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GENETIC DIFFERENCES IN THE BODY WEIGHT AND HAEMATOLOGICAL TRAITS OF LOCAL AND EXOTIC CHICKENS FED GRADED LEVELS OF *Moringa oleifera* SEED MEAL

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Moringa oleifera (Lamarck) seed is a potential novel feedstuff that can be incorporated into poultry nutrition in Nigeria. Moringa oleifera is a potential cheaper alternative than the current conventional feedstuff. However, the performance response may vary between different chicken genotypes.The objective of this study was to evaluate the effects of dietary inclusion of Moringa oleifera Seed Meal (MOSM) on performance and morphometric body parameters of local and exotic chickens. Diets containing 0, 5, 10 and 15 % MOSM were used. The comparative effects of dietary inclusion of MOSM on the performance and morphometric body parameters of local and exotic chickens were studied. Data obtained were subjected to analysis of variance using the general linear models of SPSS Version 22. The findings of this study were that; chickens fed 5% MOSM had the best morphometric body parameters ($p<0.05$). Haematological parameters increased significantly ($p<0.05$) with increasing level of MOSM. This study concluded that 5% dietary inclusion of MOSM would improve growth performance in Marshall. 10% MOSM dietary inclusion would contribute to optimum growth performance in YENLC. The study recommended that up to 5% MOSM can be included in chickens' diet irrespective of the genotype for optimum performance.

Keywords: Moringa oleifera, MOSM, morphometric body parameters, Haematological parameters, YENLC)

Moringa oleifera is rich in nutrient (Price 2007) and the dry leaf and seed may be considered a protein feedstuff based on the concentration (Ogbe and Afiku, 2012). It is also rich in active chemicals which are not in themselves nutrients that may modulate the responses of birds including: tannin, saponin, alkaloids, glucosinolates, phenols, phytates and trypsin inhibitor (Ogbe and Afiku, 2012).

Poultry production is gaining much prominence in Nigeria and it holds much potential in solving the needs for animal proteins for humans. Due to the fact that resource poor farmers raise Yoruba Ecotype Nigerian Local Chickens (YENLC) for livelihood and feed them with available feed ingredients. Also, the prolificacy of YENLC also contributed to the need for its study and the short generation interval of the broiler chickens coupled with the fact that most broiler farmers are looking for alternative source of feed ingredients that is cheaper and readily available, it is therefore essential to study the efficiency of nutrient utilization in both genotypes.

Many researchers have reported negative effects of the use of unusual ingredients on some blood parameters as a result of factors such as nutrient imbalance, improper metabolism, presence of anti-nutritional factors and toxic elements in the diets offered to livestock. In a study conducted in southern part of Kaduna State, Nigeria on the economics of animal production, cost of feed was found to be the major constraint followed by purchase of the animal and cost of labour (Ajala, 2003). The use of non-conventional feedstuffs to bring down this cost was suggested as a possible short-term method to improve poultry production in the study area. This emerging fact makes it necessary to investigate the effect of the inclusion of ingredients with established nutriceuticals on the health status of chickens via the study of the animals' blood profile.

The study was aimed at determining the effect of genotypes on body growth parameters and blood parameters as these are pointers to the productivity and health status of the animal.

MATERIALS AND METHODS

The test ingredient, *Moringa oleifera* seed, was sourced from Kaduna metropolis in Nigeria.The seeds were air dried at the room temperature after which the meal was prepared. The seeds of *Moringa oleifera* were then milled and incorporated into the chickens' diets in appropriate proportion.

The experiment was carried out at the Livestock Farm Section of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan.The city has coordinates of 70 24' 7.0632'' N and 30 55' 2.3268'' E. The eggs of Yoruba Ecotype Nigeria Local Chickens (YENLC) were sourced from Ayede and Erunmu environments in Egbeda Local Government, Oyo State and hatched at Bronco Hatchery, Oluyole Extension, Ibadan. Marshall broilers were sourced from Obasanjo Farm, Ibadan, Oyo State.

Ninety-six Marshall broiler chicks and ninety-six YENLC of mixed sexes were randomly allotted to four dietary treatments containing graded levels of MOSM: 0% (diet 1), 5% (diet 2), 10% (diet 3), 15% (diet 4) (as contained in Table 1) fed independently to the broiler chicks and local chickens such that each treatment comprised of three replicates of eight birds each in a 2 x 4 factorial design.

Data was taken weekly to determine the body weight and the morphometric parameters. The morphometric indices were determined to enable the comparative studies between the exotic and the local chickens.

Linear body measurements - shank length (SL), thigh length (TL), keel length (KL), body girth (BG), wing length (WL) and body length (BL) were determined.

Body Weight (BW): Body weight in gram (g) was recorded to two decimal places weekly using a sensitive weighing scale.

Body Length (BL): This was taken as the nostril to the pygostyle distance measured in centimeter (cm) units when a tape is stretched from the bird's nasal opening along its stretched neck and along its back to the tip of pygostyle.

Body Girth (BG): This was measured in centimeter (cm) as the distance covered when a tape is looped round the region of the breast, care was taken to ensure that the tape was run under (rather than over) the wing.

Shank Length (SL): This was taken as the distance in centimeter (cm) between the foot pad and the hock joint, measured by use of a set of Venier Calliper.

Thigh Length (TL): This was taken as distance between the tip of the tarsus and the ball joint, measured in centimeter (cm) by use of a tape measure.

Keel Length (KL): This was taken as the distance between the cranial and caudal termini of the keel bone, measured in centimeter (cm) by use of a tape measure.

Wing Length (WL): This was taken as the distance from the humerus-coracoid junction to the distal tip of the phalange digits and was measured in centimeter (cm) unit using a tape measure.

Data were analyzed using the General Linear Model procedure of the SPSS Version 22 (IBM, SPSS).Significant differences were computed using New Duncan multiple range test (Gomez and Gomez, 1984) to determine

Table 1: Composition of experimental diet

INGREDIENT	1	2	3	4
Maize	37	37	37	**37**
Full Fat Soybean	20	20	20	**20**
GNC	18	15.5	13	**10.5**
Moringa oleifera Seed Meal (MOSM)	0	5	10	**15**
Fish Meal	3	3	3	**3**
Wheat Offal	10	10	10	**10**
Corn Bran	8	5.5	3	**0.5**
Bone Meal	1.5	1.5	1.5	**1.5**
Oyster Shell	1.5	1.5	1.5	**1.5**
Premix	0.25	0.25	0.25	**0.25**
Salt	0.25	0.25	0.25	**0.25**
Lysine	0.25	0.25	0.25	**0.25**
Methionine	0.25	0.25	0.25	**0.25**
Total	100	100	100	**100**
%CP (calculated)	23.40	23.28	23.15	**23.03**
ME (Kcal/Kg) – Calculated	2,851.54	2,867.64	2,883.74	2,899.84

the significance of specific classes. The appropriate statistical model used was:

$Y_{ijk} = \mu + G_i + M_j + (GM)_{ijk} + \varepsilon_{ijk}$

Y_{ijk} = observation on kth population, of ith genotype and jth MOSM inclusion

μ = common mean

G_i = fixed effect of genotype (i=2)

M_j =fixed effect of MOSM inclusion (j=4)

$(GM)_{ijk}$ = interaction effect of genotype and MOSM

ε_{ijk} = error term associated with each record (normally, independently and identically distributed with zero mean and constant variance)

Collection of blood samples

To elucidate the effect of MOSM on haematological responses by the birds, blood was sampled at week eight from the experimental birds. Blood samples were collected from the wing web of the birds (that were previously confined without feed for 12 hours but were allowed access to water) into sterilized glass tubes containing EDTA (ethylene diamine tetra acetic acid) for immediate analysis of haematological parameters in the laboratory.

The packed cell volume (PCV) and haemoglobin (Hb) were determined using the micro haematocrit method and cyanmethehemoglobin method respectively as described by Mitruka and Rawnsley (1977). Erythrocyte count (RBC) and Leukocyte count (WBC) were determined using the improved Neubauerhaemocytometer after the appropriate dilution (Schalm et al., 1975). Differential leukocyte counts were determined by scanning Giemsa's stained slides in the classic manner (Schalm et al., 1975). Blood indices and corpuscular constants; mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were determined using the appropriate formulae (Jain, 1986).

RESULTS

Effect of MOSM and Genotype on Body Weight

Effect of Genotype on body weight: A significant difference ($p < 0.05$) was observed in the body weight throughout the experiment with the Marshall broilers being heavier than the local chickens throughout the experiment (Table 2) . Effects of MOSM on Body weight: In week 1, birds fed 10%

Table 2. Effects of Genotypes, Dietary MOSM Level (0, 5, 10 and 15 %) From 0-8 Weeks Age, and their Interaction on Weights of Chicks

	Genotype		**Diet**				
Body Weight (g)	**YENLC**	**Marshall**	**0% MOSM**	**5% MOSM**	**10% MOSM**	**15% MOSM**	**GXD**
Week 0	23.00 ± 0.38	33.85 ± 0.34 *	29.29 ± 0.93	28.17 ± 0.94	28.02 ± 0.94	28.23 ± 0.95	
Week 1	29.60 ± 0.40	62.89 ± 0.33 *	47.56 ± 2.36 c	47.08 ± 2.60 bc	46.00 ± 2.47 b	44.33 ± 2.47 a	*
Week 2	48.62 ± 0.86	101.51 ± 2.24 *	90.33 ± 5.52 d	84.88 ± 5.43 c	75.95 ± 3.66 b	60.77 ± 3.24 a	*
Week 3	74.10 ± 1.23	156.58 ± 4.28 *	138.24 ± 8.23 c	141.79 ± 11.03 c	112.46 ± 5.54 b	88.92 ± 4.14 a	*
Week 4	103.16 ± 1.62	238.20 ± 7.23 *	211.37 ± 14.15 c	209.42 ± 17.69 c	162.92 ± 8.99 b	128.62 ± 6.32 a	*
Week 5	145.13 ± 1.94	339.44 ± 11.71 *	300.39 ± 21.47 c	307.55 ± 26.5 c	233.71 ± 12.89 b	171.72 ± 7.94 a	*
Week 6	214.00 ± 2.31	473.59 ± 14.18 *	396.48 ± 28.54 c	417.27 ± 32.39 c	364.50 ± 20.44 b	259.21 ± 10.88 a	*
Week 7	238.74 ± 2.53	638.55 ± 21.60 *	525.04 ± 44.69 c	542.30 ± 48.58 c	445.97 ± 31.35 b	326.13 ± 17.78 a	*
Week 8	296.03 ± 5.82	771.35 ± 27.01 *	640.52 ± 55.83 c	646.30 ± 57.08 c	541.95 ± 35.07 b	404.63 ± 27.29 a	*

a, b, c means with different superscript are significantly different, group mean, standard error and number count of samples (x ± sem (n)) shown
**(p<0.05), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed meal GXD- Interaction between genotype and diet*

Table 3. Body Weights of Yoruba Ecotype Nigerian Local Chicken and Marshall Broiler Chickens Fed Graded Levels of Moringa oleifera Seed Meal (MOSM)

	Yoruba Ecotype Nigerian local chicken				Marshall Broiler				
Body Weight (g)	0% MOSM	5% MOSM	10% MOSM	15% MOSM	0% MOSM	5% MOSM	10% MOSM	15% MOSM	LEVEL OF SIGNIFICANCE
Week 0	24.71 ± 1.01 b	22.79 ± 0.65 ab	22.25 ± 0.61 a	22.25 ± 0.65 a	33.88 ± 0.81 c	33.54 ± 0.83 c	33.79 ± 0.58 c	34.21 ± 0.43 c	*
Week 1	31.92 ± 0.98 b	29.50 ± 0.68 a	29.33 ± 0.65 a	27.67 ± 0.61 a	63.21 ± 0.71 d	64.67 ± 0.57 d	62.67 ± 0.54 cd	61 ± 0.61 c	*
Week 2	53.64 ± 1.06 b	51.67 ± 0.87 b	49.50 ± 0.74 b	38.00 ± 0.80 a	123.96 ± 3.27 f	112.56 ± 1.47 e	94.35 ± 1.18 d	76.61 ± 1.64 c	*
Week 3	82.45 ± 1.60 b	79.33 ± 0.93 b	72.31 ± 0.94 b	59.50 ± 0.81 a	189.38 ± 3.74 c	193.83 ± 8.28 c	140.39 ± 1.70 c	109.39 ± 1.90 c	*
Week 4	114.82 ± 1.31 b	108.27 ± 1.67 b	102.13 ± 1.40 b	83.38 ± 1.79 a	299.88 ± 6.07 e	293.72 ± 12.59 e	207.14 ± 4.87 d	160.09 ± 2.40 c	*
Week 5	156.73 ± 1.44 b	151.6 ± 1.66b	149.56 ± 1.37 b	118.69 ± 1.54 a	432.08 ± 12.24 e	437.5 ± 15.34 f	294.91 ± 9.01 d	208.61 ± 5.72 c	*
Week 6	215.36± 1.82 ab	231.33 ± 1.57 b	225.06 ± 1.91 ab	184.81 ± 2.84 a	562.5 ± 23.37 e	572.22 ± 22.61 e	465.91 ± 10.32 d	310.96 ± 6.79 c	*
Week 7	232.59 ± 2.32 a	268.73 ± 1.46 a	236.5 ± 2.31 a	221.31 ± 5.21 a	793.13 ± 30.84 d	770.28 ±37.63 d	598.32 ± 19.05 c	402.36 ± 17.06 b	*
Week 8	289.68 ± 7.32 a	328.53 ± 7.26 a	323 ± 13.44 a	247.31 ± 7.50 a	962.13 ± 47.34 d	911.11 ±46.19 d	701.18 ± 27.94 c	519.05 ± 27.51 b	*

*a, b, c means with different superscript within genotype are significantly different ,group mean, standard error and number count of samples (x ± sem (n)) shown *(p<0.05), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed meal die*

and 15% MOSM had significantly ($p<0.05$) lower body weight than the control but 5% did not differ significantly ($p>0.05$) from the control (0% MOSM).

In week 2, the weights of the birds decreased significantly ($p<0.05$) with increasing levels of MOSM. However, in the late starter and throughout the finisher period, birds fed 5% MOSM was not significantly ($p>0.05$) different from the control (0% MOSM) but birds fed 10 and 15% MOSM had significantly lower body weight ($p<0.05$) – 0% MOSM=5% MOSM>10% MOSM (Table 2).

Genotype X Diet (Graded levels of MOSM) interactive effect on Body weight. The interaction of genotype and diet had significant effect on bodyweight as shown in Table 2. Effect of Graded levels of MOSM on Body weight within genotype (breed). Within the Yoruba Nigeria Local chickens, in weeks 2, 3 and 4, 0%, 5% and 10% MOSM was not significantly different but 15% MOSM differ significantly ($p<0.05$) . MOSM did not significantly ($p>0.05$) affect the body weight at weeks 7 and 8. This implies that MOSM had no effect on the later stage of YENLC after 6 weeks (Table 3).

However, within the broiler genotype treatment group at the end of the starter phase, birds fed 5% MOSM was not significantly different ($p>0.05$) from the control (0% MOSM) but with significantly higher ($p<0.05$) body weight compared to birds fed 10% MOSM and 15% MOSM. From week 6 to week 8, birds fed 5% MOSM was similar to the control (0% MOSM) but were significantly ($p<0.05$) heavier than birds fed 10% and 15% MOSM (Table 3).

Effect of MOSM and Genotype on Morphometric parameters

Effect of Genotype on morphometric parameters revealed a significant difference ($p < 0.05$) in the morphometric traits measured throughout the experiment (both at the starter and finisher stages) with the Marshall broilers having significantly higher ($p < 0.05$) morphometric traits than the local chickens throughout the experiment (Table 4). Effects of Dietary graded levels of MOSM on morphometric parameters revealed that all the birds were considered irrespective of genotype, birds fed MOSM at 5% inclusion level had significantly higher ($p < 0.05$) morphometric traits at the starter phase when compared with the birds fed higher levels of MOSM. The results were also similar ($p < 0.05$) at the latter phase for the birds except for keel length while the result was similar for birds fed 5% and 10% MOSM. (Table 5).

Genotype X Diet (Graded levels of MOSM) factor interactive effect on morphometric parameters showed that genotype and diet had significant effect ($p<0.05$) on morphometric parameters in both phases of the experiments except for shank length at the earlier phase as shown in Table 5.

Effect of Graded levels of MOSM on Morphometric parameters within genotype (breed). At the starter phase, YENLC fed 0% MOSM, 5% MOSM and 10% MOSM were significantly not different ($p>0.05$) and longer than the shank lengths, thigh length and keel length of YENLC fed 15% MOSM. Also, YENLC fed 10% MOSM had significantly higher ($p < 0.05$) wing length and body girth than other birds in the other dietary groups. Body length was significantly similar ($p > 0.05$) for all the YENLC in the dietary treatment groups. Also, for the Marshall broilers, at week 4, shank length of birds in the control (0% MOSM), 5% MOSM and 15% MOSM were similar ($P>0.0.5$). Birds fed 10% MOSM had the least shank lengths while Marshall broilers fed 5% MOSM had significantly higher ($p < 0.05$) parameters for the other traits.

However, at week 8 for YENLC, there was similarity ($p > 0.05$) from the control (0% MOSM) till 10% MOSM inclusion levels while birds fed 15% MOSM were significantly lower ($p < 0.05$) for shank length, thigh length, wing length and body girth. Also, at week 8 for the Marshall broilers there was significant similarity ($p > 0.05$) between the control and birds fed 5% MOSM while there was significant reduction from 5% inclusion till 15% MOSM inclusion for shank length, thigh length, wing length, body length and body girth. (Table 5).

Effects of Graded Levels of MOSM on Haematological Parameters of Yoruba

Table 4. Morphometric Parameters of Yoruba Ecotype Nigerian Local Chicken and Marshall Broiler Chickens Fed Graded Levels of Moringa oleifera Seed Meal (MOSM)

	Yoruba Ecotype Nigerian local chicken				Marshall Broiler				
Shank Length (cm)	0% MOSM	5% MOSM	10% MOSM	15% MOSM	0% MOSM	5% MOSM	10% MOSM	15% MOSM	SIGNIFICANCE
SL4	4.80±0.14 (22)^{b}	4.71±0.15 (15)^{b}	4.72±0.19 (16)^{b}	4.13±0.18 (16)^{a}	6.34±0.17 (24)^{d}	6.72 ± 0.13 (18)^{d}	5.86 ± 0.2 (22)^{c}	6.36±0.1 (23)^{d}	-
TL 4	4.48 ±0.18 (22)^{b}	4.45 ± 0.17 (15)^{b}	4.06 ±0.16 (16)^{ab}	3.59± 0.16 (16)^{a}	5.55± 0.27 (24)^{c}	5.96 ± 0.25 (18)^{c}	5.51 ± 0.19 (22)^{c}	5.33 ± 0.14 (23)^{c}	
KL 4	4.48 ± 0.08 (22)^{b}	4.56 ± 0.1 (15)^{b}	4.34 ± 0.09 (16)^{b}	3.76 ±0.09 (16)^{a}	5.75 ± 0.19 (24)^{d}	6.27 ± 0.14 (18)^{e}	5.37 ± 0.14 (22)^{c}	5.21 ± 0.08 (23)^{c}	
WL 4	4.97± 0.19 (22)^{ab}	5.06± 0.25 (15)^{ab}	5.23 ± 0.25 (16)^{c}	4.48 ± 0.24 (16)^{a}	6.62± 0.27 (24)^{c}	7.46± 0.21 (18)^{d}	6.23 ± 0.21 (22)^{c}	6.41 ± 0.14 (23)^{c}	
BL 4	14.51 ± 0.47(22)^{a}	14.11 ± 0.46(15)^{a}	14.84± 0.34 (16)^{a}	13.57 ± 0.32 (16)^{a}	21.03 ± 0.50 (24)^{c}	20.73 ± 0.40(18)^{c}	17.81± 0.47(22)b	17.51 ± 0.30 (23)^{b}	*
BG 4	13.14 ±0.23 (22)^{a}	13.25 ± 0.27(15)^{a}	14.5 ± 0.21 (16)^{b}	12.58 ± 0.21 (16)^{a}	19.58 ± 0.48 (24)^{e}	21.72 ± 0.77 (18)^{f}	18.4 ± 0.45 (22)^{d}	15.94±0.17 (23)^{c}	
SL 8	7.94±0.17 (22)^{b}	7.85±0.3 (15)^{b}	7.83±0.24 (16)^{b}	7.20±0.21 (16)^{a}	12.25±0.18 (24)^{e}	11.91±0.17 (18)^{e}	10.64±0.2 (22)^{d}	10.00±0.17 (22)^{c}	*
TL 8	7.51 ±0.24 (22)^{b}	7.77 ± 0.27 (15)^{b}	7.14 ±0.18 (16)^{ab}	6.54± 0.26 (16)^{a}	11.10±0.23(24)^{d}	11.03±0.25 (18)^{d}	9.63 ± 0.29 (22)^{c}	9.63 ± 0.18 (22)^{c}	
KL 8	7.28 ± 0.11 (22)^{c}	7.05 ±0.16 (15)^{bc}	6.59 ± 0.13(16)^{ab}	6.40 ± 0.14 (16)^{a}	10.46±0.21 (24)^{f}	9.79 ± 0.21 (18)^{e}	9.55 ± 0.21 (22)^{e}	8.94 ± 0.17 (22)^{d}	
WL 8	8.00 ± 0.15 (22)^{b}	8.41 ± 0.31 (15)^{b}	7.62± 0.23 (16)^{ab}	7.18 ± 0.22 (16)^{a}	11.17±0.33(24)^{cd}	11.68±0.27 (18)^{d}	10.61 ±0.31(22)^{c}	10.64 ± 0.2 (22)^{c}	
BL 8	23.42 ± 0.60 (22)^{a}	23.57 ± 0.65 (15)^{a}	23.66± 0.63 (16)^{a}	23.31 ± 0.64 (16)^{a}	33.91 ± 0.62 (24)^{c}	33.26 ± 0.42 (18)^{c}	28.00 ± 0.65 (22)^{b}	28.57±0.55 (22)^{b} *	
BG 8	22.01± 0.38 (22)^{c}	20.70±0.44(15)^{bc}	20.41±0.46 (16)^{b}	18.75 ± 0.52 (16)^{a}	32.68 ± 0.53 (24)^{f}	32.96 ± 0.63 (18)^{f}	28.52 ±0.40(22)^{e}	25.80±0.36 (22)^{d}	

a, b, c,d means with different superscript within genotype are significantly different, group mean, standard error and number count of samples (x ± sem (n)) shown(p<0.05), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed meal*

Table 5. Effects of Genotypes, Dietary MOSM Level (0, 5, 10 and 15 %) From 0-8 Weeks Age, and their Interaction on Morphometric Parameters of Chicks

	Genotype		Diet				
Shank Length (cm)	**YENLC**	**Marshall**	**0% MOSM**	**5% MOSM**	**10% MOSM**	**15% MOSM**	**G x D**
SL 4	4.61 ± 0.09 (69)	6.30 ± 0.08 (87)*	5.60 ± 0.16 (46)^{ab}	5.81 ± 0.20 (33) ^{b}	5.38 ± 0.17 (38) ^{a}	5.44 ± 0.2 (39) ^{a}	-
TL4	4.17 ± 0.1 (69)	5.57 ± 0.11 (87)*	5.04 ± 0.18 (46)^{ab}	5.27 ± 0.21 (33) ^{b}	4.9 ± 0.17 (38)^{ab}	4.61 ± 0.17 (39) ^{a}	*
KL 4	4.30 ± 0.06 (69)	5.62 ± 0.08 (87)*	5.15 ± 0.14 (46) ^{b}	5.49 ± 0.18 (33) ^{c}	4.93 ± 0.12 (38) ^{b}	4.62 ± 0.13 (39) ^{a}	*
BG 4	13.35 ± 0.14 (69)	18.76 ± 0.32 (87)*	16.5 ± 0.55 (46) ^{b}	17.87 ± 0.86 (33) ^{c}	16.76 ± 0.42 (38) ^{b}	14.56 ± 0.30 (39) ^{a}	*
WL 4	4.93 ± 0.12 (69)	6.64 ± 0.12 (87)*	5.83 ± 0.21 (46) ^{a}	6.37 ± 0.27 (33) ^{b}	5.81 ± 0.18 (38) ^{a}	5.62 ± 0.2 (39) ^{a}	*
BL 4	14.28 ± 0.21 (69)	19.22 ± 0.27 (87)*	17.91 ± 0.59 (46) ^{b}	17.72 ± 0.65 (33) ^{b}	16.56 ± 0.39 (38) ^{a}	15.89 ± 0.38 (39) ^{a}	*
SL 8	7.72 ± 0.12 (69)	11.19 ± 0.13 (86)*	10.18 ± 0.34 (46) ^{c}	10.07 ± 0.39 (33) ^{c}	9.46 ± 0.27 (38) ^{b}	8.82 ± 0.26 (38) ^{a}	*
TL 8	7.25 ± 0.13 (69)	10.33 ± 0.14 (86)*	9.38 ± 0.31 (46) ^{b}	9.55 ± 0.34 (33) ^{b}	8.58 ± 0.27 (38) ^{a}	8.33 ± 0.29 (38) ^{a}	*
KL 8	6.87 ± 0.08 (69)	9.70 ± 0.12 (86)*	8.94 ± 0.27 (46) ^{c}	8.55 ± 0.27 (33) ^{b}	8.31 ± 0.27 (38) ^{b}	7.87 ± 0.24 (38) ^{a}	*
WL 8	7.81 ± 0.12 (69)	11.00 ± 0.15 (86)*	9.65 ± 0.30 (46) ^{a}	10.19 ± 0.35 (33) ^{b}	9.35 ± 0.31 (38) ^{a}	9.18 ± 0.32 (38) ^{a}	*
BL 8	23.48 ± 0.31 (69)	30.9 ± 0.41 (86)*	28.89 ± 0.89 (46) ^{b}	28.86 ± 0.93 (33) ^{b}	26.17 ± 0.58 (38) ^{a}	26.36 ± 0.59 (38) ^{a}	*
BG 8	20.60 ± 0.26 (69)	29.91 ± 0.40 (86)*	27.58 ± 0.86 (46) ^{c}	27.39 ± 1.15 (33) ^{c}	25.10 ± 0.72 (38) ^{b}	22.83 ± 0.64 (38) ^{a}	*

a, b, c means with different superscript are significantly different, group mean, standard error and number count of samples (x±sem(n)) shown(p<0.05), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed mealGXD- Interaction between genotype and diet*

Table 6. Haematological Parameters of Yoruba Ecotype Nigerian Local Chicken and Marshall Broiler Chickens Fed Graded Levels of Moringa oleifera Seed Meal

	Yoruba Ecotype Nigerian local chicken				Marshall Broiler			
	0% MOSM	**5% MOSM**	**10% MOSM**	**15% MOSM**	**0% MOSM**	**5% MOSM**	**10% MOSM**	**15% MOSM**
PCV (%)	32.72 ± 0.56 (6) [a]	36.98 ±0.55 (6) [b]	38.67 ± 0.3 (6) [c]	41.43 ± 0.25 (6) [d]	32.27 ± 0.36 (6) [a]	37.12 ± 0.41 (6) [b]	38.65 ± 0.26 (6) [c]	40.75 ± 0.3 (6) [d]
RBC ($X10^6/mm^3$)	1.92 ± 0.04 (6) [a]	2.15 ± 0.03 (6) [b]	2.47 ± 0.03 (6) [c]	2.69 ± 0.02 (6) [d]	1.90 ± 0.03 (6) [a]	2.09 ± 0.04 (6) [b]	2.44 ± 0.02 (6) [c]	2.66 ± 0.05 (6) [d]
WBC $X10^6/mm^3$	18.55 ± 0.28 (6) [a]	20.98 ±0.48 (6) [b]	24.28 ± 0.43 (6) [c]	28.77 ± 0.3 (6) [d]	17.88 ± 0.24 (6) [a]	20.68 ± 0.43 (6) [b]	23.70 ± 0.43 (6) [c]	28.52 ±0.39 (6) [d]
Hb (gm%)	11.14±0.29 (6)[ab]	11.97 ±0.41(6)[bc]	12.73 ± 0.18 (6) [cd]	13.28 ± 0.05 (6) [d]	10.85 ± 0.33 (6) [a]	11.50 0.49 (6)[ab]	12.62±0.34 (6) [cd]	13.37 ±0.14 (6) [d]
MCV (fl)	17.09± 0.22 (6) [b]	17.22 ± 0.4 (6) [b]	15.64 ± 0.19 (6) [a]	15.40 ± 0.12 (6) [a]	17.01 ± 0.14 (6) [b]	17.81 ± 0.42 (6) [b]	15.85 ± 0.16 (6) [a]	15.34 ± 0.26 (6) [a]
MCH (µµ/g)	5.81 ± 0.07 (6) [b]	5.57 ± 0.17 (6) [b]	5.15 ± 0.05 (6) [a]	4.94 ± 0.05 (6) [a]	5.71 ± 0.09 (6) [b]	5.50 ± 0.18 (6) [b]	5.17 ± 0.11 (6) [a]	5.03 ± 0.07 (6) [a]
MCHC (%)	34.05± 0.57 (6) [b]	32.33 ±0.80(6)[ab]	32.93 ± 0.46 (6)[ab]	32.06 ± 0.21 (6)[ab]	33.60 ± 0.77 (6) [b]	30.97 ± 1.21 (6) [a]	32.63±0.74 (6)[ab]	32.81±0.37 (6)[ab]
Monocytes (%)	1.14 ± 0.02 (6) [a]	1.30 ± 0.03 (6) [b]	1.42 ± 0.01 (6) [c]	1.50 ± 0.02 (6) [d]	1.08 ± 0.03 (6) [a]	1.29 ± 0.03 (6) [b]	1.45 ± 0.01 (6) [cd]	1.51 ± 0.01 (6) [d]
Lymphocytes (%)	78.74 ± 0.31 (6) [a]	80.77± 0.72 (6) [b]	83.96 ± 0.1 (6) [c]	84.66 ± 0.15 (6) [c]	78.62 ± 0.24 (6) [a]	80.34 ± 0.3 (6) [b]	83.87 ± 0.11 (6) [c]	84.59 ± 0.17 (6) [c]
Basophils (%)	0.20 ± 0.15 (6)[ab]	0.17 ± 0.03 (6)[ab]	0.33 ± 0.02 (6)[bc]	0.48 ± 0.01 (6) [c]	0.06 ± 0.01 (6) [a]	0.14 ± 0.02 (6) [a]	0.32 ± 0.03 (6)[bc]	0.49 ± 0.01 (6) [c]
Eosinophils (%)	0.38 ± 0.03 (6) [a]	0.53 ± 0.03 (6) [b]	0.67 ± 0.03 (6) [c]	0.78 ± 0.01 (6) [d]	0.37 ± 0.03 (6) [a]	0.52 ± 0.01 (6) [b]	0.65 ± 0.02 (6) [c]	0.77 ± 0.03 (6) [d]
Heterophils (%)	3.14 ± 0.17 (6) [a]	3.99 ± 0.12 (6) [b]	5.02 ± 0.10 (6) [c]	5.55 ± 0.09 (6) [d]	3.01 ± 0.06 (6) [a]	3.90 ± 0.11 (6) [b]	4.87 ± 0.12 (6) [c]	5.38 ± 0.12 (6) [d]

a, b, c means with different superscript within genotype are significantly different, group mean, standard error and number count of samples (x±sem(n)) shown($p<0.05$), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed meal*

Table 7. Effects of Genotypes, Dietary Moringa oleifera Seed Meal (MOSM) Level, and their Interaction, On Haematological Parameters

	Genotype		Diet				
	YENLC	**Marshall**	**0% MOSM**	**5% MOSM**	**10% MOSM**	**15% MOSM**	**GXD**
PCV (%)	37.45 ± 0.69 (24)	37.2 ± 0.67 (24)	32.5 ± 0.32 (12) [a]	37.05 ± 0.33 (12) [b]	38.66 ± 0.19 (12) [c]	41.09 ± 0.21 (12) [d]	NS
RBC ($X10^6/mm^3$)	2.31 ± 0.06 (24)	2.27 ± 0.06 (24)	1.91 ± 0.03 (12) [a]	2.12 ± 0.03 (12) [b]	2.46 ± 0.02 (12) [c]	2.68 ± 0.03 (12) [d]	NS
WBC $X10^6/mm^3$)	23.15 ± 0.82 (24)	22.7 ± 0.84 (24)	18.22 ± 0.2 (12) [a]	20.83 ± 0.31 (12) [b]	23.99 ± 0.3 (12) [c]	28.64 ± 0.24 (12) [d]	NS
Hb (gm%)	12.28 ± 0.21 (24)	12.08 ± 0.26 (24)	11 ± 0.21 (12) [a]	11.73 ± 0.31 (12) [b]	12.68 ± 0.18 (12) [c]	13.33 ± 0.07 (12) [d]	
MCV (fl)	16.34 ± 0.21 (24)	16.5 ± 0.24 (24)	17.05 ± 0.13 (12) [b]	17.52 ± 0.29 (12) [b]	15.74 ± 0.12 (12) [a]	15.37 ± 0.14 (12) [a]	NS
MCH (µµ/g)	5.37 ± 0.08 (24)	5.35 ± 0.08 (24)	5.76 ± 0.06 (12) [c]	5.53 ± 0.12 (12) [b]	5.16 ± 0.06 (12) [a]	4.98 ± 0.04 (12) [a]	NS
MCHC (%)	32.84 ± 0.30 (24)	32.5 ± 0.43 (24)	33.82 ± 0.46 (12) [b]	31.65 ± 0.72 (12) [a]	32.78 ±0.42 (12) [ab]	32.44 ±0.23 (12) [ab]	NS
Monocytes (%)	1.34 ± 0.03 (24)	1.33 ± 0.04 (24)	1.11 ± 0.02 (12) [a]	1.30 ± 0.02 (12) [b]	1.43 ± 0.01 (12) [c]	1.50 ± 0.01 (12) [d]	NS
Lymphocytes (%)	82.03 ± 0.53 (24)	81.86 ± 0.52 (24)	78.68 ± 0.19 (12) [a]	80.56 ± 0.38 (12) [b]	83.92 ± 0.07 (12) [c]	84.63 ± 0.11 (12) [d]	NS
Basophils (%)	0.30 ± 0.04 (24)	0.25 ± 0.04 (24)	0.13 ± 0.08 (12) [a]	0.15 ± 0.02 (12) [a]	0.32 ± 0.02 (12) [b]	0.49 ± 0.01 (12) [c]	NS
Eosinophils (%)	0.59 ± 0.03 (24)	0.58 ± 0.03 (24)	0.37 ± 0.02 (12) [a]	0.52 ± 0.01 (12) [b]	0.66 ± 0.02 (12) [c]	0.78 ± 0.01 (12) [d]	NS
Heterophils (%)	4.42 ± 0.2 (24)	4.29 ± 0.20 (24)	3.08 ± 0.09 (12) [a]	3.94 ± 0.08 (12) [b]	4.94 ± 0.08 (12) [c]	5.46 ± 0.07 (12) [d]	NS

a, b, c means with different superscript within genotype are significantly different,group mean, standard error and number count of samples (x±sem(n)) shown(p<0.05), NS – non-significance, G – Genotype, MOSM – Moringa oleifera Seed meal, GXD- Interaction between genotype and diet*

Nigeria Local Chickens and Marshall Broilers. From Table 6., PCV, RBC, WBC, Hb, MCV, MCH, MCHC, Monocytes, Lymphocytes, Basophils, Eosinophils, Heterophils, were significantly ($p<0.05$) influenced by dietary inclusion of MOSM . PCV, RBC, WBC and Hb increased significantly ($p<0.05$) as the level of MOSM increased in the diet.

However MCV decreased significantly ($p<0.05$) from 5% to 15% inclusion of MOSM while MCHC values increased significantly ($p<0.05$) from 5% to 15% levels of MOSM for Marshall broilers. MCH decreased significantly ($p<0.05$) as the level of MOSM increased. The differential counts (monocytes, lymphocytes, basophils, eosinophils, heterophils) increased significantly ($p<0.05$) from 0% to 15% 0f MOSM as presented in Table 6. Except basophils whose values increased from 5% to 15% for YENLC.

Effect of Genotype on Haematological Parameters.

As shown in Table 7, genotype did not significantly affect ($p>0.05$) the haematological parameters measured. Also, Interaction between Genotype and Diet revealed no significant interaction ($p>0.05$) in haematological parameters. Effect of Graded Levels of MOSM on Haematological Parameters irrespective of Genotype showed that PCV, RBC, WBC, Hb, MCV, MCH, MCHC, Monocytes, Lymphocytes, Basophils, Eosinophils, Heterophils, were significantly ($p<0.05$) influenced by dietary inclusion of MOSM. Also, PCV, RBC, WBC and Hb increased significantly ($p<0.05$) as the level of MOSM increased in the diet. However MCV decreased significantly ($p<0.05$) from 5% to 15% inclusion of MOSM. MCH decreased significantly ($p<0.05$) as the level of MOSM increased. The differential counts (monocytes, lymphocytes, basophils, eosinophils, heterophils) increased significantly ($p<0.05$) from 0% to 15% 0f MOSM .

DISCUSSIONS

Results of the experiment showed that the body weight of both genotypes of chickens were significantly different irrespective of age and dietary inclusion of MOSM though they were raised under identical conditions. Marshall broiler chickens were generally heavier and bigger than the YENLC. This was in agreement with the report of Mmereole and Udeh (2009) who studied effect on genotype by diet interaction on body weight of the local chicken and its crosses with barred Plymouth Rock and observed that the effect of genotype body weight was significant throughout the 12 week period and significant in weight gain at the period of 0 – 4 weeks and 4-8 weeks of age only.

MOSM inclusion had significant effect on bodyweight of the birds. This was in agreement with the report of Gadzirayi et al. (2012), who observed that final weight and weight gained declined as MOLM level increased, however, they offered 0%, 25%, 50%, 75% and 100% levels of MOLM to Chickens.

Dietary MOSM inclusion had significant effect on both genotypes. In Marshall broilers, it was observed that the inclusion of MOSM depreciated growth. Also, in YENLC, highest levels of MOSM (10% and 15% inclusion) were found to depress body weight but birds fed 5% MOSM had the highest body weight from week 6 to week 8.

Selle et al. (2010) reported that inconsistencies, and even sub-optimal growth performance in broiler chickens are often encountered with feedstuffs that contain kafirin, phytate and condensed tannin, however, Moringa oleifera contained both phytate and tannins, which have the capacity to bind proteins in the gut and depress protein digestibility, as well as intestinal uptakes of dietary and endogenous nutrients (Selle et al., 2010; Moyo et al., 2011). This may account for lowered rate of growth at 10% and 15% inclusion levels for the Marshall broilers and 15% inclusion levels for the YENLC.

It also agreed with the report of Olawumi et al. (2012) that genotype of birds had significant ($p<0.01$) effect on all the performance traits.

All the haematological parameters measured were within the normal physiological ranges reported for poultry. Madubuike and Ekenyem (2006) reported that

haematological characteristics of livestock suggested their physiological disposition to the plane of nutrition.

The results on haematological and serum biochemical profiles were in contrast with the report of Odetola et al. (2012) who studied the utilization of Moringa leaves meal as a replacement for soyabean meal in rabbits' diets and the report of Ewuola et al (2012)

They observed that feeding rabbits to 15% MOLM showed no significant effect ($p>0.05$) on serum biochemical parameters and haematological parameters except WBC.

The results on WBC contradicted with the report of Odetola et al. (2012), which stated that WBC decreased as the level of MOLM increased in rabbit but the opposite was observed in broiler chickens fed varying levels of MOSM.

Reports by Aletor and Egberongbe (1992) and Aletor (1989) indicated that the blood variables most consistently affected by dietary influence include: RBC, PCV and Plasma protein. The higher values of WBC observed in broiler chickens fed MOSM diet compared with the control is an indication that the immunity levels of the birds were challenged.

There was significant difference ($p<0.05$) for all the serum biochemical parameters observed. Isaac et al. (2013) stated that haematological components, which consists of red blood cells, white blood cells or leucocytes, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration are valuable in monitoring feed toxicity, especially, with feed constituents that affect the blood as well as the health status of farm animals. Aro and Akinmoegun (2012) and Aro et al. (2013) reported that haematological parameters like haematocrit value, haemoglobin concentration, white blood cell count, red blood cell count among others are used in routine screening for the health and physiological status of livestock and even humans.

Etim et al. (2014) reported that haematological traits especially Packed Cell Volume (PCV) and Haemoglobin (Hb) were correlated with the nutritional status of the animal. Isaac et al. (2013) stated that PCV is involved in transport of oxygen and absorbed nutrient. Other blood parameters like blood viscosity are often neglected in routine clinical and physiological investigations. Blood viscosities are however, also affected by nutrition, especially, when processed agro-industrial wastes are taken into consideration. Livestock blood, for instance, may be subjected to hyperviscosity syndrome consequent on the feed they consume which may ultimately affect other blood values like haematocrit and erythrocyte sedimentation rate (Rosencranz and Bogen, 2006; Aro et al., 2013). Blood viscosity can also help to unravel clinical case of blood abnormalities like polycythemia and reduced plasma volume (Jain, 1993; Aro and Akinmoegun, 2012).

Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu et al., 2001).

As reported by Etim et al. (2014), haematological traits, especially, PCV and Hb were correlated with the nutritional status of the animal. Adamu et al. (2006) observed that nutrition had significant effect on haematological values like PCV, Hb and RBC. Togun et al. (2007) reported that increase in PCV coupled with the marginal increase in RBC is indicative of more efficient erythropoiesis in experimental rabbits.

Eheba et al. (2008) noted that a decrease in WBC count, however, reflected a fall in the production of defensive mechanism to combat infection. Togun et al. (2007) reported that a significantly lower lymphocyte count was an indication of a reduction in the ability of the experimental rabbits to produce and release antibiotics when infections occur (Campbell and Lasley, 1975). White Blood Cells Count (WBC) of 5 – 13 (x109/l) is considered to be within normal range according to Burke (1994). Reilly (1993) opined that normal range of values for WBC indicated that the animals were healthy because decrease in number of WBC below the normal range is

an indication of allergic conditions, anaphylactic shock and certain parasitism.
Schalm et al. (1975) reported a normal PCV range of 31 – 50%. Harkness and Wagner (1989) reported a RBC range of 4.8 – 6.3 (x106/mm3). Etim et al. (2014) opined that increased RBC values are associated with high quality dietary protein and with disease free animals. PGCVS (1990) reported a normal range of values for Hb of 8 – 17g/dl. Normal range of values for Hb indicated that the vital physiological relationship of haemoglobin with oxygen in the transport of gases (oxygen and carbon dioxide) to and from the tissues of the body has been maintained and was normal (Njidda et al., 2006). According to Isaac et al. (2013) Packed Cell Volume is involved in the transport of oxygen and absorbed nutrients. Njidda et al. (2006) posited that MCV, MCH and MCHC are used in diagnosing anaemic conditions. Ahmed et al. (1994) observed that MCHC values decrease with increase in the level of protein.

CONCLUSION

It can be concluded that feeding both genotypes of chickens up to 5% MOSM will be effective in terms of weight gain. The effects of MOSM varied based on genotype as it was observed that feeding YENLC up to 10% MOSM improved their weight gain but for best performance in Marshall Broiler chickens 5% inclusion of MOSM is safe.
It is concluded from this study that MOSM can be included in the diets of broiler chickens up to 10% as all the haematological and biochemical parameters were within the normal physiological ranges at this point.
Marshall broilers had better body weights and linear body measurements than the YENLC. There was significant interaction between MOSM and genotype.
Feeding MOSM to 5% for chickens is desirable without any adverse effect on the growth parameters (body weight and morphometric parameters). However, the weights decreased from 5% with increasing levels of MOSM.
It is recommended from this study that the dietary inclusion of MOSM is affected by genotypes hence generalizations can not be made on chickens generally as their performance responses were different genotypically. MOSM can be included up to 5% and 10% in Marshall broilers and YENLC respectively for optimum performance response.

REFERENCES

1. Adamu, S., Thomas, A., Iseh, N. M., Fatihumi, M. Y. and Esieno, K. A. N. (2006). Normal values of haematology of Nigeria adopted albino rats (*Rattus norvegicus*) in Zaria. *Proc. of 31st Annual Conf. of Nig. Soc. for Anim. Prod.* (NSAP).
2. Ahmed, M. K., Bargue, A. R., Nawaz, H. and Siddiqui, R. H. (1994). Effect of varying energy and protein levels of the haematology of Japanese quail. Pakistan Vet. Journal. 14(4): 200-202.
3. Ajala, M.K. (2003). Economics of swine production in Jama'a Local Government Area of Kaduna State, Nigeria. Tropical Journal of Animal Science 6: 53-62.
4. Aletor, V.A. (1989). Effect of varying levels of fishmeal substitution with soybean meal on certain serum metabolites. Niger. J. Technol. Res., 1: 111-114.
5. Aletor, V.A. and Egberongbe, O. (1992). Feeding differently processed soybean. Part 2: An assessment of haematological responses in the chicken diet. Nahrung, 36(4): 364-369.
6. Aro, S. O. and Akinmoegun, M. B. (2012). Haematology and red blood cell osmotic stability of pigs fed graded levels of fermented cassava peel based diets. Proc. 17th Annual Conf. of Anim. Sci. Assoc. of Nigeria (ASAN), 152-153.
7. Aro, S. O., Ogunwale, F. F. and Falade, O. A. (2013). Blood viscosity of finisher cockerel fed dietary inclusions of fermented cassava tuber wastes. Proc. of the 18th Annual Conf. of Anim. Sci. Assoc. of Nig., 74-77.

8. Burke, J. (1994). Clinical care and medicine of pet rabbit. In: Proc. of the Michigan Veterinary Conf., 49-77.
9. Campbell, J. R. and Lasley, J. F. (1975). The science of animal that serve man. 2nd ed. McGraw Hill Book Company, New York, USA: 200-222.
10. Eheba, E. T. E., Omoikhojie, S. O., Bangbose, A. M., Druna, M. B., Isidhahomen, C. E. (2008). Haematology and serum biochemistry of weaner rabbits fed cooked bambara groundnut meal as replacement for soybeans meal. Proc. of 33rd Annual Conf. of Nig. Soc. for Anim. Prod., 192-196.
11. Esonu, B.O., Emenelom, O.O., Udedibie, A.B.I., Herbert, U., Ekpor, C.F., Okoli, I.C. and Iheukwumere, F.C. (2001). Performance and blood chemistry of weaner pigs fed raw Mucuna (Velvet bean) meal. Trop. Anim. Prod. Invest, 4:49-54.
12. Etim, N. N., Enyenihi, G. E., Akpabio, U and Offiong, E. E (2014) Effects of nutrition on the heamatology of rabbits: A review. European Scientific Journal, 10(3):413-424.
13. Ewuola E.O., Jimoh O.A., Atuma O.V. and Soipe O.D. (2012). Heamatology and serum biochemical response of growing rabbits fed graded levels of Moringa oleifera leaf meal. World Rabbit Science Association Proceedings 10th World Rabbit Congress – September 3 - 6, 2012– Sharm El- Sheikh Egypt, 679 - 683
14. Gadzirayi, C.T., Masamha, B., Mupangwa, J.F. and Washaya, S. (2012). Performance of broiler chickens fed on mature Moringa oleifera leaf meal as a protein supplement to Soyabean Meal. International Journal of Poultry Science; 2012, 11 (1): P5.
15. Gomez, K. A. and Gomez, A. A. (1984). Statistical procedures for agricultural research (2nd ed.).Los Banos, Laguna, Philippines: An International Rice Research Institute.
16. Harkness, J. E. and Wagner, J. E. (1989). The Biology and medicine of rabbits chemistry. 17th ed. Lang Medical, Los Altos, California, 9442:60-81; 188-216.
17. Isaac, L. J., Abah, G., Akpan, B. and Ekaette, I. U. (2013). Haematological properties of different breeds and sexes of rabbits. Proc. of the 18th Annual Conf. of Anim. Sci. Assoc. of Nig., 24-27.
18. Jain, N.C. (1986). Schalms veterinary haematology. 4th Edition. Philadephia, USA. Lea and Febiger.
19. Jain, N.C. (1993). Essentials of Veterinary Hematology. The Amazon Book Review
20. Madubike, F.N. and Ekenyem, B.U. (2006). Haematology and Serum Biochemistry Characteristics of Broiler Chicks fed varying Dietary Levels of Ipomoea Asarifolia leaf meal. Int. J.Poult. Sci., 5:9-12.
21. Mitruka, B.M. and Rawnsley, H.M. (1977). Clinical biochemical and haematological reference values in normal experimental animals. NewYork: Masson Publishing.
22. Mmereole, F.U.C. and Udeh, I. (2009). Genotype by diet interaction on body weight of the local chicken and its crosses with Barred Plymouth Rock. International Journal of Poultry Science, 8: 504-507.
23. Moyo, B, Masika, P.J, Hugo, A. and Muchenje, V. (2011). Nutritional characterization of Moringa (Moringa oleifera Lam) leaves. Afr. J. Biotechnol. 10(60):12925-12933

24. Njidda, A. A., Igwebuike, J. U. and Isidahomen, C. E. (2006). Haematological parameters and carcass characteristics of weaning rabbits fed grade levels of molasses. Global Journal of Agric. Sci., 5(7):167-172.
25. Odetola, O. M., Adetola, O. O., Ijadunola, T. I., Adedeji, O. Y. and Adu, O. A., (2012). Utilization of moringa (Moringa oleifera) leaves meal as a replacement for soya bean meal in rabbit's diets. Schol. J. Agric. Sci., 2 (12): 309-313.
26. Ogbe, A.O. and Affiku, J.P. (2012). Proximate study, mineral and anti-nutrient composition of Moringa oleifera leaves harvested from Lafia, Nigeria: potential benefits in poultry nutrition and health. Journal of Microbiology, Biotechnology and Food Sciences, 1: 296-308.
27. Olawumi, S.O., Fajemilehin, S.O. and Fagbuaro, S.S. (2012). Genotype x Sex interaction effects on carcass traits of 3 strains of commercial broiler chickens. Journal of World's Poultry Research, 2(1):21-24.
28. Post Graduate Committee in Veterinary Science (PGCV) (1990). Rabbits and rodents laboratory Animal Science. Proc. No. 142. PGCVs, University of Sydney, Australia.
29. Price, M.L. (2007). The moringa Tree. ECHO technical l note. Revised edition. 11-12.
30. Reilly, J. S. (1993). Euthanasia of animals used for scientific purposes. ANZCCART, Glen Osmond. South Australia, 7(4).
31. Rosencranz, R. and Bogen, S.A. (2006). Clinical Laboratory Measurement of Serum, Plasma, and Blood Viscosity. American Journal of Clinical Pathology 125.
32. Schalm, O.W., Jane, N.C. and Carol, E.J. (1975). Veterinary Haematology. 3rd Edition. Lea and Febiger, Philadelphia.
33. Selle, P.H, Cadoganb, D.J, Li, X. and Bryden, W.L. (2010). Implications of sorghum in broiler chicken nutrition. Animal Feed Science and Technology; 156:57-74.
34. SPSS (2012). User's Guide: Statistics. IBM Version 22. SPSS Inc., Chicago, IL, USA.
35. Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., Oyeniran, A., Nwosisi, I. and Mustapha, F. (2007). Effects of chronic lead administration on the haematological parameters of rabbit – a preliminary study. Proc. of the 41st Conf. of the Agric. Soc. of Nig., 341.

