UTILIZATION OF COMPOUNDED FEED AND POULTRY HATCHERY WASTE IN THE DIET OF *Clarias gariepinus*

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ABSTRACT
Five isonitrogenous diets (100% compounded feed - control feed), 75% compounded feed and 25% poultry waste, 50% compounded feed and 50% poultry waste, 25% compounded feed and 75% poultry waste and 100% poultry hatchery waste) were formulated . The hatchery waste was sun dried for three days, ground, added to the feed and fed to 150 juveniles of Clarias gariepinus distributed in 15 (high density polyethylene) tanks. Ten specimens were stocked in each of the plastic tanks and fish were fed thrice daily for 12 weeks. The result showed that specimens fed with 75% compounded feed and 25% poultry hatchery waste had the highest mean weight gain (MWG) (22.7g) and specific growth rate (SGR) (45.3%). The second best result was shown in specimens fed with 100% compounded feed with the highest daily rate of growth (DRG) (0.0105), gross efficiency of feed conversion (GEFC) (0.4688), protein efficiency ratio (PER) (0.153) and lowest feed conversion ratio (FCR) (3.657). The poorest result was shown in the specimens fed with 25% compounded feed and 75% poultry hatchery waste recording the least MWG (16.2), SGR (40.3), DRG (0.0073), GEFC (0.0268), PER (0.106) and the highest FCR (5.257). This implies that poultry hatchery waste can best be utilized when formulated with compounded feed at a ratio of 25% to 75%. Therefore, this ratio should be adopted by fish farmers whose intention is profit maximization and reduction in running cost.
Keywords: waste re-use, fish protein, bio-indicator, African catfish

INTRODUCTION

Aquaculture is one of the fastest growing food production sectors in the world and provides significant supplement and substitute to wild fishes (Francis *et al*., 2001). The aquaculture sector is confronted with the problem of high cost and irregular supply of conventional fish feed ingredients. However, Omitoyin (1995) and Aderemi *et al.* (2004) observed that majority of feed ingredients required for the animal feeds can be met by using agro-industrial products, which are considered as wastes. The use of live organisms in aquaculture has for the past decades received tremendous attention in countries where aquaculture is well developed. Faturoti (2000) noted that for aquaculture industry to thrive apart from development of adequate manpower there is also need to research and develop various inputs of production such as feed. The cost of feeding fish fry on artificial feed is very high only very few farmers can afford it, also artificial feed tends to pollute water as a result there is the need to find alternative feed for fish fry.

Some problems are associated with aquaculture in Nigeria and the major one is inadequate quality and quantity of fish supply (Fagbenro, 2002). Omitoyin (2005) also reported that Nigeria aquaculture industry is currently faced with the problem of inadequate supply and prohibitive cost of quality fish feeds. Due to the high and increasing demand of fish and animal protein, aquaculture has been used as an alternative to bridge the gap of this scarce commodity.

Nutrition is the process by which organisms obtain food and use it for metabolic processes, growth and repair of worn out tissues. Feeding usually represents the single most expensive production cost in intensive aquaculture. Therefore, the development of formulated feeds which satisfy the nutritional requirement of the fish is considered to be one of the major tasks in aquaculture. Much research is therefore directed towards the development of least-cost feeds to rear the fish as cost effectively as possible. High cost of feed has been recognized as a major factor militating against rapid development of aquaculture in the developing countries and feed is the most expensive cost item in semi-intensive and intensive fish culture. Therefore, the need for an alternative arises. In Nigeria, catfish is widely cultured (Cowx, 1992, Sogbesan and Ugwumba, 2008, Ayoola, 2009b) because of its high growth rate, ability to withstand stress, ability to withstand disease and ability to spawn easily. *Clarias gariepinus* is one of the most suitable aquaculture species in Nigeria. This could be credited to its hardy, resistant to handling and stress, better growth and feed conversion ability. The high quality and better taste of its flesh makes it a highly demanded fish; hence there is a need to increase the local production of this species at cheaper production cost. Fagbenro and Adeparusi (2003) reported increasing attempt to develop practical diets for farmed fish in Nigeria. The increasing cost of fish feed has made research interest to be focused on reducing cost of the most expensive ingredients by alternative protein sources.

It may be feasible to replace expensive conventional fish feedstuffs with cheaper alternatives in order to reduce the cost of the feed. However most fish farmers particularly in the rural area still depend on agricultural wastes including poultry litter for feeding fish. The use of poultry waste as a dietary supplement in *Clarias gariepinus* ration could have a considerable effect on reducing cost, insufficient protein in diet and solving disposal problem. Poultry litter has been considered to have some nutritional values containing about 25.75% crude protein (Ndifon, 1987). While Omitoyin (1995) noted that the concept of utilizing poultry litter is highly desirable since it will not only eliminate the problem of waste disposal but also provide cheap fish feed at little cost. Leray (1970), Kerns and Roelofs (1973) and Gallagher and Degani (1988) have fed different species of fish with poultry litters and other form of non protein nitrogen with different results. The high content of protein, energy and mineral in poultry waste indicates its importance as a partial substitute for concentrates in diet of *C. gariepinus*. Furthermore, poultry waste has a substantial amount of crude protein and is rich in calcium and phosphorus. Poultry manure is a potential source of protein. It has attracted the attention of animal nutritionists all over the world because of its richness of protein, calcium (5.4%), phosphorus as K_2O and magnesium as MgO (0.335%) and other minerals (SPFG, 1994). Recently, fish farmers especially in the integrated farming system have been encouraged to recycle wastes from animal dung (especially poultry) as food for fish rather than discard them. Poultry manure is not only used as organic manure in the production of plankton but also directly consumed by fish in the culture system. Although, this observation has been verified by many workers (Oladosu *et al*., 1990; Gavina, 1994; Ugwumba and Abumoye, 1998), information on the effect of the dung and poultry hatchery waste when incorporated into artificial fish diets are scarce.

Poultry waste is now widely used in commercial freshwater aquaculture. Supplementing use of poultry hatchery waste will result in cheap and available direct feeding of fish as an alternative strategy of reducing the high cost of fish feed.

Therefore, this study is to determine the utilization of poultry hatchery waste in the diet of *C. gariepinus*, the best level of supplementation of poultry hatchery waste and the economic viability of feeding *C. gariepinus* with poultry hatchery waste.

MATERIALS AND METHODS

One hundred and fifty juveniles *Clarias gariepinus* (mean weight of 14.6 ± 0.54 g and mean length of 6.60 ± 0.31 cm) of fish where purchased from Ibafo fish farm in Ogun state farm Nigeria. The fishes were transported in an open 25 L container to the Marine Research Laboratory of the University of Lagos in clean fresh water. The specimens were acclimated for 14 days in the laboratory prior to the start of the experiment.

After 14 days of acclimation, 10 juveniles of *C. gariepinus* were transferred into each of the plastic experimental tanks using a scoop net. Suitable water quality was maintained by daily water exchange and regular tank cleaning.

The poultry hatchery waste was purchased from Ajanla fish farm, along Lagos – Ibadan expressway in Oyo state. The poultry hatchery waste was further processed by par boiling and sun drying for 2 days after which it was ground and pelleted into 2 mm sizes, some of the ground poultry hatchery waste was incorporated into the compounded feed and the mixture was mixed with hot water to aid digestibility and then sun-dried before it was pelleted. The feed was pelleted into 2 mm pellet size using pelletizing machine (with drier) to enable the specimens swallow them easily. Part of the poultry hatchery waste (which comprises of unhatched eggs, dead pre-mature day old chicks) was taken to the Animal Science Laboratory of the University of Ibadan for proximate analysis (Table 1).

Table 1: Proximate Composition of Poultry Hatchery waste

Components	Composition (%)
Crude protein	21.44
Ash	50.00
Ester extract	12.00
Crude fibre	2.00
Dry matter	97.57
Moisture content	2.43

Experimental Set-Up

Fifteen plastic tanks of dimension (48 x 30 x 26 cm) were employed during the course of the experiment. Each plastic container previously disinfected and filled with dechlorinated tap water were stocked with 10 juveniles of *C. gariepinus*. The water was filled to 2/3 of the volume of each tank. The tanks were labeled $T_{0,}$ T_1, T_2, T_3 and T_4 each in triplicate. The tanks labeled represent each of the feeding regimes. The feeds used for this study were formulated feed (Table 2) and poultry hatchery waste at different percentage substitution. The percentage substitutions are indicated below:

Tank T_0: 100% Compounded feed (Control feed)
Tank T_1: 75% Compounded feed and 25% poultry hatchery waste
Tank T_2: 50% compounded feed and 50% poultry hatchery waste
Tank T_3: 25% compounded feed and 75% poultry hatchery waste
Tank T_4: 100% poultry hatchery waste.

Table 2: Weight composition of formulated feed

INGREDIENT	WEIGHT (%)
Maize	10.54
Wheat offal	10.54
Fish meal	21.96
Soya meal	21.96
Groundnut Cake	21.96
Premix	2.5
Indomie	10.54
Total %	100%

The crude protein (CP) content of T_0, T_1, T_2, T_3, T_4, were 40.00, 38.35, 37.20, 35.70 and 22.44% respectively. Fish were fed three times a day in equal proportions with their various experimental feeds for a period of 12 weeks. The daily feeding ration was measured at the beginning of every week using the weighing scale (OHAUS MODEL 5000).

Feeding response was monitored and mortality was recorded. The water was changed every day in order to avoid contamination of the water with uneaten feed and faeces.

The mean standard weight of the fish in each tank was determined at the beginning of the experiment and thereafter weekly. Fish weight was determined using weighing scale (OHAUS MODEL Cs 5000, Capacity 5000×2 g) and mean value was calculated.

Growth and Nutrient Utilization Parameters

The following indices were used to determine the biological evaluation of growth performance and nutrient utilization of the experimental fish.

Mean Weight Gain (MWG)

The weight gained per week was calculated using the formula below.

$$\text{MWG} = \text{Final weight (g)} - \text{Initial weight (g)}$$

Percentage Weight Gain (PWG) per week

This was calculated using the formula below:

PWG per week

$$= \frac{\text{Mean weight gain per week (g)}}{\text{Initial mean weight (g)}} \times 100$$

Feed Conversion Ratio (FCR)

This is the amount of unit weight of food that specimens were able to convert into unit muscle. It was determined by the formula below.

$$\text{FCR} = \frac{\text{Feed intake (g)}}{\text{Total weight gain (g)}}$$

Specific Growth Rate (SGR)

This is the percentage rate of change in the logarithmic body weight. It was computed according to Hopkins (1992). The SGR was calculated using the formula below.

$$\text{SGR} = \frac{\text{Log}_e W_f - \text{Log}_e W_i}{T_1 - T_2} \times 100$$

Where W_f = final body weight at time T_2 (days) and

W_i = initial body weight at time T_1 (days)

Protein Efficiency Ratio (PER)

This was calculated from the relationship between the increments in the weight of fish (i.e. weight gain of fish) and protein consumed.

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

Daily Rate of Growth (DRG)

This was calculated with the formula below.

$$\text{DRG} = \frac{\text{Mean increase in weight per day (g)}}{\text{Body weight of fish (g)}}$$

Daily rate of feeding (DRF)

This was calculated with the formula below.

$$\text{DRF} = \frac{\text{Mean ration per day}}{\text{Body weight of fish (g)}}$$

Gross Efficiency of Food Conversion (GEFC)

This parameter was calculated from the formula below.

$$\text{GEFC} = \frac{\text{Daily rate of growth}}{\text{Daily rate of feeding}}$$

Protein intake (P.I.)

This was determined from the proportion of protein content in the total feed consumed. Protein intake was calculated using the formula below.

PI

$$= \frac{\text{Total feed consumed} \times \text{percentage protein}}{100}$$

Statistical Analysis

Analysis of variance (ANOVA) was carried out to test significance of the treatments on the fish growth rate pattern within the study period and level of significance was determined using the Duncan multiple range test.

RESULTS

Gains in Weight

The initial mean weight of the specimens in tanks T_0, T_1, T_2, T_3 and T_4 were 14.2 g, 14.2 g, 14.2 g, 14.5 g and 14.3 g respectively, while their mean final weight at the end of the experiment were 30.9 g, 36.9 g 34.0 g, 28.7 g and 35.4 g for tanks T_0, T_1, T_2, T_3 and T_4 respectively. The percentage mean weight gained were 209%, 159.9%, 139.4%, 129.6% and 129.6% for tanks T_0, T_1, T_2, T_3 and T_4 respectively. The percentage weight gain per week was highest in Tank 0 (100% compounded feed). The lowest percentage weight gain per week was obtained in Tank 3 with a value of 10.8%. The percentage weight gain values of Tanks 1, 2 and 4 were 13.3%, 11.6% and 12.3% respectively. The mean weight, percentage mean weight gain per week and percentage mean weight gained in the various feeding regimes are further illustrated in Table 3.

Table 3: Mean weight, percentage mean weight gain per week and percentage mean weight gained in the various feeding regimes

Feeding Regimes	Initial mean weight(g)	Final mean weight(g)	Mean weight gained(g)	% mean weight gained	% mean weight gain per week
100% Compounded Feed (C.F.)	14.2	35.1	20.9	209	17.4
75% C.F and 25% P.W	14.2	36.9	22.7	159.9	13.3
50% C.F and 50% P.W	14.2	34	19.8	139.4	11.6
25% C.F and 75% P.W	14.5	30.7	16.2	129.6	10.8
100% Poultry Hatchery Waste	14.3	35.4	21.1	147.6	12.3

Growth and nutrient utilization Parameters

Table 4 highlights growth and nutrient parameters obtained. Food conversion ratio (FCR) shows the amount of unit weight of food that specimens were able to convert into unit weight of muscle. The higher the FCR, the worse it is while the lower the FCR the better it is. The highest and hence the worse FCR of 5.257 was obtained in Tank 3 (25% Compounded feed and 75% poultry hatchery waste). The lesser and hence the better FCR was obtained in Tank 0 (100% Compounded feed). The second highest FCR value of 4.214 was obtained in Tank 4 while Tanks 1 and 2 had FCR value of 3.711 and 4.159 respectively.

The SGR value was lowest in Tank 3 (25% compounded feed and 75% poultry hatchery waste) with a value of 40.3% while the highest SGR of 45.3% was obtained from Tank 1 (75% compounded feed and 25% poultry hatchery waste). The SGR values of Tanks 0, 2 and 4 were 44%, 43.3% and 44%. The PER which is the relationship between increase in weight of fish and protein intake was calculated for the five tanks. The highest PER, value was obtained in tank 0 with a value of 0.153 while the lowest PER value was obtained from tank 3 with a value of 0.106. Tanks 1, 2 and 4 had values of 0.151, 0.135 and 0.133 respectively. The daily rate of growth showed by the specimens was almost similar in all the tanks. The highest value was showed by fishes in tank 0 with a value of 0.0105 and the lowest was shown by fishes in tank 3. Tanks 1, 2 and 4 had values of 0.0090, 0.0085 and 0.0086 respectively. The daily rates of feeding of the specimens were similar in all the tanks except tank 0 with a remarkable difference having a value of 0.0224. Tanks 1, 2, 3 and 4 had values of 0.2498, 0.2441, 0.2720 and 0.2564. The gross efficiency of food conversion which is calculated by the daily rate of growth over the daily rate of feeding was highest in tank 0 with a value of 0.4688 which was remarkably higher than the other feeding regimes. Tanks 1, 2, 3 and 4 had values of 0.0360, 0.0348, 0.0268 and 0.0335.

The highest amount of protein was consumed by fishes in tank 4 with value of 158.9 while fishes in tank 0 had the lowest protein intake with value of 136.6. Fishes in tanks 1, 2 and 3 had protein intake values of 150.5, 147.1 and 152.2 respectively.

Table 4: Growth and nutrient parameters of *Clarias gariepinus* fed with compounded ration and poultry hatchery waste

Parameters	T_0	T_1	T_2	T_3	T_4
MWG	20.9	22.7	19.8	16.2	21.1
% MWG	209	159.9	139.4	129.6	147.6
%MWG/Wk	17.4	13.3	11.6	10.8	12.3
SGR	44	45.3	43.3	40.3	44
FCR	3.657	3.711	4.159	5.257	4.214
DRF	0.0224	0.2498	0.2441	0.2720	0.2564
DRG	0.0105	0.0090	0.0085	0.0073	0.0086
GEFC	0.4688	0.0360	0.0348	0.0268	0.0335
PER	0.153	0.151	0.135	0.106	0.133
PI	136.6	150.5	147.1	152.2	158.9

Economic viability of feeding *Clarias gariepinus* with poultry hatchery waste

Twenty-five kilogrammes (25 kg) of poultry hatchery waste was purchased at N14/kg. The cost of transportation and processing was N3000. Twenty-five kilogrammes (25 kg) of the compounded feed was purchased at N400/kg, while cost of transportation and processing was N10, 000. Therefore, the percentage gain of using poultry hatchery waste with compounded feed is calculated as:

$$\%\,Gain\; = \frac{14}{400} \times \frac{100}{1} = 3.5\%$$

From the result obtained, feeding *C. gariepinus* with poultry hatchery waste is 3.5% cheaper than feeding with compounded feed; this implies that there is a marginal difference of 3.5% in substituting poultry hatchery waste with compounded feed.

Furthermore, 25 kg of poultry hatchery waste at N14/kg was N350. Transportation and processing cost was N3000. Therefore, cost of poultry hatchery waste, cost of transportation and processing was N350 in total while 25 kg of compounded feed at N400/kg is N10, 000 and cost of processing and transportation was N10, 000. Therefore cost of compounded feed, cost of transportation and processing is N20, 000 in total.

DISCUSSION

The feeding trials revealed that *Clarias gariepinus* responded to all the diets, irrespective of their composition. *C. gariepinus* was able to effectively utilize the poultry hatchery waste for growth. The highest mean weight gain was obtained in tank T_1 (75% compounded feed and 25% poultry hatchery waste) as compared to the control diet Tank T_0 (100% Compounded feed) implying that lowest inclusion of poultry hatchery waste gave the best growth performance. This could be as a result of a balance in the protein content present in the diet fed to the fishes in that tank. More so, the level of poultry hatchery waste was minimal compared to the other feeding regimes. Supplemental feed has been shown to increase the yield of fish (Davis and Stickney, 1976; Moav *et al.*, 1977; Balarin, 1979; Jauncey and Ross, 1982 and Ayoola, 2010).

It is interesting to note that better growth and nutrient utilization were achieved at relatively low inclusion level of poultry hatchery waste compared to high incorporation of the test ingredient. This could be due to the better performance and utilization of the diets in spite of fibre levels. Lovell (1989) opined that the fibre probably reduced the passage rate of the diet in the digestive tract and increased digestion. Falaye (1998) also recorded higher growth and nutrient utilization in *Oreochromis niloticus* as the fibre levels of diets increased. Moreover, Lovell (1989) stated that the fibre probably reduced the passage rate of the diet in digestive tract and thereby increasing digestion.

The protein quality of the feed fed the fish determines whether the feed material accepted by the fish is balanced or not. *Clarias gariepinus* juveniles fed with poultry hatchery waste show the best growth performance than the control diet tank T_0 (100% compounded feed). Tank T_1 (75% compounded feed and 25% poultry hatchery waste) had the highest growth performance. However, Massumotu *et al* (1996) reported that the biological value of protein source does not only depend on its amino acid profile but also on its digestibility. Since the inclusion of poultry hatchery waste increased the protein content of the diet, this has been documented to enhance growth performance in fish (Steffens, 1989). Ayoola (2010) argued that the quality of a fish diet is greatly determined by the amount of fishmeal in such diet.

From this trial, it is apparent that dried poultry hatchery waste can be used at different composition with compounded fish feed without any adverse effect on growth and nutrient utilization of *C. gariepinus* juveniles. The performance exhibited by fish fed 25% compounded feed and 75% poultry hatchery waste being a waste product from poultry birds contains anti-nutritional factors which inhibit the activities of protein digesting enzymes. Therefore, if not well treated can still affect its utilization by fish (Faris and Singh, 1990; Osho, 1993).

From the result obtained, feeding *C. gariepinus* with poultry hatchery waste is 3.5%

cheaper than feeding with compounded feed; this implies that there is a marginal difference of 3.5% in substituting poultry hatchery waste with compounded feed. The potential of feeding poultry hatchery waste to *C. gariepinus*, and the low cost of purchasing, transporting and processing it, should be considered as a better alternative to expensive fish feed products.

Furthermore, the superior growth and nutrient utilization resulting from the use of dried poultry hatchery waste has economic significance considering that the price of fish feed has become expensive in many developing countries including Nigeria. This is important in aquaculture particularly as the cost of fish feed currently accounts for 40% to 70% of the variable costs of fish farming ventures (Ghallagher, 1994).

CONCLUSION

According to the results obtained from the various feeding regimes, it could be concluded that the best treatment and the best to venture into is the 75% compounded feed and 25% poultry waste hence; it should be better adopted by fish farmer whose intention is profit maximization since both conferred excellent fish performance without significant difference. The second most advisable treatment is the 100% compounded feed. The worst treatment and hence not advisable to any fish farmer or economist is 25% compounded feed and 75% poultry hatchery waste. The result obtained showed that specimens fed with 75% compounded feed and 25% poultry hatchery waste had the highest mean weight gained (MWG) (22.7g) and specific growth rate (SGR) (45.3%). The second best result was shown in specimens fed with 100% compounded feed with the highest daily rate of growth (DRG) (0.0105), gross efficiency of feed conversion (GEFC) (0.4688), protein efficiency ratio (PER) (0.153) and lowest feed conversion ratio (FCR) (3.657). The poorest result was shown in the specimens fed with 25% compounded feed and 75% poultry hatchery waste recording the least MWG (16.2), SGR (40.3), DRG (0.0073), GEFC (0.0268), PER (0.106) and the highest FCR (5.257). This implies that poultry hatchery waste can be utilized best when compounded with compounded feed at a ratio of 25% to 75%. Therefore, this ratio should be adopted by fish farmers whose intention is profit maximization and reduction in running cost.

The high economic importance of poultry hatchery waste cannot be overemphasized since it is a waste product. Using it in aquaculture is a very good means of disposing these waste products as its presence in the environment causes pollution.

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