

Growth performance and haematological traits of Nigerian local chickens fed varied dietary protein levels

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Abstract

This study was carried out to investigate the growth performance and haematological traits of Nigerian local chickens (NLC) fed varied dietary protein levels. An eleven week feeding trial was done in a 3 x 2 factorial arrangement using six treatment groups comprising a combination of two genotypes of the NLC identified as normal feather (na) and naked neck (Na) and three dietary protein levels - high protein: HP (22% and 20% CP chick mash and grower mash respectively), medium protein: MP (20% and 18% chick mash and grower mash respectively) and low protein: LP (18% and 16% chick mash and grower mash). Data were collected on growth performance traits (body weight, feed intake, feed conversion ratio and protein efficiency ratio). At the end of the feeding trial a haematological assay was done. Neither genotype nor interaction of genotype and dietary protein level influenced ($p > 0.05$) any of the growth performance traits studied. Birds on HP ate 10.21% and 7.09% less feed than those on MP and LP respectively. A better ($p < 0.05$) protein efficiency ratio (up to 20.79%) was observed in birds fed LP. Na birds had 4.55% and $17.50 \times 10^3 L^{-1}$ more packed cell volume and platelets respectively than na birds ($p < 0.05$). All haematological traits studied, except white blood cell count, showed significant variations ($p < 0.05$) due to varied dietary protein levels. Higher haemoglobin, red blood cell counts, mean corpuscular haemoglobin concentration and platelets were observed in birds fed LP diet. Reducing the dietary protein level had no adverse effect on the NLC thus, the LP diet is recommended for raising the Nigerian local chicken.

Keywords: dietary protein, growth performance, local chicken, haematology, naked neck, normal feather

Introduction

The Nigerian local chickens are rich animal genetic resource and are widely distributed in the country. They are generally hardy and possess good adaptive traits, contributing significantly to human livelihood and food security (Ndofor-Foleng *et al.*, 2015). Over the past few decades, there have been increased concerns towards improvement and conservation of the local chicken (Nwosu, 1979; Nwosu and Omeje, 1985; Adebambo, 2005; Oleforuh-Okoleh *et al.*, 2012; Udeh *et al.*, 2013). Incidentally, their genetic potentials have not been fully harnessed in order to incorporate them into large scale poultry production (Oleforuh-

Okoleh, 2013). Mugga (2007) attributed the non-integration of the local chicken into commercial poultry production to the slow growing nature of the birds.

Growth is an essential yardstick in measuring the performance of chickens and depends not only on the growth hormone but also on other factors which could be genetic, environmental or an interaction of both. The poultry breeder during the process of selection aims at genetic improvement to produce birds which are larger at a given age and show greater potentials than their ancestors. The genetic potential of an animal however, can only be fully manifested under a favourable

environment. One major problem associated with efficient management of local chickens is feeding. Most often, they are raised extensively with little or no supplementation with formulated diets. Bearing in mind that the speed of growth of this class of chickens will depend, among other factors, on its plane of nutrition, it becomes imperative that the nutritional status is improved.

Genetically, chickens have predetermined nutrient requirement and usually consume feed to meet this requirement; of much relevance is the protein requirement. Liu *et al.* (2015) noted that protein is an essential nutrient required for the process of life. Harper and Rogers (1965) from their study asserted that protein deficiency tends to reduce growth and feed efficiency. Unlike the commercial chicken strains whose nutrient requirements have been studied and documented (Wethl and Morris, 1978; Havenstein *et al.*, 1994; NRC, 1994; Neto *et al.*, 2000), there is dearth of such information with respect to local chickens. The works of Chemjor (1998) and Magala *et al.* (2012) with local chickens of Kenya and Uganda respectively showed that variations in the dietary protein influenced the performance of intensively raised chickens. This led us to hypothesize that there could also be a variation in the dietary protein requirements of the Nigerian local chicken. Taking into cognizance that any component (feed or otherwise) ingested by an animal has a measureable effect on its blood composition, studies of haematological traits have become crucial measures for not only feed stress monitoring but also disease diagnosis and curative therapy (Olabanji *et al.*, 2007; Togun *et al.*, 2007). This study was therefore intended to compare the effect of three dietary protein levels on the growth performance and hematological traits of Nigerian local chickens.

Materials and Methods

Study site

The experiment was carried out at the Poultry Unit of the Department of Animal Science, Rivers State University of Science and Technology (RSUST), Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria. The average annual rainfall in Port Harcourt is 200.45mm with average monthly temperature and relative humidity of 22.54 -31.03°C and 69.08 -112.47% respectively. (Uko and Tamunobereton-Ari, 2013).

Experimental design and treatments

126 day-old improved Nigerian local chicks (NLC) of two genotypes were used for the study. The local chicks originated from a population of NLC under limited selection (about eight generations) for growth at the Poultry Breeding Unit, Federal University of Agriculture, Abeokuta, Nigeria. They were brooded and allowed to acclimatise for 7 days on dietary crude protein of 20% before the feeding trial which lasted eleven weeks commenced. Six treatment groups consisting of two genotypes of the NLC designated *na* (normal feather) and *Na* (naked neck) and three isocaloric diets but varied dietary protein levels were used. The diets were identified as HP (high crude protein), MP (medium crude protein) and LP (low crude protein) - formulated such that from 1-8weeks, the birds were fed diets consisting of 22, 20 and 18% crude protein (CP) respectively and from 8-12 weeks 20, 18 and 16% crude protein (CP) respectively. Each treatment group was replicated three times with seven birds per replicate. Gross and determined compositions of the diets are presented in Table 1. The crude protein and energy analysis were done according to the methods of AOAC (2010). The birds had access to fresh water *ad-libitum* throughout

the study period. Birds in all treatment groups received similar standard routine management practices. They were

vaccinated against the following diseases - Newcastle (intra-ocular and lasota), gumboro and fowl pox as per routine vaccination schedule.

Table 1: Gross and determined composition of diets

Feed type	Chick mash			Growers mash		
	HP	MP	LP	HP	MP	LP
%CP	22	20	18	20	18	16
Ingredient (kg)						
Maize	53.00	54.35	55.70	41.70	43.05	44.40
Soybean meal	32.00	25.00	18.00	23.50	16.50	9.50
Palm kernel cake	5.00	8.30	11.60	20.00	23.30	26.60
Wheat bran	2.65	5.00	7.35	10.00	12.35	14.70
Fish meal	2.50	2.50	2.50	0.00	0.00	0.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
DL-Methionine	0.15	0.15	0.15	0.10	0.10	0.10
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Protein and Energy Composition						
Crude Protein (%)	22.10	20.10	18.20	20.04	18.07	16.09
Metabolizable energy (Kcal kg ⁻¹)	2804.00	2804.00	2804.00	2604.60	2604.60	2604.30

Data collection

Birds were weighed on commencement of the feeding trial and weekly thereafter up to the 12th week of age (11 weeks of feeding trial). From this, the average daily body weight gain (ADG) was estimated. Measured quantity of feed was given to the birds on a daily basis and this was used to obtain the average daily feed intake (ADFI) at the end of the feeding trial. The ratio of ADFI to ADG was used to calculate feed conversion ratio (FCR) and the protein efficiency ratio (PER) obtained using the ratio of gain in body weight to protein consumed. At the end of the feeding trial, haematological assay of the birds was carried out. To achieve this, three birds were picked at random from each replicate per treatment group. Blood samples were drawn from the right jugular vein of each of them using sterile syringe after swabbing with methylated spirit. The blood was quickly discharged into bottles containing an anticoagulant EDTA (ethylene diamine-

tetraacetic acid). The samples were used to perform the following haematological analysis: red blood cell (RBC) count using the improved Neubauer ruled chamber; haemoglobin concentration (Hb) - using the cyanmethaemoglobin method; white blood cell (WBC) counts and packed cell volume (PCV) using the microhaematocrit method. The procedure outlined in Feldman *et al.* (2000) was applied. Red blood indices which include mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated using the formula of Bull and Hay (2001).

Statistical Analysis

The study was a 3 x 2 factorial in Completely Randomized Design (CRD). The analysis of variance (ANOVA) for all data was done using multivariate analysis in General Linear Model (GLM) procedure of SPSS (2010). Significant means were separated using Duncan. The following

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model was adopted:

$$X_{ijk} = \mu + D_i + G_j + DG_{ij} + E_{ijk}$$

Where

X_{ijk} = the analysed measurement

μ = overall mean

D_i = effect of D_{th} -dietary protein level (i = 1, 2, 3)

G_j = effect of G_{th} genotype (j = 1, 2)

DG_{ij} = Interaction of the D_{th} dietary protein level and G_{th} genotype

E_{ijk} = random error

interaction with dietary protein levels did not significantly ($p > 0.05$) control any growth performance trait studied. However, main effect of dietary protein levels statistically ($p < 0.05$) affected ADFI, FCR and PER. Birds on HP diet consumed 2.80 – 3.77g less feed than those on LP and MP respectively. Though the FCR obtained for birds fed LP diet compared with those fed HP, their PER was better than those on HP and MP diets. Studies carried out on Ethiopian local chicken by Tadelle *et al.* (2003) and Kenyan local chicken by Kingori *et al.* (2007) under improved environmental (nutrition and management) conditions, growth performance of the local chickens improved remarkably.

Results and Discussion

Effect on Growth Performance Traits

Results presented in Table 2 showed that the genetic constitution of the NLC and its

Table 2: Growth performance traits of Nigerian local chicken fed different dietary protein levels

Genotype x Diet	CP (%)	FBW (g)	ADG (g)	ADFI (g)	FCR	PER
<i>na</i>	<i>HP</i>	1182.33	14.13	37.91	2.70	1.77
	<i>MP</i>	1161.86	14.17	41.42	2.93	1.80
	<i>LP</i>	1218.92	14.90	38.60	2.59	2.25
<i>Na</i>	<i>HP</i>	1158.75	14.17	35.47	2.51	1.90
	<i>MP</i>	1137.08	13.70	40.29	2.95	1.79
	<i>LP</i>	1199.61	15.26	40.04	2.62	2.26
SEM ±		84.83	1.31	2.18	0.25	0.17
Main effects						
Genotype	<i>na</i>	1187.71	14.40	39.42	2.75	1.94
	<i>Na</i>	1165.18	14.38	38.60	2.71	1.98
SEM ±		34.63	0.54	0.89	0.10	0.09
Diet	<i>HP</i>	1170.54	14.15	36.69 ^b	2.61 ^b	1.84 ^b
	<i>MP</i>	1149.48	13.93	40.86 ^a	2.93 ^a	1.79 ^b
	<i>LP</i>	1209.31	15.09	39.49 ^a	2.63 ^b	2.26 ^a
SEM ±		42.14	0.65	1.09	0.12	0.08
				P-Level		
Genotype		NS	NS	NS	NS	NS
Diet		NS	NS	**	*	**
Genotype x Diet		NS	NS	NS	NS	NS

^{ab}means on the same column having different superscripts are significantly different (* $p < 0.05$; ** $p < 0.01$)

^{NS}Means on the same column for respective effect are non-significant at $P > 0.05$

CP-Crude protein; *HP*- High protein; *MP*- Medium protein; *LP*-Low protein;

na -normal feather; *Na*-Naked neck

FBW-final body weight; ADG-average daily gain; ADFI-average daily feed intake; FCR-feed conversion efficiency; PER-protein efficiency ratio

Although, Isika *et al.* (2006) observed that the performance of Nigerian local chicken was not influenced by dietary manipulations between 0-12 weeks of age, the present findings do not contend to that since dietary protein levels influenced some performance traits. The performance of birds on LP as observed is in line with the findings of Liu *et al.* (2015) who reported better performance in daily weight gain and feed: gain ratio (FCR) in Lueyang black-boned chicken populations fed 18%CP than those on 20%CP. The effects of dietary crude protein levels on growth performance traits as presented in this study refutes the findings of Kermanshahi *et al.* (2011) who reported that broiler birds on 20.80%CP performed better than those on 23.97%CP and 17.70%CP in body weight gain, feed intake and feed conversion ratio. Ndegwa *et al.* (2001) reported that *ad libitum* feeding of higher protein diets resulted in better growth rate in Kenyan indigenous chickens at early growth stage however this advantage was later lost during the growing stage when diets with 17-23% CP were fed. Nguyen *et al.* (2010) found that Betong chicks fed dietary protein levels of 17, 19 and 21%CP between 42-84 days of age did not differ in feed:gain and protein:gain ratio though Nguyen and Bunchasak (2005) reported that the Betong chicks on 17% CP had smaller weight gain and poorer FCR than those that received 19, 21 and 23% CP during early growth stage. Similarly, Buyse *et al.* (1992) found that decreasing the crude protein content of isoenergetic diets resulted in depressed body weight gain and reduced feed efficiency. Our findings contradict that of Hossemi-Vashan *et al.* (2010) who observed a decreased PER in relation to lowering the crude protein content of the diet in broiler chickens. The variation in the various studies could be attributed to varied factors including

breed/strain, sex, age, management and environmental conditions (Magala *et al.*, 2012; Kingori *et al.*, 2003; Najib and Al-Aqil, 2015). The birds used for the present study were improved Nigerian local chickens that had undergone some generations of selection but have not been genetically classified either as meat or layer type chickens. The birds were reared under intensive management system which could have influenced their performance.

Effect on Haematological Traits

Table 3 shows the results of the genotype and dietary protein levels on the haematological traits studied. Packed cell volume (PCV) and platelets were different for the normal-feathered (*na*) and the naked neck (*Na*) birds. The *Na* had higher PCV and platelets concentrations than the *na* (a variation of $4.55 \pm 1.36\%$ and $17.5 \pm 5.35 \times 10^3 L^{-1}$ respectively). There were changes in Hb concentrations, RBC, MCHC and platelets when birds were fed different dietary protein levels. These measures were higher for birds on the LP diet than for birds on the HP diet ($P < 0.05$). Much genotype x diet interaction was observed with the *Na* on HP having the highest PCV while *na* birds on LP diet had the highest Hb concentration, RBC and platelet counts ($p < 0.05$).

The WBC count was not affected by genotype, dietary protein levels or interaction of genotype and diet. Variations in the haematological status of birds have been traced to their genetic constitution (Islam *et al.*, 2004; Peters *et al.*, 2011; Mohamed *et al.*, 2012).

The haematological values obtained in this study vary from those reported by Pampori and Iqbal (2007) and Elagib and Ahmed (2011) for native chickens of Kashmir and indigenous chickens of Sudan respectively. The PCV concentrations of the two experimental birds affirms the findings of Ladokun *et al.* (2008) who observed higher

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Table 3: Haematological traits of Nigerian local chickens as influenced by genotype, dietary protein and their interaction

Genotype x Diet	CP (%)	PCV (%)	Hb (g dL ⁻¹)	RBC (x10 ¹² L ⁻¹)	WBC (x10 ⁹ L ⁻¹)	Platelets (x10 ⁹ L ⁻¹)	MCV (fL)	MCH (pg)	MCHC (g L ⁻¹)
<i>na</i>	<i>HP</i>	26.85 ^b	7.67 ^c	2.19	1.53	158.50 ^c	122.49	34.98	28.59
	<i>MP</i>	29.63 ^b	9.17 ^b	2.41	1.65	153.75 ^c	140.66	41.22	31.76
	<i>LP</i>	26.58 ^b	10.68 ^a	3.53	2.07	216.00 ^a	76.68	30.79	40.51
<i>Na</i>	<i>HP</i>	37.65 ^a	9.39 ^b	2.76	1.93	196.75 ^b	137.72	34.25	25.10
	<i>MP</i>	29.80 ^b	10.11 ^b	2.63	1.78	192.00 ^b	112.98	38.45	33.93
	<i>LP</i>	29.25 ^b	9.70 ^b	2.83	1.88	190.00 ^b	103.40	34.51	35.50
SEM ±	1.40	0.23	0.13	0.15	6.56	30.99	5.90	2.25	
Main effects									
Genotype	<i>na</i>	27.68 ^b	9.18	2.71	1.75	175.42 ^b	113.06	35.66	33.62
	<i>Na</i>	32.23 ^a	9.74	2.74	1.87	192.92 ^a	118.03	35.73	30.85
SEM ±	1.36	0.40	0.10	0.13	5.35	11.42	2.41	1.84	
Diet	<i>HP</i>	32.25 ^a	8.53 ^b	2.48 ^b	1.73	176.63 ^b	130.10 ^a	34.62	26.85 ^b
	<i>MP</i>	29.71 ^{ab}	9.64 ^a	2.52 ^b	1.71	172.88 ^b	125.49 ^a	39.83	32.84 ^a
	<i>LP</i>	27.91 ^b	10.19 ^a	3.18 ^a	1.97	203.00 ^a	90.63 ^b	32.65	37.01 ^a
SEM ±	1.66	.48	0.12	0.15	6.56	2.25	2.95	2.25	
P-value									
Genotype	**	NS	NS	NS	*	NS	NS	NS	NS
Diet	*	**	**	NS	NS	**	**	*	*
Genotype x Diet	*	*	*	NS	*	NS	NS	NS	NS

^{abcd} means on the same column having different superscripts are significantly different (*p<0.05; **p<0.01)

^{NS} Means on the same column for respective effect are non-significant at P>0.05

CP-Crude protein; *HP*- High protein; *MP*- Medium protein; *LP*-Low protein;

na-normal feather; *Na*-Naked neck

PCV-packed cell volume; Hb -haemoglobin concentration; RBC-red blood cell; WBC -white blood cell; MCV - mean corpuscular volume; MCH - mean corpuscular haemoglobin; MCHC- mean corpuscular haemoglobin concentration

SEM - Standard error of mean

PCV values in the *Na* compared to the *na*. It has been reported that increased PCV indicates better transportation of oxygen and hence, absorbed nutrients (Isaac *et al.*, 2013). There seems to however be a modification to this statement from the present study because birds on HP which had the highest PCV concentrations had similar FCR with those on LP. The volume of the red blood cells in an individual is important because the RBC is involved in the transport of oxygen and carbondioxide in the body since they carry the haemoglobin which reacts with oxygen in the blood to form oxyhaemoglobin during respiration. Soetan *et al.* (2013) posited that a reduction in the red blood cell count would influence the circulatory/respiratory process by decreasing the volume of oxygen carried to the tissues as well as that of carbondioxide returned to the lungs. Adamu *et al.* (2006) worked with albino rats and observed that the diets fed influenced the packed cell volume (PCV),

haemoglobin (Hb) and red blood cell (RBC) counts of the rats. Some studies did not observe any variation in some haematological indices of birds due to different dietary protein/amino acid levels (Kermanshahi *et al.*, 2011; Adeyemo *et al.*, 2010). The WBC plays a key role in defending an individual against various pathogenic agents. George-Gay and Parker (2003) noted that decreased WBC count results when there is a decrease in their production in the bone marrow or an increase in their destruction due to viral infections or toxic reactions. None of the factors evaluated in the present study significantly affected the WBC counts. This implies that the immune system of the birds was not compromised by either reducing or increasing the protein levels of the diet. Though it has been posited that high dietary contents could result in low values of haematological indices (Bawala *et al.*, 2007), the results of the present findings indicate that the value of all the

haematological traits studied fall within the normal/reference range for domestic fowls as reported by Gullard and Hawkey (1990) and Teare (2006). When haematological values are within the reference range reported for an animal, it implies that the treatment given did not have any adverse effect(s) on the animal during the course of treatment (Togun *et al.*, 2007).

From this study, we can surmise that the observed differences in some of the growth performance traits studied were due to variations in the dietary protein levels given to the birds and had no interference by the genotype of the local chicken nor any interactive effect of genotype and dietary protein levels. The dietary treatments influenced the haematological values of the chickens but not in any adverse way since the values obtained were within the reference range for chickens. Based on the premise that the higher the protein content of a diet, the more expensive it would be, we would suggest that to minimise cost and optimise profit, it would be necessary to raise the Nigerian local chickens on LP diets (18% and 16% chick mash and grower mash respectively) as employed in the present study.

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