

Original Research Article

Biometric, Thermo-Physiology and Blood Profile of Noiler Chickens under Intensive Management in Lafia, Nasarawa State, Nigeria

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Abstract: This study aimed at assessing biometric, thermo-physiology and blood profile of Noiler birds under intensive management in Lafia. The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Livestock Complex of College of Agriculture, Science and Technology Lafia, Nasarawa State. A total of 100 of Noiler birds of equal number of both sexes at six weeks of age were procured from the brood and sell farmers of reputable Poultry Farms in Jos Plateau State Nigeria. Body weight, six biometric traits and thermo-physiological traits were measured on the birds on four-weekly basis for six (6) months (January 2025 – June 2025). 2ml of blood samples were taken from the jugular veins of ten birds for blood profile analysis. The General Linear Model was adopted for the analysis. Body weight and biometric traits of the male birds were higher ($P<0.05$) than their female counterparts. Female birds recorded higher ($P<0.05$) rectal temperature and respiratory rate as well as white blood cell and mean corpuscular volume than their male counterparts. Male birds recorded higher ($P<0.05$) low density lipoprotein than their female counterparts. The highest ($P<0.01$) significant positive correlation for male and female birds were observed between body weight vs breast circumference ($r = 0.894$) and total leg length vs foot length ($r = 0.773$). Prediction of body weight was at the optimal ages of 28.85 and 29.50 weeks for male and female birds. The findings of this study would provide an understanding of sexual differences in terms of meat production, adaptation as well as the well-being of the birds.

Keywords: Biometric, Thermo-Physiology, Blood Profile, Noiler Birds, Intensive System.

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INTRODUCTION

The Nigerian chickens are of special interests due to their contribution to food security and livelihoods of rural households and smallholder farmers, especially women who are the primary keepers of the village chickens (Yakubu *et al.*, 2019; Ochora *et al.*, 2023).

Although the Nigerian chickens might be low in production performance, which could be attributed mainly to low genetic potential, genetic erosion occasioned by indiscriminate cross breeding, poor nutrition, health and housing, and vagaries of climatic factors (Wilson *et al.*, 2022).

Nigerian chickens have high genetic diversity and have demonstrated the ability to survive persistent exposure to pathogens and harsh environmental conditions (Mpenda *et al.*, 2019). Some chickens with

desirable phenotypes and genotypes may be more useful than others in the changing environment agro-ecological conditions (Lozano-Jaramillo *et al.*, 2019).

Biometric traits have been widely reported to be good predictors of live weight and animal carcasses (Vargas *et al.*, 2020). Biometric characterization, which contributes to maintain phenotypic traits, is a necessary prerequisite for indigenous breed development and the development of rural poultry. Such characterization reevaluates local breeds/strains, allows the preservation of animal biodiversity and supports consumer demands (Yakubu *et al.*, 2022).

The use of quantitative traits such as body weight and biometric traits have been reported to be a practical and easy technique, especially among rural poultry breeders with lack of resources (Olutunmogun *et al.*, 2016).

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Chickens may also be characterized based on thermo-physiological characteristics. Among all, thermal/heat stress (HS) is the most concerning issue in the ever-changing climatic scenario, and is one of the most important stressors, especially in the tropical, sub-tropical, arid, and semi-arid regions of the world (Al Tamimi *et al.*, 2019). Physiological response to heat stress is a good indicator of the degree of comfort or discomfort in farm animals.

Blood plays an important role in the transportation of nutrients, metabolic waste products and gases around the body, and its profile represents a means of assessing clinical and health status of animals. Their values are influenced by age, sex, breed, climate, geographical location, season, day length, time of day, nutritional status, life habit of species, present status of individual and their factors (Islam *et al.*, 2004).

Noiler chicken is a newly developed, improved, dual-purpose breed of chicken in Nigeria (Bamidele *et al.*, 2019). It is a tropically-adapted breed developed specifically for smallholders to increase production, stimulate higher income, and improve the livelihoods of women and youth, especially within the rural setting (Bamidele *et al.*, 2019). The broad objective of the research is to investigate the biometric, thermo-physiology and blood profile of Noiler birds under intensive management in Lafia, Nasarawa State, Nigeria.

METHODOLOGY

Study Area

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Livestock Complex of College of Agriculture, Science and Technology Lafia, Nasarawa State. Nasarawa State lies within the Guinea savanna zone of Nigeria at Latitude 8.33°N and Longitude 8.33°E. It is positioned at altitude 181.35m above sea level with an average rainfall of 1182mm annually (NIMET, 2023).

Experimental Birds and Management

A total of One hundred (100), six (6) weeks old Noiler chickens of equal number of males and females (50 each) were procured from the brood and sell farmers of reputable Poultry Farms in Jos Plateau State, Nigeria. The birds were managed in a deep litter intensive system for the duration of six months (January 2025 – June 2025). Commercial concentrate finisher (chikun) feeds were supplied to the birds throughout the experimental period. Routine deworming/vaccination was applied to the birds and the sick birds were treated accordingly following the standard procedures.

Body Size, Biometric and Thermo-Physiological Data Collection

Body weight (BW) and six biometric traits: body length (BDL), breast circumference (BC), thigh circumference (TC), foot length (FL), total leg length

(TLL) and wing length (WL) were measured/ determined on each Noiler chicken on a four-weekly basis for six months following the standard anatomical description adopted by FAO (2012) and AUIBAR (2015). At the same time, the thermo-physiological traits such as pulse rate (PR), rectal temperature (RT) and respiratory rate (RR) of each Noiler chicken were taken according to standard methods adopted by Yahav and McMurtry (2001). The anatomical references for the body weight, biometric and thermo-physiological traits of Noiler chickens are as follows: Body weight (BW):-10-kg WeiHeng digital screen hanging scale was used for the individual weight measurement, Body length (BDL):- Was taken between the tip of the *Rostrum maxillare* (bill) and that of the Cauda (tail, without feathers), Breast circumference (BC):- Was measured under the wings of the birds at the edge of the sternum, Thigh circumference (TC):- Was measured as the circumference of the drumstick at the coxa region, Foot length (FL):- Was measured from the shank joint region to the extremity of the *Digitus pedis*, Total leg length (TLL):- This was measured as the length of the femur, shank and metatarsal, Wing length (WL):- This was measured from the shoulder joint region to the extremity of the terminal phalanx, digit 111, Rectal Temperature:- This was measured using a clean digital clinical thermometer inserted into the vent/cloaca for one minute after which the readings were taken (°C), Respiratory Rate:- This was recorded by counting the number of movements of the abdominal region or vent of each Noiler birds for one minute using a stopwatch as breaths/minute and Pulse Rate:- This was recorded by the placement of the finger tips under the wing vein/counting the number of beats per minute using a stop watch as beats/minute.

Blood Haematology

2ml of blood samples were taken from the jugular veins of ten (10) Noiler chickens (5 Cocks and 5 Hens) into Ethylene Diamine Tetra Acetate (EDTA) bottles and transported to the laboratory under cold condition (ice box) within 2 hours of collections for analyses following the procedures of Sood (2016). Packed cell volume was determined using microhaematocrit capillaries, haemoglobin concentration was determined using cyanmethaemoglobin method, blood counts (red blood cell, white blood cell, lymphocytes and neutrophils) were determined using the improved Neubauer's chamber (area of 9sq/mm and depth of 0.1 mm), platelet count was determined using ReesEcker method. Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were also calculated as described by Sood (2016).

Serum Lipid Profile

2ml of blood samples were taken from the jugular veins of ten (10) Noiler birds (5 Cocks and 5 Hens) into clean test-tubes without anti-coagulant (EDTA) and transported to the laboratory on a slanted

rack (test-tube holder) and allowed to stand for about 4 - 5 hours till it is clotted and a straw coloured liquid which had gathered on top of the clotted blood were harvested by decanting it from the test-tube into a cryo-preservative container and stored at -20°C before eventual analysis for serum lipid profile. The lipid profile components analyzed included Cholesterol, Triglycerides, High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) using a lipid profiles kit (Bafawat Diagnostic Laboratory, Lafia Nasarawa State) by spectrophotometric method.

Statistical Analysis

Body weight, biometric and thermo-physiological data were subjected to Levene's test to confirm homogeneity of variances ($P > 0.05$) as described by Brown *et al.*, (2017).

The General Linear Model (GLM) of SPSS version 22 was employed to test the fixed/main effects of Sex (S_i) on body weight, biometric, thermo-physiological data and blood lipid profile. The below linear model was employed as thus:

$$Y_{ij} = \mu + S_i + e_{ij}$$

Y_{ij} = individual observation

μ = overall mean;

S_i = fixed effect of i th sex (i = male, female);

e_{ij} = random error associated with each record.

Relationship among body weight and biometric traits of the Noiler birds for male and female were computed using Pearson's coefficients of correlation.

The relationships between body weight (kg) of the Noiler chicken (males and females) and age at (6, 10, 14, 18, 22 and 26 weeks) under intensive management in Lafia was established using linear and quadratic regression models of SPSS.

The linear and quadratic functions fitted were as follows:

a. Linear model: $Y = b_0 + b_1X + e$ and

b. Quadratic model: $Y = b_0 + b_1 X + b_2 X^2 + e$

Where;

Y = body weight of the Noiler chickens

b_0 = the intercept

X = age of birds (6, 10, 14, 18, 22, 26 weeks)

b_1 and b_2 = regression coefficients

The slope of the quadratic regression plots ($y = dy/dx = 0$) was used to determine the optimum age in weeks for each production characteristic as described by Dağdemir *et al.*, (2007).

RESULTS

Effect of sex on body weight and biometric traits of Noiler birds is presented in Table 1. The result was significant ($P < 0.05$) for body weight and all the biometric traits measured. Body weight and biometric traits of the male Noiler birds were higher than their female counterparts.

Table 1: Effect of sex on body weight and biometric traits of Noiler birds

Traits	Male	Female	Significance
Body Weight (Kg)	1.38±0.01 ^a	1.10 ±0.01 ^b	0.00*
Body length (cm)	34.06±0.14 ^a	33.41±0.14 ^b	0.00*
Breast circumference (cm)	27.20±0.13 ^a	24.50±0.13 ^b	0.00*
Thigh circumference (cm)	11.96±0.09 ^a	11.72±0.09 ^b	0.05*
Foot length (cm)	21.84±0.10 ^a	20.94±0.10 ^b	0.00*
Total leg length (cm)	19.13±0.22 ^a	17.38±0.19 ^b	0.00*
Wing length (cm)	23.35±0.08 ^a	22.67±0.08 ^b	0.00*

^{ab} means on the same row with different superscripts are significant ($P < 0.05$).

The result of the effect of sex on thermo-physiological traits on Noiler birds is presented in Table 2. Pulse rate was not influenced by sex. The result of rectal temperature and respiratory rate were significant

($P < 0.05$). Rectal temperature (41.88) and respiratory rate (30.33) of the female birds were higher than their male (41.77 and 29.51) counterparts.

Table 2: Effect of sex on thermo-physiological traits of Noiler birds

Traits	Male	Female	Significance
Pulse rate (bpm)	127.91±0.46	129.13±0.46	0.06 ^{NS}
Rectal temperature (°C)	41.77±0.03 ^b	41.88±0.03 ^a	0.01*
Respiratory rate (bpm ^l)	29.51±0.06 ^b	30.33±0.06 ^a	0.00*

^{ab} means on the same row with different superscript are significant ($P < 0.05$); bpm - beat per minute bpm^l - breath per minute

The effect of sex on haematological parameters of Noiler birds is presented in Table 3. Sex effect was not significant ($P < 0.05$) on the measured parameters except

for the white blood cell and mean corpuscular volume. The white blood cell and mean corpuscular volume was

significantly ($P<0.05$) higher in female Noiler birds than their male counterparts.

Table 3: Effect of sex on haematological parameters of Noiler birds

Traits	Male	Female	Significance
PCV (%)	31.80±0.81	28.60±0.81	0.25 ^{NS}
RBC ($\times 10^3/\mu\text{L}$)	3.04±0.18	2.67±0.18	0.18 ^{NS}
Haemoglobin (g/dl)	9.98±0.52	9.44±0.52	0.48 ^{NS}
Platelet ($\times 10^3/\mu\text{L}$)	80.98±11.38	76.68±11.38	0.80 ^{NS}
WBC ($\times 10^3/\mu\text{L}$)	79.08±9.71 ^b	112.98±9.71 ^a	0.04*
Neutrophils (%)	3.6±1.33	5.60±1.33	0.32 ^{NS}
Lymphocytes ((%)	95.40±2.06	92.80±2.06	0.40 ^{NS}
MCV (fl)	101.60±0.87 ^b	105.60±0.87 ^a	0.01*
MCH (pg)	32.00±0.71	34.00±0.71	0.08 ^{NS}
MCHC (%)	32.40±0.79	30.57±0.79	1.19 ^{NS}

^{ab}Mean on the same row bearing different superscripts are significant ($P<0.05$). LOS- Level of significance;

*Significance at 95% (0.05); NS-Not significant.

Mean ± SE, PCV= Packed Cell Volume, RBC= Red Blood Cell, Hb= Haemoglobin, WBC= White Blood Cell, MCV= Mean Corpuscular Volume, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration.

The result of the lipid profile effect on Noiler chickens is presented in Table 4. There was a significant

difference ($P<0.05$) recorded for Low Density Lipoprotein (LDL). Male Noiler chickens recorded high value of LDL (1.15) than their female (1.07) counterparts. There was no significant differences recorded for cholesterol, triglycerides and High Density Lipoprotein.

Table 4: Effect of sex on Serum lipid profile (g/dl) of Noiler birds

Traits	Male	Female	Significance
Cholesterol	2.45±0.05	2.50±0.05	0.89 ^{NS}
Triglycerides	1.29±0.05	1.37±0.05	0.18 ^{NS}
High Density Lipoprotein	0.79±0.02	0.81±0.02	0.08 ^{NS}
Low Density Lipoprotein	1.15±0.02 ^a	1.07±0.02 ^b	0.04 ^{NS}

^{ab}Mean on the same row bearing different superscripts are significant ($P<0.05$).

The Pearson's correlations of body weight and biometric traits of male and female Noiler birds is presented in Table 5.

There was strong and positive significant ($P<0.01$) phenotypic correlations of body weight and biometric traits. The highest significant positive

correlation for male was observed between body weight vs breast circumference ($r = 0.894$) and for female was between total leg length vs foot length ($r = 0.773$) while the least positive correlation for male was observed between total leg length vs thigh circumference ($r = 0.408$) and for female was between thigh circumference vs body length ($r = 0.198$).

Table 5: Pearson's correlation of body weight and biometric traits of male and female Noiler birds

Traits	BW	BL	BC	TC	FL	TLL
Male						
BL	0.616**					
BC	0.894**	0.545**				
TC	0.543**	0.525**	0.503**			
FL	0.860**	0.516**	0.838**	0.514**		
TLL	0.537**	0.571**	0.526**	0.408**	0.586**	
WL	0.539**	0.533**	0.507**	0.437**	0.531**	0.664**
Female						
BL	0.601**					
BC	0.674**	0.512**				
TC	0.564**	0.198**	0.393**			
FL	0.819**	0.465**	0.640**	0.718**		
TLL	0.735**	0.590**	0.448**	0.570**	0.773**	
WL	0.717**	0.354**	0.607**	0.597**	0.698**	0.492**

**Significant at $P<0.01$

Regression models for the prediction of body weight from the age of Noiler birds is presented in Table 6. The predictions were for both linear and quadratic functions. However, the quadratic function appears to predict better body weight from age. This is due to the higher coefficient of determination (R^2) and its Adjusted (R^2) as well as lower root mean square error (RMSE)

values. The R^2 values and the RMSE for male Noiler birds for both linear and quadratic functions are 0.744, 0.781 and 0.204, 0.189 while those of the female Noiler chickens are 0.859, 0.864 and 0.116, 0.114. The body weight of both Noiler male and female chickens from the quadratic functions were predicted at optimal ages of 28.85 and 29.50 weeks.

Table 6: Regression models for the prediction of body weight from the age of Noiler birds

Equation	Optimal Age	R^2	Adj R^2	RMSE	P-Value
Body weight (Male Noiler)					
BW= 0.548+0.051Age		0.744	0.743	0.204	0.000*
BW=0.114+0.113Age -0.002Age ²	28.85	0.781	0.780	0.189	0.000*
Body weight (Female Noiler)					
BW=0.446+0.04A2ge		0.859	0.859	0.116	0.000*
BW= 0.333+0.059Age-0.001Age ²	29.50	0.864	0.863	0.114	0.001*

*Significant at $P<0.05$; R^2 = Regression coefficient of determination; Adj R^2 = Adjusted Regression coefficient of determination; RMSE=Root Mean Square Error; Sig= Significance.

DISCUSSION

The superiority of male Noiler chickens to their female counterparts revealed potential genetic differences (Hassan *et al.*, 2024). The higher body weight and biometric traits of male Noiler birds of the study could be related to sexual differences and this indicates that male birds are more muscular and meaty (Faith *et al.*, 2024). This findings is corroborates the report of Brown *et al.* (2017) that female chickens are always significantly smaller than their male counterparts. The observation on body weight could have been triggered by selection pressure (Maniatis *et al.*, 2013).

Increase in respiratory rate of the female Noiler birds of the study could be as a result of greater demand for oxygen as well as evaporative cooling requirements. The higher values of rectal temperature recorded for the female birds of the study indicates that they are more prone to stress and may therefore elicit different homeostatic responses compared to their male counterparts. The results of pulse rate of this study is in contrast with the findings of Espinha *et al.*, (2014) and Faith *et al.*, (2024) where higher pulse rate were recorded in females than their male counterparts. The findings of this study corroborate the work of Mutibvu *et al.* (2017) who reported higher pulse rate in male free-range chickens.

Blood haematology plays a vital role in assessing overall health, diagnosing diseases, and monitoring the impact of various factors like nutrition and stress on the body.

Haematological indices were used extensively in avian medicine as physiological indicators and disease diagnostic tools and sex appeared to be one of the factors affecting avian haematology (Oluyemi and Robert, 2000). The haematological parameters of the study were within the normal range as reported by Islam *et al.* 2014. Female Noiler birds recorded higher values

for WBC than their male counterparts. The WBC play vital role in disease resistance, especially with respect to the generation of antibodies and the process of phagocytosis. They act as the body's defense mechanism, similar to warriors in the bloodstream, fighting off invaders like bacteria and viruses. WBCs are produced in the bone marrow and circulate in the blood and lymph tissues. This could explain the reason of high degree resistance to disease for the Nigerian local chicken (Anyanwu and Adikuru, 1993). Female Noiler birds also recorded higher values for MCV than their male counterparts. MCV values (101.6-105.60fl) of the study corroborate with the normal reference value (90 - 140fl) as reported by Bounous and Stedman (2000). However, MCV value obtained in this study was in contrast with the report of Faith *et al.*, (2018) who reported higher MCV values (132.55 -134.50fl) for indigenous normal feathered chickens. MCV specifically quantifies the average volume of individual red blood cells, providing information about their size. It is often used in conjunction with other red blood cell indices to diagnose and classify anemia in chickens.

High values of Low Density Lipoprotein (LDL) recorded by the male birds indicates a bad cholesterol. However the values obtained in the study (1.07-1.15g/dl or 107-115mg/dl) were within the normal values of ≤ 130 mg/dl as reported by Basmacioglu and Ergul, 2005. LDL plays a role in providing cholesterol in the body tissues and it is a main carrier for cholesterol from liver to the body tissues, so that serum LDL level is affected by cholesterol concentration. LDL is a cholesterol with a low density and functions to carry cholesterol and triglycerides to the organs (Lada and Rudel, 2003).

The strong and positive correlation recorded in the study signified that body weight is a valuable trait in assessment of relationship with body parameters (Yakubu *et al.*, 2022; Faith *et al.*, 2020). This positive correlations of traits suggest that the traits are under the same gene action (Pleiotropy) (Mallam *et al.*, 2024). The

result of this study corroborates with the positive correlation reported by Ikpeme *et al.*, (2016) in three Nigerian local ducks.

The R^2 value of the present study on quadratic model for male and female Noiler chickens (0.74 and 0.86) were similar with the report of Yakubu and Madaki (2017) and Faith *et al.*, (2024) where the prediction of body weight from age (weeks) using quadratic model gave R^2 values of 0.852, 0.852 and 0.76, 0.79 respectively. The present information on body weight prediction is useful especially under the management conditions of smallholder farmers, where weighing scale is not readily available (Negash, 2021).

CONCLUSION

Body weight and biometric traits of the male birds were higher than their female counterparts. Female birds recorded higher rectal temperature and respiratory rate as well as white blood cell and mean corpuscular volume than their male counterparts. Male birds recorded higher low density lipoprotein than their female counterparts. The highest significant positive correlation for male and female birds were observed between body weight vs breast circumference ($r = 0.894$) and total leg length vs foot length ($r = 0.773$). Prediction of body weight was at the optimal ages of 28.85 and 29.50 weeks for male and female birds. The findings of this study would provide an understanding of sexual differences in terms of meat production, adaptation as well as the well-being of the birds.

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Conflict of Interest: The authors have declared no conflict of interest exist.

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