Growth performance of broiler chickens fed maize offal and crayfish-waste based diets

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Abstract

This study was conducted to evaluate the value of maize offal and cray fish waste meals as the main energy and protein sources respectively in broiler chicken diets. One hundred and twenty day-old-Lohmann Brown broiler chicks were randomly allotted into two treatment groups of three replicates of 60 and 20 birds, respectively. Maize offal and crayfish waste meals were used to replace maize and soybean/fishmeal, respectively in the control diet (T_1) to form (T_2). Growth parameters monitored were final live weight, daily weight gain, feed conversion ratio, internal and external body linear measurements were evaluated were statistically analysed using the studentized t-test at 5% and 1% probability. Results showed significantly ($P<0.05$) higher values in all the parameters apart from feed intake for birds on the control diet. The final live weight of birds on the test diet (T_2) only reached that of the control at 10 weeks of age. The phenotypic correlation of body weight and linear body measurements for birds on both the control and test treatment diets were high and positively significant ($P<0.01$). However, birds on the control diet had the longest body parts than those of the test diet, likewise the internal body parts. When expressed based on percentage body weight, birds on the test diet tended to have longer external and internal body parts. It is concluded that if maize offal and crayfish waste are to be used as total replacement for maize, soybean and fishmeal, the period of broiler production should be extended from 8 weeks to 10 weeks for birds to reach market weight and with attendance lower cost of production.

Keywords: Maize offal, crayfish waste, phenotypic correlation, linear measurement

Introduction

Feed is the major component of the total cost of livestock production, representing 70-75% of the total cost of production (Esonu *et al.* 2008). A way of reducing this trend is for producers to direct their efforts towards harnessing and utilizing unorthodox feed ingredients like agro industrial by products in order to save man and his livestock from starvation (Ojabo *et al.*, 2014). Agroindustrial by-products can be derived from the product from stages of food processing or industrial processing of a target product. Two of such are crayfish waste and maize offal. Crayfish waste is derived from commercial crayfish and other marine organisms from the sea and rivers. They are usually dried and sieved, the waste discarded is the crayfish waste

which could be used as a protein supplement or replacement in livestock and poultry feeds. Crayfish wastes is made up of shrimps, shrimp's heads, shell, tendrils, sea debris and so on. The crude protein varies from 30-70% based on the amount of the above components (Olomu, 2010). However, most of the protein comes from the chitin, an indigestible nitrogen containing polysaccharide, but is high in choline and contains some important carotenoids (Fanimu *et al.*, 2007; Olomu, 2010 Ukoha *et al.*, 2019). In recent times, the waste is being sold as a result of high demand by farmers who realize its usefulness in livestock and poultry feeds. Maize residue (offal) is an energy source by – product derived from maize after the extraction of starch “Ogi”. Although, it has

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low energy but high protein level when compared to maize. Nsa *et al.* (2009) and Ogungbeuro *et al.* (2013) reported a high fibre content of 11.36% and crude protein content of 11.05% for maize offal. Its usage in poultry diet especially for young birds is limited by its fibre content especially when other fibre sources like wheat offal and palm kernel cake are included (Hedge *et al.*, 1978). Thus, the objective of this study was to assess the growth performance phenotypic correlation for body weight and linear body measurements of broiler chickens fed diets with maize offal and crayfish waste as the only energy and protein sources.

Materials and methods

Experimental site

The experiment was carried out at a standard Poultry Unit located at the Federal Housing Estate, Calabar, Nigeria. Calabar is located within the tropical rain forest zone of Nigeria. It lies between latitude 4°58'N and 41°39'N and longitude 8°17'E and 10°43'E of the equator with annual temperate and rainfall ranges between 25-30°C and 1260 – 3500mm respectively (Google Earth, 2017).

Experimental diets

Maize offal was purchased from local “Ogi” sellers within Calabar Municipality. They were sundried by spreading on concrete slab and allowed to dry for 2-3 days to a constant moisture level of 10% before being stored in jute bags.

Crayfish waste was bought from crayfish sellers in Calabar South Local Government Area and thereafter dried and milled with a meadow model 35 hammer mill and stored in sack bags. Representative samples of

both test ingredients were analysed for proximate composition. Maize offal and crayfish waste were made to replace the energy source (maize) and protein sources (soybean and fish meal) respectively in the control diet (T₁) to form treatment diet T₂ (Table 1).

Experimental animals and management

One hundred and twenty Lohmann Brown broiler chicks were purchased from a reputable farm. They were weighed and randomly allotted to two treatment groups and within each treatment groups, birds were divided into three replicates of 20 birds each. Each bird was marked for easy identification and housed in a deep litter pen. All routine vaccination and medications were given. Birds were offered experimental starter diet for the first four weeks followed by experimental finisher diets for the next four weeks. Parameters measured included: Records of daily feed intake and weekly weight gain were taken throughout the eight weeks of the experiment. At the end of 8th week, the birds were starved overnight, weighed, slaughtered, de-feathered, eviscerated and cut into primal parts for external and internal parts measurement with the use of a sensitive weighing balance of 0.05g sensitivity and a measuring tape calibrated in centimetres.

Statistical analysis

The studentized t-test was used to analyzed and compare between two means. Regression model: Traits studied were body weight, body circumference, body length, body height, shark length, leg length, thigh length, head circumference, wing length and knee angle using simple linear regression analysis (SAS, 2012).

Table 1: Composition of experimental starter and finisher diets of broiler chickens fed maize offal - crayfish waste based diet

Diets Ingredients	Starter diets		Finisher diets		Maize offal	Cray fish waste
	T ₁ (control)	T ₂	T ₁ (control)	T ₂		
Maize	54.50	-	60.00	-		
Maize offal	-	71.00	-	73.50		
Soybean meal	32.00	-	25.00	-		
Wheat offal	7.10	-	8.60	-		
Fish meal	2.50	-	2.50	-		
Crayfish waste	-	24.50	-	18.50		
Palm oil	-	2.00	-	5.5		
Bone meal	3.00	2.00	3.00	2.00		
Salt	0.30	0.30	0.30	0.30		
Lysine	0.20	-	0.20	-		
Methionine	0.20	-	0.20	-		
*Vit/min premix	0.20	0.20	0.20	0.20		
Total	100.00	100.00	100.00	100.00		
Calculated analysis						
Crude protein (%)	23.00	23.51	20.0	21.03	11.38	58.90
Crude fibre (%)	3.85	6.71	4.26	7.88		
ME(Kcal/Kg)	2885.50	2508.92	3001.83	2544.00		
Determined analysis						
Crude fibre %					8.82	2.01
Ether extract %					3.04	3.67

*Composition per 2kg of mixture contains; Vitamin A - 15,000,000 iu, Vitamin D - 3,000,000 iu., Vitamin E - 15,000 iu, Vitamin K - 2.5g, Vitamin B₁- 1g, Vitamin B₂- 10g., Vitamin B₁₂- 4g, Folic acid - 2g, Biotin - 0.1g, Niacin - 70g, BHT - 125g, Calcium-Pantotenic acid - 20g

Model Function

Linear $Y = a + bx$

Where

Y = body weight (dependent variable)

N = body parameters (independent variables)

b = slope

$a = y - bx$

Where y and x = means of y and x respectively

Cost analysis

The following formulae were used to determine the economics of production of the birds.

Cost of weight gain =

$\frac{\text{Average wt gain kg} \times \text{cost of feed (N)}}{\text{Weight gain (kg)}}$

Cost of feed/kg weight gain =

$\frac{\text{cost of feed (N/kg)} \times \text{Ave feed consumed (Kg)}}{\text{Average weight gain (kg)}}$

Relative cost benefit (%) = cost of feed

(N/kg) weight gain of control diet – cost of feed (N/kg) weight of test diet x 100/ cost of feed (N/kg) weight gain of control diet
Cost differential = cost of feed/kg weight

Results and discussion

The result of growth performance of broiler chickens fed diet with maize offal and crayfish waste as the main sources of energy and protein is presented in Table 2. Apart from feed intake, birds on the control diet (T₁) had significantly ($P < 0.05$) favourable growth parameters. The higher ($P < 0.05$) feed intake observed from birds on the test diet (T₂) could be attributed low energy and high fibre of the diet, which is in the consonance with the reports of Olumu (2010), Oyawoye *et al.* (2012), Nsa *et al.* (2013) that birds eat more to meet their requirement for some dietary components other their energy. The low energy content

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of maize offal which contributed to the low energy content of the feed according to Reddy (2007) could be the cause of high feed intake since birds eat to meet their energy requirement. The more favourable values were recorded in birds fed the control diet in all other growth parameters; final live weight, weight gain and feed conversion ratio indicated that maize offal and crayfish waste diet lack necessary nutrients to support birds' optimum performance. The fibre content in starter and finisher mashes were above the recommended values by NRC (2000) of 4% and 5% for starter and finisher birds. These levels can hamper growth performance as it acts as a diluent and as a barrier to the attack of intracellular compounds by enzymes of the gastro intestinal tract (Tashrio and Maki, 1979). High fibre in feed increases the transit rate resulting in decrease nutrient absorption which according to Knogdah (1986) reduces the protein and energy utilization to about 20% under practical condition.

The results of external and internal body parts are presented in Table 4. Birds on the control diet (T_1) had significantly ($P<0.05$) higher values for external body parts than birds on the test diet (T_2). This was expected since body weight of bird is directly correlated with body parts (Ezzeldin *et al.*, 1994). However, when expressed based on percentage live weight the values for birds on test diet seem to be significantly ($P<0.05$) higher than that of birds on control diet. This observation could be attributed to the fact that the birds on test diet thou small in size but were of the age and the organs were relatively developed but not directly proportional to the body live weight. The internal body parts values showed the same pattern as external body parts in terms of

higher values for birds on the control diet (T_1) than birds on the test diet (T_2). An indication that body live weight is directly proportional to the internal organ development. When expressed based on percentage body the reverse was the case where the internal body weights were higher than that of birds on the control diet. The same explanation as that of the external body parameters could be given as all birds were of the same age with relatively mature organs for effective metabolic functions. The equation estimate of parameter and coefficient of determination of the fitted functions are presented in Table 4 which demonstrated a strong inter-relationship ($P<0.001$) between body weight and linear body measurements. The prediction equation showed that body weight in broiler chicken fed both the control diet and test diet is linearly related to the body measurements especially the thigh length, body length and shank length. The prediction equation as provided in this study using high length, body length and shank length can assist producers and buyers to have accurate and easy means of estimating body weight of broiler chickens on both diets without resorting to weighting the birds. Coefficient of determination (r^2) varied from 83% to 97% for head circumference and thigh length in birds on control diet (T_1) while for birds or test diet (T_2), coefficient of determination (r^2) varied from 94% to 99% for body length and thigh length. These results showed high accuracy of prediction of body weight, which is in line with the reports of Adeniyi and Ayorinde (1990), Monsis (1992), Adeleke *et al.* (2004) and Peter *et al.* (2006) who reported that shank length, thigh length and body length could be used effectively to predict body weight of chicken.

Table 2: Performance of experimental birds fed maize offal- crayfish waste based diet

Parameters	T ₁ control	T ₂	LOS
Initial body weight(g)	71.74	73.72	NS
Daily feed intake (g)	69.86	85.66	S
Total feed intake at 8weeks	4172.62	5621.50	S
Total feed intake at 10weeks	-	6890.19	NE
Final live weight at 8 weeks	1208.96	893.41	S
Final live weight at 10wks	-	1212.60	NE
Daily weight gain at 8 weeks(g)	23.21	16.73	S
Daily weight gain at 10 weeks	-	23.07	NE
Total weight gain at 8weeks	1299.79	936.88	S
Total weight gain at 10 weeks	-	1171.10	NE
Feed conversion ratio	3.01	5.12	S
Feed cost/Kg (₦)	120.25	65.00	S
Total cost of feed(N) at 8wks	501.76	365.40	S
Total cost of feed(N) at 10wks	-	447.86	NE
Cost of feed/kg live wt gain (₦) at 8 wks	385.97	390.01	S
Cost of feed/1kg live wt gain(N) at 10wks	-	382.46	

LOS= level of significant, S= significant at 5% level, NS=non-Significant at 5% level, NE=non- estimated

Table 3: External and internal parameters of experimental birds fed maize offal -crayfish waste based diets

Treatments	T ₁	T ₂	Los
External body parameters (cm)			
final live weight(g)	1208.96	893.41	S(S)
Body circumference	24.51(2.03)	22.64 (2.53)	S(S)
Body length	23.02(1.90)	21.77(2.44)	S(S)
Body height	15.06((1.25)	14.42(1.61)	S(S)
Shank length	5.10(0.42)	4.34(0.48)	S(S)
Leg length	7.39(0.61)	6.82(0.76)	S(S)
Thigh length	5.96(0.49)	5.81(0.65)	S(S)
Head circumference	9.53(0.79)	8.87(0.99)	S(S)
Wing length	13.27(1.10)	13.14(1.45)	S(N)
Knee Angle	5.22(0.43)	4.70(0.53)	S(S)
Internal body parameters (cm)			
Gullet	11.24(0.93)	9.54(1.07)	S(S)
Liver	6.36(0.53)	5.96(0.67)	S(S)
Gizzard circumference	13.20(1.09)	11.68(1.31)	S(S)
Small intestine	162.38(13.43)	156.82(17.55)	S(S)
Large intestine	11.34(0.94)	10.02(1.12)	S(S)
Heart circumference	5.54(0.46)	5.48(0.61)	S(N)
Lung circumference	5.26(0.44)	5.00(0.56)	S(N)
Ceca	18.98(1.57)	17.86(2.00)	S(S)
Crop	10.20(0.84)	9.58(1.07)	S(S)
Proventriculus	4.42(0.37)	4.12(0.46)	S(S)

Values in brackets are expressed in percentage of live weight (% LW) S=significant at 5% probability, N=non-significant.

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Table 4: Prediction equation for body parameters using body weight as independent variable (simple linear function)

Treatments	T ¹ (control)	r ²	T ²	r ²	LOS
Linear measurement	Functions		Functions		
Body circumference	$Y = -768.29 + 51.62X$	89.32	$Y = -823.27 + 56.19X$	96.66	**
Body length	$Y = -870.25 + 59.31X$	95.75	$Y = -732.49 + 54.24X$	94.20	**
Body length	$Y = -1076.47 + 104.47X$	93.85	$Y = -740.24 + 81.38X$	98.05	**
Thigh length	$Y = -686.98 + 198.63X$	98.45	$Y = -354.69 + 135.04X$	99.43	**
Leg length	$Y = -701.19 + 161.03X$	98.02	$Y = -536.14 + 141.25X$	97.88	**
Shank length	$Y = -916.68 + 277.16X$	93.25	$Y = -579.54 + 231.30X$	98.27	**
Wing length	$Y = -623.59 + 84.43X$	97.11	$Y = -508.71.94X$	99.06	**
Head circumference	$Y = -1434.60 + 202.67X$	90.95	$Y = -1095.65 + 171.31X$	97.10	**
Allometric (Huxley equation $y = ax^b$)					
Body circumference	$Y = 0.042X^{2.86}$		$Y = 0.031X^{3.00}$	98.88	**
Body length	$Y = 0.017X^{3.19}$	95.54	$Y = 0.038X^{1.98}$	98.29	**
Body height	$Y = 0.0295X^{3.48}$	97.88	$Y = 0.144 X^{2.91}$	96.39	**
Thigh length	$Y = 2.74X^{2.86}$	94.07	$Y = 10.18 X^{2.01}$	96.01	**
Leg length	$Y = 1.72X^{2.71}$	97.47	$Y = 2.758 x^{2.50}$	94.70	**
Shank length	$Y = 1.59X^{3.39}$	89.17	$Y = 7.671X^{2.51}$	90.20	**
Wing length	$Y = 1.25 X^{2.40}$	91.18	$Y = 0.9012X^{2.32}$	98.40	**
Head circumference	$Y = 0.007X^{4.85}$	99.80	$Y = 0.0860x^{3.77}$	93.61	**

LOS= level of significant, **=significant at 1% probability

Conclusion

The study showed that in maize offal and crayfish waste based- diets for broiler chickens, extra two weeks should be added for birds to reach market weight.

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