50% POM having the highest of 69.88±0.02 and was significantly different with all other diets. Crude lipid differ significantly between the initial and the experimental diets ranging from 4.39 to 5.21, while crude fibre did not differ significantly (P>0.05) among the treatments. Ash and nitrogen free extract NFE also differs between the treatment and the initial with each ranging from 10.08-13.04 and 16.67-23.56 respectively. Dry matter ranged from 22.36 - 26.27 with 50% POM being the highest while the initial has the lowest value.

Table 5: Proximate Compositions (Carcass) of *Clarias gariepinus* Fed Poultry Offal Meal

	Initial	Control	Diet 1 0:100%	Diet 2 25:75 %	Diet 3 50:50 %	Diet 4 75:25%	Diet 5 100:0%
Dry matter	22.36±0.0^{f}	23.28±0.0^{e}	23.52±0.08^{d}	25.43±0.08^{b}	26.21±0.08^{a}	26.07±0.08^{a}	24.37±0.08^{c}
Crude protein	59.41±0.0^{g}	65.38±0.02^{f}	65.64±0.02^{e}	69.07±0.02^{b}	69.88±0.02^{a}	68.58±0.02^{c}	66.06±0.02^{d}
Lipid	5.21±0.02^{a}	4.90±0.02^{c}	4.39±0.02^{f}	5.01±0.02^{b}	4.68±0.02^{e}	4.12±0.02^{g}	4.74±0.02^{d}
Crude fibre	0.00±0.00^{a}	O.OO±0.0^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}	0.00±0.00^{a}
Total ash	11.82±O.3^{b}	13.04±O.3^{a}	8.04±O.O3^{f}	11.09±O.3^{d}	11.43±O.O3^{c}	10.08±O.3^{e}	6.64±O.O3^{g}
NFE	23.56±O.4^{a}	16.67±O.4^{e}	21.93±O.4^{c}	14.82±O.4^{f}	14.02±O.O4^{g}	17.22±O.4^{d}	22.56±O.4^{b}
Gross energy	472.81±0.2^{g}	474.48±0.2^{f}	492.62±0.2^{b}	488.27±0.2^{c}	486.24±0.2^{e}	486.96±0.2^{d}	500.88±0.2^{a}

Means with same letter for a given parameter in same horizontal row are not significantly different (P>0.05)

NFE= Nitrogen Free Extract.

DISCUSSION

The proximate compositions of the experimental diets fed to C. *gariepinus*, the crude protein are not significantly different (P>0.05) between the experimental diets because they are isonitrogenous and isocaloric; this is the same with the results of initial weight of fishes at the start of the experiment. There is an inverse relation between crude protein and dietary inclusion of POM by increasing the poultry offal there is a decrease in the crude protein of the POM this in conformity with the findings of Mohamad salehi and MehranJavaheri (2015).

The mean weight gain showed a significant difference (P<0.05) between the weights gains of all fishes fed. The diet containing 50% has the highest final mean weight which is significantly different from all diets; the specific growth ratio in this research shows there is no significant difference at (P>0.05) between the fishes fed 50% with commercial and 25% POM, while it is significantly different with diet 0%POM and 75%POM the lowest value was observed in 100% POM because of high crude lipid observed in the feed. This is contrast with the finding of Ismail *et al*. (2012) where the highest specific growth rate was found in 75% POM and it was no significantly different from diet 50%POM and 100%POM but is significantly different from diet 0%POM and 25%POM. Baboli *et al*. (2013) observed the specific growth rate (SGR) of juvenile trout fed diets in which fish meal protein was replaced by poultry by-product meal, although the fish fed PBM0 and PBM50 diets had a higher SGR than the other diet and they are significantly different from fish fed 100%PBM (P<0.05). The highest recorded value of Protein Efficiency Ratio (PER) of the experimental diet was 50% POM, this is similar with the findings of Yildirim *et al*. (2009) on *Tilapia zilli*. The values of the Feed Conversion Ratio has diet 50% POM being the lowest while 100% POM the highest. The overall high survival rate in all the treatment suggest that all diets including the control were suitable for the fish and met its nutritional requirement.

Carcass Composition

The initial and final carcass composition of the fish fed the experimental feed revealed an increase in the crude protein level after feeding the fishes with experimental diets, the highest value was obtained in the group fed 50% POM.

This findings is similar to that of Falaye *et al*. (2011) on *Clarias gariepinus*, Yildirim *et al*. (2009) on *Tilapia zilli* where they observed an increase of body protein as the POM level is increased, while in contrast Reginald (2014) on *Heterobranchus longifilis*, Mohamad salehi *et al*. (2015) on *Huso huso* observed a decrease in the body protein as the POM level is increased. The crude lipid observed in this present study showed a significant difference ($P<0.05$) between all treatments, this could be as a result of the lipid content of the poultry offal. This is in contrast to those obtained by Reginald (2014) on *Heterobranchus longifilis* observed an increase in the lipid content with increase in the POM dietary level while Yildirim *et al*. (2009) on *Tilapia zilli* reported that the body lipid of the fishes fed experimental diets is not significantly different ($P>0.05$).

CONCLUSION

Due to the high protein content and survival rate of the fishes fed poultry offal meal, this experiment suggest that Fishmeal can be successfully replaced by 50% POM in the diets of *C. gariepinus* without any adverse effect on its growth performance and feed utilizations.

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