Journal of Animal and Veterinary Sciences
2017; 4(5): 36-42
http://www.openscienceonline.com/journal/javs

Open Science

Effect of Cage and Floor Litter Environment on the Blood Profiles of Broiler Chickens Reared in Derived Savanna Zone of Nigeria

Amao Shola Rasheed

Department of Agricultural Education (Animal Sci. Division; Animal Breeding & Genetics Unit), School of Vocational and Technical Education, Emmanuel Alayande College of Education, Oyo, Nigeria

Email address

sholaamao@gmail.com, sholaamao@eacoed.edu.ng

To cite this article

Amao Shola Rasheed. Effect of Cage and Floor Litter Environment on the Blood Profiles of Broiler Chickens Reared in Derived Savanna Zone of Nigeria. *Journal of Animal and Veterinary Sciences.* Vol. 4, No. 5, 2017, pp. 36-42.

Received: May 7, 2017; **Accepted**: July 19, 2017; **Published**: October 18, 2017

Abstract

The current study evaluate the effect of cage and floor litter environment on the haematological and serological indices of broiler chickens consisting of 100 Ross and Anak strain of broiler chicks each in a completely randomly design. The blood samples were collected at three intervals of 6, 8 and 10th week of age. Data were collected on haematological and serological indices of both strains in the two different environments. Haematological indices including Red blood cell (RBC), Packed cell volume (PCV), haemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration and (erythrocytic values). White blood cells (WBC), heterophils (H), Lymphocytes (L), Heterophils: Lymphocytes (H/L) monocytes (M) Eosinophils (E) and Basophils (B) as Leukocytic indices. Regardless to the strains-cage environment, higher significant ($P < 0.05$) effects on RBC, WBC, PCV, H, L, H/L, E, PCV, MCV and ESR counts while floor litter shows significant ($P < 0.05$) effects for both strains for Hb and MCH, while no significant ($P > 0.05$) responses were observed for MCHC and monocyte. The serological indices determined were serum total protein (TP) serum albumin (SA), serum globulin (SG), Uric acid (UA) serum glucose (SGL), Creatine (C), Serum aspertate amino transferase, (SAST), total cholesterol (TC) and Serum alanine amino transferase (SALT). Caged birds showed significant ($P < 0.05$) different values in TP, SA, SG, SALT, SAST and TC than their counterpart on the floor litter environment while higher significant ($P < 0.05$) values were obtained for creatine and Uric acid. The study concluded higher H:L value which is an indicator of stress in the cage environment and improvement in the floor system could result into better health improvement of birds. The results could be a baseline for breeding programme in this environment.

Keywords

Broiler, Cage, Floor Litter, Environment, Haematology, Biochemical Indices, Derived Savanna

1. Introduction

Broilers are specially meat type chicken bred to mature at 7-8 weeks and at most 10 weeks and sold at mature body weight of 1.5-2.0 kg “[1]”. There is need to encourage the production of broiler birds in the third world countries because broiler are breeds of poultry birds that are genetically bred for meat production “[2]”. There are three basic systems of rearing poultry: they are free range, deep litter system and cage system but broilers are mainly reared or kept on litter system “[3]”. Attempts to develop cages similar to layers cages were made in 1960s and early 1970s “[4]”.

In large-scale poultry production, environment is a serious issue because it affects the performance of the birds and hence profitability. Experiment that were well carried out and the data collected and analysed, reveal ways of reducing costs and improving performance with new facilities. One of the important facilities for a poultry production is the cage“[5]”. Reports from “[6], [7], [8], [9]” stressed their findings on different strains of poultry birds in terms of blood profiles in deep litter environment but not in cages.

Haematological and biochemical indices were often been used for the assessment of health and disease, besides some

parameters there are good indicator of haemogramme "[10]". Thus, variations in the values of these blood indices outside the normal physiological ranges are pointer to various disease conditions even at sub-clinical levels in the birds "[11]". Meanwhile it is very difficult to assess the correct health status of an animal without first examination of its blood in relation to adequate response of a wide range of environmental situation in both cage and floor litter environment "[12]". Therefore, in this current study we compared broilers reared in cage with those reared on floor litter (the floor group) on the blood haematological and serological indices in derived savanna region of Nigeria.

2. Materials and Methods

2.1. Experimental Site

The research was carried out at the Poultry unit of Teaching and Research Farm of the Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso lies on the Longitude $4^0$15' East of the Greenwich Meridian and Latitude $8^0$15' North-East of the equator. It is about 145 kilometers North-Eastwards from Ibadan, the capital of Oyo state. The altitude is between 300 and 600 meters above sea level. The mean annual temperature is about 27°C while that of rainfall is 1247mm "[13]".

2.2. Experimental Birds and Design

A total of 200 day-old chick comprising of 100 Ross and Anak strains each was brooded for four weeks of age using coal pot as a source of heat. Each strain was identified by wing tag and also given a separate pen in an environmentally controlled brooder house, wood shaving was used as litter material and it was kept dry throughout the breeding period. All necessary vaccination were administered when due. Thereafter, after 4 weeks of age, the birds were divided into two within the strain. 50 birds of each strain were placed on fresh wood shaving litter. The other 50 birds of each strain were then transferred into the cage and each strain was divided into five replicates to make ten (10) birds per replicate. The cage used in this study is 2-tier battery cage, made up of 40cells per tier. The broilers were randomly and individually assigned to the cells of the cage at the lower and the upper levels. The measurement of the floor used to given area of 1.55 by 0.80 m for a stocking density of 0.05 m^2 per bird. Chicks were fed *ad libitum* with broiler starter and finisher mashes offered to the birds from 0 to 4weeks and 5 to 10weeks respectively.

2.3. Haematological Analysis

Sixty (60) birds were selected at random from each strain at floor litter environment (30 birds) and cage (30 birds) for blood samples analysis. Blood samples were taken when the birds were at 6, 8 and 10 weeks of age from the wing vein into two different sets of bijou bottles. The first set of bottles contained Ethylene-diamine-tetra-acetic acid (EDTA anti coagulant) while the other set was without EDTA.

The set with EDTA was used to determine Red Blood Cells (RBC), White Blood Cells (WBC) using the improved Neubauer haemocytometer as described by "[14]". Packed cell volume (PCV) was determined using the microheamatocrit method and haemoglobin (Hb) using cyanomethemoglobin method according to "[15]". Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were determined using the appropriate formulae by "[16]".

2.4. Serological Analysis

The set of samples bottles without EDTA were centrifuged in a micro centrifuge to generate serum for biochemical analysis. Total protein was determined using the Biuret method as described by "[17]", albumin using dye- binding techniques with bromocresol green as described by "[18]", globulin by difference (total protein minus albumin), total cholesterol by enzymatic method as described by "[19]". Creatinine by Jaffe reaction method as described by "[20]". Urea by di-methyl monoxide method as described by "[21]". Serum alanine amino transferase (SALT) and Serum aspartate amino transferase (SAST) described by "[22]", Serum glucose by enzymatic method of "[23]".

2.5. Statistical Analysis

The data collected were subjected to one way analysis of variance (ANOVA) at a significant level of 5% "[24]". Means were compared by the test of Tukey after sample homogeneity was verified "[25]".

3. Results

Table 1 shows the least square means of erthyrocytic values of Ross broilers under cage and floor litter environment. Significant ($P < 0.05$) differences were observed in all parameters measured with increase in age except MCHC. Caged Ross broilers had higher values of RBC counts, PCV, MCV and ESR than their counterpart on floor litter while Hb and MCH values were higher in Ross broiler on floor litter environment. However, there were no significant ($P > 0.05$) differences between environmental effects on MCHC absolute values.

Table 1. *Least square means of erythrocytic values of Ross broilers under cage and floor litter environment.*

Parameters	Environment	N	Interval of blood collections		
			1	2	3
RBC ($x10^6/\mu$)	Cage	30	$2.70+0.10^a$	$2.79+0.30^a$	$3.58+0.35^a$
	Floor litter	30	$2.49+0.06^b$	$2.51+0.15^b$	$3.00+0.41^b$

Parameters	Environment	N	Interval of blood collections		
			1	2	3
PCV (%)	Cage	30	35.10+2.53[a]	37.11+3.25[a]	40.32+4.22[a]
	Floor litter	30	31.43+4.31[b]	35.25+4.00[b]	38.41+3.20[b]
Hb (g/dl)	Cage	30	9.16+1.12[b]	9.31+2.32[b]	11.42+2.47[b]
	Floor litter	30	9.89+1.43[a]	10.88+1.41[a]	13.00+1.38[a]
MCV (fl)	Cage	30	120.35+21.34[a]	115.00+11.45[a]	110.24+14.32[a]
	Floor litter	30	118.41+20.44[b]	110.14+20.00[b]	100.34+11.47[b]
MCH (pg)	Cage	30	27.00+3.10[b]	30.18+1.35[b]	32.45+3.47[b]
	Floor litter	30	29.29+4.57[a]	32.41+2.41[a]	37.00+1.35[a]
MCHC (%)	Cage	30	28.30+2.13	31.45+3.42	31.65+4.25
	Floor litter	30	28.37+3.41	31.47+2.57	31.68+2.47
ESR (mm/h)	Cage	30	3.50+0.10[a]	3.85+0.02[a]	3.98+0.13[a]
	Floor litter	30	2.10+0.10[b]	2.30+0.07[b]	2.60+0.15[b]

[abc] Means along the same column with at least one common superscript at the same environment are not significantly different (P>0.05).
RBC- Red Blood Cell, PCV- Packed Cell Volume, Hb-Haemoglobin, MCV-Mean Corpuscular Volume, MCH-Mean Mean Corpuscular Haemoglobin, MCHC- Mean Corpuscular Haemoglobin Concentration, ESR-Erythrocyte Sedimentation rate.

Significant (P<0.05) differences in the least square means of leukocytic values of Ross broiler under two different environments is presented in Table 2. The leukocytic components shows pattern of variation as a function of age. Caged Ross broiler shows a significant (P<0.05) higher values of WBC counts, Heterophils, Eosinophils, Basophils and H:L counts than their floor litter counterpart birds, while higher values were only obtained for lymphocytes count in floor litter -environment. There were no significant (P > 0.05) differences environmental effects on monocyte values.

Table 2. *Least square means of leukocytic values of Ross broilers under two different environments.*

Parameters	Environment	N	Interval of blood collections		
			1	2	3
WBC (x 10^6/µ)	Cage	30	25.18+1.38[a]	28.18+1.22[a]	30.20+1.35[a]
	Floor litter	30	20.30+2.45[b]	21.71+1.07[b]	25.60+3.45[b]
Heterophils (x10^3/µ)	Cage	30	10.21+1.12[a]	8.33+1.11[a]	6.34+0.20[a]
	Floor litter	30	8.25+1.25[b]	6.46+1.00[b]	4.54+0.35[b]
Lymphocytes (x10^3/µ)	Cage	30	8.15+0.72[b]	8.23+0.14[b]	10.33+0.78[b]
	Floor litter	30	10.06+1.80[a]	11.24+0.18[a]	14.61+2.37[a]
H:L	Cage	30	1.25+0.01[a]	1.01+0.01[a]	0.61+0.03[a]
	Floor litter	30	0.82+0.01[b]	0.57+0.01[b]	0.31+0.02[b]
Monocytes (x10^3/µ)	Cage	30	1.10+0.01	1.10+0.01	0.93+0.02
	Floor litter	30	1.10+0.10	1.09+0.02	0.92+0.01
Eosinophils (x10^3/µ)	Cage	30	0.78+0.02[a]	0.75+0.01[a]	1.00+0.02[a]
	Floor litter	30	0.53+01[b]	0.58+0.02[b]	0.60+0.02[b]
Basophlis (x10^3/µ)	Cage	30	0.30+0.02[a]	0.35+0.03[a]	0.39+0.04[a]
	Floor litter	30	0.16+0.03[b]	0.20+0.01[b]	0.25+0.02[b]

[abc] Means along the same column with at least one common superscript at the same environment are not significantly different (P>0.05).
WBC-White Blood Cell, H:L- Heterophil: Lymphocyte ratio.

Table 3 reveals the least square means of erythrocytic values of Anak broiler strain under two different environments. There were significant (P < 0.05) differences for all the erythrocytic components except for MCHC. Caged Anak broilers had higher values of RBC, PCV, MCV, ESR (at 2nd and 3rd blood collection interval) while Hb and MCH values were higher in broilers kept on floor litter environment.

Table 3. *Least square means of erythrocytic values of Anak broilers under two different environments.*

Parameters	Environment	N	Interval of blood collections		
			1	2	3
RBC (x10^6/µ)	Cage	30	3.50+0.02[a]	3.86+0.04[a]	3.98+0.05[a]
	Floor litter	30	2.92+0.03[b]	3.10+0.06[b]	3.74+0.04[b]
PCV (%)	Cage	30	38.14+2.47[a]	39.88+3.38[a]	41.05+3.79[a]
	Floor litter	30	36.32+3.00[b]	37.47+3.48[b]	39.32+3.11[b]
Hb (g/dl)	Cage	30	9.10+0.11[b]	9.60+0.32[b]	10.21+0.35[b]
	Floor litter	30	9.85+0.30[b]	10.25+0.47[a]	12.31+1.47[a]
MCV (fl)	Cage	30	122.06+9.20[a]	118.14+9.14[a]	112.32+10.24[a]
	Floor litter	30	120.73+8.67[b]	116.32+8.35[b]	111.61+8.11[b]
MCH (pg)	Cage	30	28.00+3.11[b]	30.14+4.35[b]	31.35+3.48[b]
	Floor litter	30	30.35+4.47	31.45+3.47[a]	33.10+7.11[a]
MCHC (%)	Cage	30	29.63+3.47	31.32+6.14	31.93+3.47

Parameters	Environment	N	Interval of blood collections		
			1	2	3
ESR (mm/h)	Floor litter	30	29.60+4.38	31.30+3.17	31.98+3.10
	Cage	30	2.80+0.01	3.70+0.03[a]	4.10+0.02[a]
	Floor litter	30	2.10+0.02	2.40+0.03[b]	3.00+0.04[b]

[abc] Means along the same column with at least one common superscript at the same environment are not significantly different (P>0.05).
RBC- Red Blood Cell, PCV- Packed Cell Volume, Hb-Haemoglobin, MCV-Mean Corpuscular Volume, MCH-Mean Mean Corpuscular Haemoglobin, MCHC- Mean Corpuscular Haemoglobin Concentration, ESR-Erythrocyte Sedimentation rate.

The least square means of leukocytic values of Anak broiler under two different environments is shown in Table 4. The total WBC, Heterophils, Lymphocyte, H/L, Eosinophils and Basophils counts were higher for caged Anak than its floor litter counterparts. No significant (P > 0.05) different were obtained for monocytes counts in both environments.

Table 4. *Least square means of leukocytic values of Anak broilers under two different environments.*

Parameter	Environment	N	Interval of blood collections		
			1	2	3
WBC ($x10^6/\mu$)	Cage	30	27.88+1.22[a]	29.24+3.41[a]	30.34+3.48[a]
	Floor litter	30	25.11+2.48[b]	26.35+1.57[b]	28.41+3.11[b]
Heterophils ($x10^3/\mu$)	Cage	30	7.85+1.00[a]	7.00+1.11[a]	6.44+1.21[a]
	Floor litter	30	6.70+0.20[b]	5.90+1.25[b]	5.35+0.35[b]
Lymphocytes ($x10^3/\mu$)	Cage	30	8.38+1.11[b]	9.45+0.33[b]	9.99+0.48[b]
	Floor litter	30	10.35+1.35[a]	11.47+0.66[a]	12.35+0.37[a]
H:L	Cage	30	0.80+0.01[a]	0.62+0.02[a]	0.54+0.01[a]
	Floor litter	30	0.76+0.02[b]	0.61+0.01[b]	0.52+0.02[b]
Monocytes ($x\ 10^3/\mu$)	Cage	30	0.83+0.10	0.93+0.01	0.95+0.32
	Floor litter	30	0.81+0.03	0.92+0.03	0.90+0.06
Eosnophils ($x\ 10^3/\mu$)	Cage	30	0.85+0.10[a]	0.98+0.20[a]	1.12+0.14[a]
	Floor litter	30	0.60+0.03[b]	0.65+0.01[b]	0.90+0.04[b]
Basophils ($x\ 10^3/\mu$)	Cage	30	0.38+0.02[a]	0.42+0.01[a]	0.56+0.02[a]
	Floor litter	30	0.14+0.01[b]	0.20+0.03[b]	0.30+0.01[b]

[abc] Means along the same column with at least one common superscript at the same age are not significantly different (P>0.05).
WBC-White Blood Cell, H:L- Heterophil: Lymphocyte ratio.

Table 5 reveals the least square means of serological indices of Ross birds under two different environments. All the biochemical indices shows a significant (P<0.05) effects on both environmental housing. Serum albumin and creatine had higher values in floor litter environment than their caged counterparts. Caged Ross birds were higher in Serum total protein, uric acid, serum glucose, total cholesterol, SALT and SAST values than their counterpart in the floor litter environment. Serum globulin values shows a significant (P<0.05) different only at the last phase of blood collection (3^{rd} collection).

Table 5. *Least square means of serological indices of Ross birds under two different environments.*

Parameters	Environment	N	Interval of blood collections		
			1	2	3
Serum Total protein (gd/l)	Cage	30	51.33+4.34[a]	53.44+3.73[a]	56.34+4.35[a]
	Floor litter	30	45.45+3.45[b]	48.34+4.34[b]	50.44+3.75[b]
Serum Albumin (gd/l)	Cage	30	30.35+1.38[b]	32.47+2.78[b]	33.36+3.80[b]
	Floor litter	30	35.46+2.47[a]	36.48+3.01[a]	40.49+3.47[a]
Serum Globulin (gd/l)	Cage	30	15.87+1.02	15.87+1.25	17.08+1.45[a]
	Floor litter	30	15.10+0.30	14.86+0.45	14.85+1.00[b]
Uric acid (mg/dl)	Cage	30	2.85+0.12[a]	2.98+0.11[a]	3.06+0.05[a]
	Floor litter	30	2.10+0.14[b]	2.50+0.12[b]	2.56+0.11[b]
Serum glucose (gd/L1)	Cage	30	65.60+3.36[a]	68.32+4.35	70.48+3.47[a]
	Floor litter	30	60.32+4.00[b]	63.33+6.25[b]	65.34+3.11[b]
Creatine (mg/dl)	Cage	30	0.49+0.06[b]	0.42+0.01[b]	0.40+0.03[b]
	Floor litter	30	0.85+0.03[a]	0.80+0.01[a]	0.75+0.01[a]
SAST (U/ml)	Cage	30	170.18+16.32[a]	225.90+50.69[a]	278.92+54.33[a]
	Floor litter	30	151.22+14.11[b]	193.45+41.32[b]	200.01+35.62[b]
Serum Cholesterol (mg/dl)	Cage	30	140.32+11.40[a]	135.35+14.21[a]	130.35+1.45[a]
	Floor litter	30	136.45+12.35[b]	131.42+13.11[b]	127.86+12.01[b]
SALT (μ/ml)	Cage	30	10.95+1.23[a]	10.10+0.28[a]	9.85+0.36[a]
	Floor litter	30	8.38+0.32[b]	8.12+0.10[b]	7.65+0.02[b]

[abc] Means along the same column with at least one common superscript at the same environment are not significantly different (P>0.05).
SAST-Serum aspertate amino transferase, SALT -Serum alanine amino transferase

The least square means of serological indices of Anak birds under two different environments is shown in Table 6. Significant ($P < 0.05$) differences were observed in all the parameters measured. Floor litter environment shows superiority for serum albumin and creatine, while higher values were obtained for serum glucose, Uric acid, serum glucose, creatinine, SAST, SALT and total serum cholesterol values in caged birds than their counterpart in the floor litter environment.

Table 6. *Least square means of serological indices of Anak birds under two different environments.*

Parameters	Environment	N	Interval of blood collections		
			1	2	3
Serum Total protein (gd/1)	Cage	30	48.45+4.01[b]	49.49+4.45[b]	50.35+4.78[b]
	Floor litter	30	52.31+4.44[a]	55.37+4.99[a]	55.98+5.01[a]
Serum Albumin (gd/1)	Cage	30	30.00+2.45[b]	31.98+3.47[b]	32.90+3.21[b]
	Floor litter	30	34.58+3.14[a]	35.49+4.25[a]	39.98+4.01[a]
Serum Globulin (gd/1)	Cage	30	18.45+0.45[a]	17.51+2.11[b]	17.45+3.11[a]
	Floor liter	30	17.73+1.30[a]	19.88+1.13[a]	16.00+1.45[b]
Uric acid (mgd/1)	Cage	30	2.88+0.11[a]	2.99+0.31[a]	3.10+0.06[a]
	Floor litter	30	2.20+0.15[b]	2.41+0.11[b]	2.50+0.14[b]
Serum glucose (gd/1)	Cage	30	66.11+3.45[a]	68.47+6.35[a]	69.35+4.15[a]
	Floor litter	30	60.45+4.38[b]	65.45+3.47[b]	66.47+5.88[b]
Creatinine	Cage	30	0.50+0.01[b]	0.48+0.03[b]	0.46+0.02[b]
	Floor litter	30	0.80+0.02[a]	0.78+0.02[a]	0.75+0.01[a]
SAST (U/ml)	Cage	30	175.14+15.62[a]	210.45+19.35[a]	250.35+20.35[a]
	Floor litter	30	148.35+15.22[b]	198.36+20.41[b]	121.47+11.75[b]
Serum cholesterol (mg/dl)	Cage	30	143.45+14.50[a]	138.45+14.78[a]	131.47+15.35[a]
	Floor litter	30	138.36+14.77[b]	134.65+10.35[b]	125.48+14.38[b]
SALT (u/ml)	Cage	30	10.90+0.35[a]	10.20+0.01[a]	9.35+0.35[a]
	Floor litter	30	9.35+0.45[b]	9.11+0.03[b]	8.38+0.49[b]

[abc] Means along the same column with at least one common superscript at the same environment are not significantly different ($P>0.05$).
SAST-Serum aspertate amino transferase, SALT -Serum alanine amino transferase

4. Discussion

The erythrocytic and leukocytic values obtained for Ross and Anak strains in this present study present a similar pattern of variation as a function of age, with higher values observed in cage environment as reported by "[26]". This current study on broilers showed housing conditions affected haematological and biochemical indices which resulted in slight differences in the H:L ratio between broilers reared on floor litter and those kept in cages. Since various environmental factors can affect the immune status of broilers when measured by H:L in the blood. The pattern of both strains on erythrocyte and leukocyte values had been reported by "[27], [28]". These authors reported their findings based on H/L that favoured cage environment and considered H/L as a better indicator for stress in the environment. Moreso, this current findings that favoured cage environment was also in agreement with the works of "[29], [30]" who reported a significant higher values for broiler kept in cages in terms of heterophil concentration and lymphocytes than those in floor litter. The differences in amount and proportions of circulating leukocytes for both strains with different environment may suggest a greater need for immune activity in broilers reared in cages which had been supported by the study of "[12]" who reported differences in haematological indices for 4 strains of broiler chickens kept in cage and deep litter systems respectively. The values obtained in this present study were disagreed with the work of "[31]"who reported higher values for both erythrocytic and leukocytic values indices in three commercial layers strains of chickens reared in Ghana.

The biochemical indices of the two strains in the different environments in this present study were in line with the findings of "[32]"for Hybro-Per broilers reared at different ages but disagreed with the works of "[33]". These authors obtained higher values of blood profiles in birds reared on the floor litter than the birds counterparts in the cages. The higher values of these biochemical indices in cages had been reported by "[34]" who attributed this to low mobilization of tissues of the birds to their intense synthesis by the liver. The creatinine values obtained in this present study were similar to the findings of "[35]" who reported creatinine values were directly related to muscle volume and activity and therefore its lower blood levels in old and young chickens. The Uric acid levels obtained were in lines works of "[36]". These authors found higher Uric acid levels in broiler strains during the early rearing phase compared to the latter phases. The variations patterns of the serum biochemical indices that differentiate the two environments had been documented by "[36]". This may be as a result of housing effect on the strain and the genetic line as these may influence the biochemical indices of chickens.

5. Conclusion

Cage confinement of birds having higher heteophils and Lymphocyte (H:L ratio) which has been considered as a better indicator for stress factors to broilers in the environment. Although the two strains of broiler chickens responded similarly to both environments and the response in the floor litter environment was less pronounced than cage environment. Hence, an improvement in the floor litter

environment could enhance better improvement in the health status of the birds.

References

[1] Agricultural Research (1998). Giving broilers a firmer leg to stand on USDA-ARS. Poultry Production Product safety. Res. Unit University of Arkansas, Anes. 46 (5): 1-7.

[2] Nkwocha, G. A., Anukam, K. U and Nkwocha, U. I (2009). Growth response and carcass characteristics of broiler finisher chickens fed varying dietary levels of sun-dried animal plasma. *Proceeding of 14th of Animal Science Association of Nigeria* (ASAN)-Lautech. Pp 375-378.

[3] Magdelaine, P and Guibert, F (1997). Agriculturure 1994 SCEES-ITAVI Les cashiers 17-18. Pp 101.

[4] Bell, D. D (1995). A case study with laying hens. Product Animal behaviour and the design of livestock and poultry systems. *Int. Conf. Indiana. USA*. Pp. 307-319.

[5] Dhia, A (2007). Designing a trial house. In: Setting up on a small scale: how to design a broiler research unit. *Poultry International Magazine*. 46 (4). Pp 8.

[6] Ladokun, A. O., Yakubu, A., Olite, J. R., Omeje, J. N., Sokunbi, O. A and Onyeji, E (2008). Haematological and serum biochemical indices of naked neck and normally feathered Nigerian indigenous chicken in a sub- humid tropical environment. *Int. J. Poultry Science.* 7 (1): 55-58.

[7] Ojedapo, L. O., Adedeji, T. A., Odunsi, A. A., Ojebiyi, O. O., Olayeni, T. B and Aderinola, O. O (2006). Comparison of the haematological parameters of the three different strains of commercial broiler chickens at two different ages in the derived savanna zone. *Int. J. Apl. Agr. and Agr. Res*. IJAAAR. 3 (1): 10-16.

[8] Talebi, A., Assi-Reznei, S., Rozch-chai, R and Sahraei, R (2005). Comparative studies on haematological values of broiler strains (Ross, Cobb, Arbor-Acres and Arian). *Int. J. Poultry Science*. 4 (8): 573-579.

[9] Islam, M. S., Lucky, N. S., Islam, M. R., Ahadi, A., Das, B. R., Rahman, M. M and Siddini, M. S. I (2004). Haematological parameter of Fayoumi, Asil and local chickens reared in Sylhet region in Bangladesh. *Int. J. Poultry Science* 3: 144-147.

[10] Ameen, S. A, Adedeji, O. S., Akingbade, A. A, Olayeni, T. B, Ojedapo, L. O and Aderinola, O. A (2007). The effect of different feeding regimes on haematological parameters and immune status of commercial broilers in derived savanna zone of Nigeria. *Proceedings of the 32nd Annual Conference of Nigerian Society for Animal Production*- Calabar Pp 176-178.

[11] Hawkey, C., Hart, M. G., Samour, H. J., Knight, J. A and Hutton, R. E (1984). Heamatological findings in healthy and sick captive Rosy flamingoes (Phoenicopterus rubber). *Avian Pathology*. 13: 163-172.

[12] Amao, S. R (2009). Comparative studies of growth performance and blood parameters of four strains of broilers chickens under deep litter and cage systems M. Tech dissertation submitted to the department of Animal Production and Health- Lautech. Ogbomoso.

[13] BATC (2004). British American Tobacco Company Meterological site. Ogbomoso. Nigeria.

[14] Dacie, J. V and Lewis, S. M (1991). Practical Haematology 7th (ED) ELBS with Churchill livingstone. England Pp 37-85.

[15] Coles, E. H (1986). Veterinary Clinical Pathology. 4th (ED), W. B. Saunders. Philadelphia.

[16] Jain, N. C (2000). Schalm's Veterinary Haematology, 5th (Ed), Baltimore, Lippincott.

[17] Doumas, B. T (1975). Standards for total serum protein assay. *Clinical Chemistry.* 21: 1159.

[18] Doumas, B. T and Biggs H. G (1972). Determination of serum albumin. In standard methods of Clinical Chemistry Vol. 7 (Ed) Cooper. G. R. Academic Press, New York, Pp: 175.

[19] Allain, C. C., Poon, L. S., Chon, C. G. S, Richmond, W and Fu, P. C. (1974). Enzymatic determination of total serum cholesterol. *Clinical Chemistry*, 20: 470.

[20] Henry, R., Cannon, D. C and Winkelman, J. W (1974). Clinical Chemistry: Principle and Technics. Hagerstown, MD. Harper and Row. London. Pp. 543.

[21] Varley, H., Gowshock, A. H and Bell, M (1980). Determination of serum urea using the diacetyl monoxide method. Practical Clinical Biochemisty. 5th (Ed). William Heinemann Medical Books Ltd, London.

[22] Bergmeyer, H. U., Scheibe, P and Wahlefeld, A. W (1978). Optimization of methods for aspartate amino-transferase and alanine amino-transferase. *Clinical Chemistry*. 24: 58-73.

[23] Kaplan, A and Szabo, L. L. (1983). Clinical Chemistry: Interpretation and Techniques. 2nd (Ed). Lea and Ferbiger, Philadelphia. Pp 313-314.

[24] SAS (Statistical Analysis System). (2003) Version 10, SAS. Institute Inc. Carry N. C. USA.

[25] Zar, J. H (1999). Biostatistical analysis. 4th (Ed), New Jersey: Prentice Hall.

[26] Oguz, H., Kurtoglu, F., Kurtoglu, V., Birdane, Y. O (2002). Effect of clinoptilolite onserum biochemical and hematological characters of broiler chickens during the aflatoxicosis. *Research in Veterinary Science*. 73: 101-103.

[27] Maxwell, M. H., Hocking, P. M and Robertson, G. W (1992). Differential leucocyte responses to various degrees of food restriction in broilers, turkeys and ducks. *Br. Poultry Science.* 33: 177-187.

[28] Zulkifli, E., Dunnington, E. A., Gross, W. B and Siegel, P. B (1994). Food restriction early or later in life and its effects on adaptability, disease resistance and immunocompetence of heat stressed dwarf and non-dwarf chickens. *Br. Poult. Sci*. 35: 309-313.

[29] Mcfarlane, J. M and Curtis, S. E (1989). Multiple concurrent stressors in chicks. 3. Effects on plasma corticosterone and the heterophil: lymphocyte ratio. *Poultry Science*. 68: 522-527.

[30] Wang, W., Widerman Jr, R. F., Chapman, M. E., Bersi, T. K and Erf, G. F (2003). Effect of intravenous endotoxin on blood cell profile of broilers housed in cages and floor litter environments. *Poultry Science*. 82: 1886-1897.

[31] Awotwi, E. K. (1991). Haematological studies on three commercial layer strains of chickens in Ghana. *Bull. Anim. Hlth. Prod Afr*. 39: 231-236.

[32] Silva, P. R. L., Freitas Neto, O. C., Laurentiz, A. C., Junqueira, O. M and Fagliari, J. J (2007). Blood Serum components and serum protein test of Hybro- PG broilers of different ages. *Rev. Bras. Cienc. Avic.* Vol 9, No 4.

[33] Sogunle, O. M., Egbeyale, L. T., Bajomo, T. T., Bamigboje, O. V and Fanimo, A. O (2008). Comparison of the performance, carcass characteristics and haematological parameters of broilers chicks reared in cage and floor. *Pakistan Journal of Biological Sciences*. 11 (3): 480-483.

[34] Szabo, A., Mezes, M., Horn, P., Suto, Z., Bazar, G. and Romvari, R (2005). Developmental dynamics of some blood biochemical parameters in the growing turkey (*Meleagris gallopavo*)*, Acta Veterinary*. Hungary. 53 (4): 397-409.

[35] Rajman, M., Jurani, M., Lamosova, D., Macajova, M., Sedlackova, M., Kostal, L., Jesova, D. and Vybah, P (2006). The effects of feed restriction in plasma biochemisry in growing meat type chickens (*Gallus gallus*). *Comparative Biochemistry and Physiology.* 145: 363-371.

[36] Gyenis, J., Suto, Z., Romvari, R and Horn, P (2006). Tracking the development of serum biochemical parameters in two laying hen strains a comparative study. *Archieve. Tierzlander*. 49 (6): 593-606.