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Effect of sex and systems of production on the hematological and serum biochemical characters of helmeted guinea fowls (*Numida meleagris pallas*) in South Eastern Nigeria

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Abstract

A study was conducted to establish the blood characteristics of helmeted guinea fowl as well as to evaluate the sex and system of management effect on their hematology and serum biochemistry. Sex had a significant effect on the hematological components. Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin (MCH), with males being significantly ($P<0.05$) higher than females in PCV, HBC and RBC while females were significantly higher ($P<0.05$) than males in MCV and MCH. No significant sex effect ($P>0.05$) was recorded on Mean Corpuscular Hemoglobin Count (MCHC), White Blood Cell count (WBC), Neutrophils, Lymphocytes, Monocytes, Esinophils and Basophils. Systems of production had a significant effect ($P<0.05$) on hematology of guinea fowl particularly on WBC, Neutrophils and Lymphocytes, with those kept on extensive system having a significantly higher ($P<0.05$) WBC and Neutrophil than battery cage system while the battery cage system was significantly higher ($P<0.05$) in Lymphocytes than those kept in extensive system. Sex had a significant effect on serum biochemical characters such as Chloride, Glucose, and SGOT with males being significantly higher ($P<0.05$) in chloride and SGOT than females while females were significantly higher ($P<0.05$) in glucose than males. No significant sex effect ($P>0.05$) was recorded on other biochemical characters. System of production had a significant effect on SGPT only, with birds kept in extensive system having a significantly higher ($P<0.05$) SGPT than those kept in battery cage system. No significant effect on ($P>0.05$) system of production was recorded in the rest. These findings has revealed the activities of male and female guinea fowls as it affects hematology and serum biochemistry as well as the effects of intensive or extensive systems of production on their blood parameters.

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Introduction

Guinea fowls are indigenous to Africa, where there are still several wild species (Williamson and Payne, 1978). The helmeted guinea fowl (*Numida melleagris Pallas*) is most common and native to West Africa. Recent researches utilize the biochemical parameters of the blood in livestock for selection and improvement (Nguyen and Tran, 2003) to enhance the productivity of the specie. With the increased production of guinea fowl due to its acceptability, no cultural and religious barriers against its consumption (Ayorinde, 1999), as well as its comparative advantage over the chicken due to its low production cost, premium quality meat, greater capacity to scavenge for insect pests and grains, better ability to protect itself against predators and its resistance to disease of poultry, guinea fowl production has become a special poultry of choice (Ayorinde, 1999). Guinea fowl can also be raised intensively and extensively where they can range extensively in the open (Nwagu and Alawa 1995).

Substances such as serum enzymes, serum proteins and bilirubin have been established as genetic markers in farm animals (Pagot, 1992). Enzyme activity can be useful in selecting males to improve fertility and or hatchability of females in chicken (Orunmiyi et al, 2007). Values for the hematology and serum biochemical characters for helmeted guinea fowl has been established elsewhere (Oyewale and Ogwuegbu, 1986, Oyewale, 1988 and Orji et al, 1986a) but the values as it affects sex and systems of production in the South Eastern Nigeria is limited. Hence, the need to fill the gap and to provide baseline data on which breed and improvement criteria may be based.

The objective of this study is to establish the bench marks for hematology and serum biochemical characters for helmeted guinea fowl as well as to evaluate the effect of sex and system of production on the hematology and serum characteristics of the Helmeted Guinea Fowl in South Eastern Nigeria.

Materials and methods

This study was conducted at the poultry unit of the Federal University of Technology, Teaching and Research farm, Owerri. Owerri is the capital of Imo State, in South-Eastern agro-ecological zone of Nigeria. It lies between Lat 4°4', 6°3'N and Longitude 6°15', 8°15'W of equator. The mean annual rainfall is 250mm, temperature range is 26.5 – 27.5°C and humidity range of 70 – 80%. The research was conducted between March and September, 2009. 40 adult helmeted guinea fowl were procured and used for this experiment. The birds were dewormed with piperazine wormer-17 (Pfizer), wings clipped with scissors and placed in the intensive dip litter pen for 10 days before the commencement of this research. They were fed with sorghum grains, millet and forages for the first week to get them acclimatized before a feed containing19.9-20% Crude protein and 2906Kca/kg Metabolisable energy was offered them. Fresh water was also offered *ad libitum*. 20 adult guinea fowls were reared in the battery cage unit of the teaching and research farm, while 20 others were reared in an extensive system at Duroc farms, some 3 km from the intensive unit. Those reared in intensive unit comprised of 9 males and 11 females, while those in semi intensive system comprised of 7 males and 12 females. In the extensive system, the birds were allowed to range freely and then go into a thatched hut at night. The birds were aged between 40-48 weeks weighing between 0.9 – 1.3kg at the time of bleeding. They were also certified clinically healthy at the time of bleeding.

Blood collection

The birds were bled between 8 and 9.30 am from a punctured wing vein to aspirate 7ml of blood from each bird. Two milliliter of each blood sample was discarded into Ethylene Di-amine Tetra Acetic acid (EDTA) treated bottles for hematological assay. The

remaining 5ml of each blood sample were allowed to coagulate to produce sera for blood chemistry measurements. The blood was collected bi-monthly, three times and during each collection was analyzed extensively for both hematology and serum biochemistry. The samples were collected in April, June and August.

Blood analysis

Blood samples were analyzed within 3 hours of their collection for total erythrocyte and leukocyte counts, hematocrit (PCV), hemoglobin and differential leukocyte count according to methods described by Dein (1984). Erythrocyte count (RBC) was done in a hemocytometer chamber. Total leukocyte count was obtained using a hematocytometer with Natt and Henrick's diluent to obtain a 1:200 blood dilution. The number of leukocytes were thereafter estimated as total WBC/ul= number of cell to total WBC x 200. PCV was measured by the microhematocrit method with 75 x 16 mm capillary tubes filled with blood and centrifuged at 3000 rpm for 5 min. Differential count of leukocytes was made from blood smears stained with Wright's dye and each type of cell was counted with a laboratory counter. Hemoglobin concentration (HBC) was also measured by the cyanmethemoglobin method. Various hematological indices like mean corpuscular hemoglobin (MCH), Mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were calculated from results obtained. The neutrophil, lymphocytes, monocytes, eosinophil and basophils were read off from a microscope of x100 objective in femtolitres (FL).

Serum biochemistry

The bottles of coagulated blood were subjected to standard method of serum separation and the harvested sera used for evaluation of total serum protein (TSP) and total serum electrolyte (TSE). Total serum protein was determined by the Goldberg refractometer method to obtain concentrations (g/dl) for each blood sample. The standard flame photometry using Gallenkamp analysis was used to determine serum sodium (Na+) ion. Calcium (Ca^{2+}) ion was determined by atomic absorption photometry. Chloride and bicarbonate were determined using trichloroacetic acid ammonuium molybdate and ferrous suphate to develop a color read thereafter spectophotometrically. The serum enzymes - Aspartate amino transferase (AST), previously known as serum glutamate oxaloacetate transaminase (SGOT), Alanine amino transferase (ALT) previously known as serum glutamate pyruvate transaminase (SGPT), and Alkaline phospatase (ALP) were determined by using RANDOX SGOT, RANDOX SGPT and RANDOX ALP manual and kits respectively. Alkaline phosphate was measured by the concentration of phosphate from P-nitrophenyl phosphate. Albumin and globulin were determined as component parts from which the total protein was made up of. Cholesterol was determined spectrophotometrically in plasma.

Data analysis

The Randomized Complete Block Design (RCBD) of ANOVA according to SAS (2000) was used to analyze the sex and system of production effect on the hematology and serum biochemical characteristics of helmeted guinea fowl. The model is

$Y_{ijk} = U + S_i + T_j + e_{ijk}$

Where Y_{ijk} = Observation on the Kth blood sample of the Jth system of production of the Ith sex.

S_i = Fixed effect of sex (block).

T_j = Fixed effect of system of production.

E_{ijk} = Random error, iind $(0, \delta^2)$

The Fischer's Least Significant Difference (F-LSD) was used to separate the means where there is significance.

Results and discussion

The hematological and serum biochemical characteristics of Helmeted Guinea Fowl shows values that lies in the range of 0.82 (%) for Basophils to 333.38 (g/dl) for MCHC (table 1). The Total protein

(g/dl) and PCV (%) values are the same as reported by Oke et al (2003) for early laying Pearl Guinea Fowls fed 2750Kcal/Kg ME diet at 18% CP. This explains the dietary energy of 2950Kcal/Kg ME and 19.9% CP used in the experiment which enhanced the total protein and PCV of the Helmeted Guinea Fowl. Other parameters were also in the range as reported by Orji et al (1986a), Oyewole and Ogwuegbu (1986) and Oyewole (1988), with few variations between the values reported.

Table 1. Hematological and serum biochemical characteristics of helmeted guinea fowls.

Hematology	Mean	±SEM	Serum biochemical characters	Mean	±SEM
PCV (%)	37	2.02	Na^+ (Mmol/l)	111.92	5.01
HBC (g/%)	12.17	0.62	Chloride (Mmol/l)	94.33	2.03
RBC ($x10^{12}$/L)	1.13	0.14	Bicarbonate (Mmol/l)	19.08	0.60
MCHC (g/dl)	333.38	1.06	Ca^{2+} (Mg/dl)	14.89	1.16
MCV (FL)	318.50	35.12	Glucose (Mg/dl)	221.25	24.81
MCH (pg)	120.33	9.95	Cholesterol (Mg/dl)	111.83	4.30
WBC ($x10^9$/L)	1.43	0.08	Total Protein (g/dl)	4.78	0.25
NEUTROPHILS (%)	60.75	1.49	Albumin (g/dl)	2.26	0.25
LYMPHOCYTES (%)	31.33	1.51	Globulin (g/dl)	4.94	2.39
MONOCYTES (%)	5.50	0.54	Total bilirubin (Mg/dl)	0.50	0.02
ESINOPHILS (%)	3.25	1.55	Conj. Bilirubin (Mg/dl)	0.30	0.02
BASOPHILS (%)	0.82	0.18	SGPT (IU/L) – (AST)	22.00	1.92
			SGOT (IU/L) – (ALT)	10.75	0.87
			Alkaline Phosphate (IU/L)	122.42	5.10

Each sample was replicated three times.

Table 2. Mean Effect of sex on Hematology of helmeted guinea fowls.

	Sex		
Hematology	Mean Male Values	Mean Female Values	±SEM
PCV (%)	41.33^a	31.67^b	1.76
HBC (g/%)	3.73^a	10.60^b	0.59
RBC ($x10^{12}$/L)	1.45^a	0.80^b	0.12
MCHC (g/dl)	332.08	311.48	0.11
MCV (FL)	302.83^b	412.17^a	35.45
MCH (pg)	101.17^b	139.50^a	12.48
WBC ($x10^9$/L)	1.67	2.01	0.08
NEUTROPHILS (%)	58.67	63.83	1.90
LYMPHOCYTES (%)	33.18	29.50	1.97
MONOCYTES (%)	5.83	5.17	0.78
ESINOPHILS (%)	2.00	1.50	0.39
BASOPHILS (%)	0.50	1.00	0.00

Means with different superscripts are significantly different (P<0.05) with three replications per sample.

Sex showed significant (P<0.05) effect on hematology with males being higher in PCV (%), HBC (%), and RBC($x10^{12}$/L), while females were higher in MCV (FL) and MCH (pg) than the males (table 2). This could be as a result of the male's increased courting around the female since the period of blood collection was their breeding season. According to Sturkie (1965) HB and PCV were influenced by androgen. However, the Nigerian Laughing Dove has lower hematological values compared to the helmeted guinea fowl while the Nigerian Duck has higher values than the helmeted guinea fowl (Oluyemi et al 2006).

Table 3. Mean Effect of system of production on the hematology of helmeted guinea fowls.

	System of production		
Hematology	Mean Battery Cage Values	Mean Extensive System Values	±SEM
PCV (%)	37.63	34.25	2.85
HBC (g/%)	12.55	10.60	0.67
RBC ($x10^{12}$/L)	1.24	0.80	0.12
MCHC (g/dl)	333.13	329.00	1.23
MCV (FL)	326.37	412.17	35.32
MCH (pg)	110.13	139.50	11.78
WBC ($x10^9$/L)	1.28^b	1.73^a	0.06
NEUTROPHILS (%)	58.50	65.25	2.06
LYMPHOCYTES (%)	33.50	27.00	2.00
MONOCYTES (%)	5.50	5.50	0.76
ESINOPHILS (%)	1.75	1.75	0.35
BASOPHILS (%)	0.88	0.50	0.25

Means with different superscripts are significantly different (P<0.05) with three replications per sample.

The system of production had no significant (P>0.05) effect on the hematology and serum biochemical characteristics of helmeted guinea fowl (Tables 3 and 5). Though numerically the values for PCV, HBC, RBC, Na+, Cl, Glucose, Albumin and SGOT are higher in battery cage than in extensive system, it follows the findings of Ayeni (1980) which posited that the plasma alkaline phosphatase, cholesterol, blood platelet count and packed cell volume improved with increasing time spent in captivity or domestication. The plasma alkaline phosphatase and packed cell volume in healthy adult guinea fowl were higher in value than in adult healthy domestic fowl of both sexes. Also the WBC ($x10^9$/L) and SGPT (IU/L) –

AST (tables 3 and 5) showed a higher value in extensive system than in battery cage. Since a higher globulin:albumin ratio is normally associated with better antibody production, this is probably why the helmeted guinea fowl has better disease tolerance than most other poultry birds, moreso in extensive system where physical body activity is high than in battery cage system. Although the glucose value is numerically higher in battery cage than the extensive system (table 5), this can be ascribed to the low rate of energy usage compared to the extensive system where the birds are in constant movement hence low level of plasma glucose. Helmeted guinea fowl also has high plasma glucose levels that supply the high energy required for flight, vocalization, running and constant movement compared to chicken (Ayorinde, 1999). The chloride and SGOT (IU/L) – ALT showed significantly ($P<0.05$) higher effect on sex (table 4) with males having higher than the females. This indicates that the activities of this mineral and enzyme are higher in males than in females.

Table 4. Mean Effect of sex on serum biochemical characteristics of helmeted guinea fowls.

	Sex		
Serum biochemical characteristics	Mean Male Values	Mean Female Values	±SEM
Na^+ (Mmol/l)	103.5	120.33	5.85
Chloride (Mmol/l)	100.17^a	88.50^b	1.57
Bicarbonate (Mmol/l)	20.17	18.00	0.65
Ca^{2+} (Mg/dl)	16.27	13.52	1.56
Glucose (Mg/dl)	185.50^b	257.00^a	33.15
Cholesterol (Mg/dl)	112.67	111.00	6.19
Total Protein (g/dl)	4.37	5.20	0.32
Albumin (g/dl)	2.05	2.47	0.36
Globulin (g/dl)	2.53	2.67	0.38
Total bilirubin (Mg/dl)	0.48	0.51	0.03
Conj. Bilirubin (Mg/dl)	0.29	0.32	0.02
SGPT (IU/L) – (AST)	12.00	9.50	1.10
SGOT (IU/L) – (ALT)	27.33^a	16.67^b	1.72
Alkaline Phosphate (IU/L)	128.66	116.67	5.66

Means with different superscripts are significantly different (P<0.05) with three replications per sample.

Table 5. Mean Effect of system of production on serum biochemical characteristics of helmeted guinea fowls.

	System of production		
Serum biochemical characteristics	Mean Battery cage Values	Mean Extensive System Values	±SEM
Na^+ (Mmol/l)	114.25	107.25	6.53
Chloride (Mmol/l)	94.75	93.50	2.82
Bicarbonate (Mmol/l)	18.38	20.50	0.65
Ca^{2+} (Mg/dl)	14.88	14.93	2.01
Glucose (Mg/dl)	226.88	210.00	28.76
Cholesterol (Mg/dl)	111.00	113.50	0.24
Total Protein (g/dl)	4.59	5.18	0.26
Albumin (g/dl)	2.48	1.83	0.25
Globulin (g/dl)	2.28	3.25	0.20
Total bilirubin (Mg/dl)	0.51	0.46	0.02
Conj. Bilirubin (Mg/dl)	0.31	0.29	0.02
SGPT (IU/L) – (AST)	9.50^b	13.25^a	1.32
SGOT (IU/L) – (ALT)	22.75	20.50	2.72
Alkaline Phosphate (IU/L)	120.25	126.75	5.52

Means with different superscripts are significantly different (P<0.05) with three replications per sample.

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