Nigerian J. Anim. Sci. 2018, 20 (1): 42-51

Characterization of the Nigerian local turkey based on blood markers and rectal temperature

[1]Nosike, R. J., *[2]Onunkwo, D.N., [1]Ezike, J.C., [1]Amaefule, R.A. [1]Amaraduruonye, W., [1]Nwakpu, O. F. [1]Obike, O.M. [1]Ibe, S.N. and [1]Oke, U.K.

[1]Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria .
[2]Department of Animal Nutrition and Forage science, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

[*]Corresponding author: ***donunkwo1@gmail.com***

Target audience: *Poultry farmers, animal breeders and animal physiologist.*

Abstract

Two hundred and ten (210) day-old F_1 progeny obtained from parental population of 78 random-bred Nigerian local turkeys (Black, White and Spotted/Lavender) were used for blood markers and rectal temperature to characterize Nigerian local turkeys. Blood markers, namely; packed cell volume (PCV), haemoglobin (Hb), white blood cell (WBC), red blood cell (RBC), total blood protein (TBP) and blood glucose (BGC) were determined and rectal temperature (RT) was measured. Rectal temperature (RT) was significantly different ($p<0.05$) at 9, 13, 17, 19 and 23 weeks of age (WOA) among the colour types. The PCV was significantly different ($p<0.05$) among the colour type at 7 and 11 WOA, with highest value in black and White at 7 WOA, and Black and Spotted at11 WOA, respectively. The Hb counts were significantly different ($p<0.05$) with highest value in black at 7 and 23 WOA and white at 7weeks old. The WBC was significantly ($p<0.05$) highest in spotted colour at 11, 13, 19 and 23 WOA. The RBC was significantly different ($p<0.05$) among the colour types at 7, 11 and 23 WOA with highest values in black at 7 and 23 week old, in spotted and white at week 11 and 7 WOA. However, BPT was significant difference ($p<0.05$) with highest values in spotted and white in week 7 and black at 23 week old. The BGC was significantly different ($p<0.05$) among the birds at 7, 11 and 23 weeks old, with highest values in black colour at 7 and 11WOA, and black and white colours at 23 WOA. Improvement for local turkey in Nigeria could be made using the markers RT, PCV, Hb, WBC and RBC for Marker-assisted selection. In view of the results obtained in this study, it is recommended that the black phenotype be selected by breeders to achieve improved production.

Keyword: *Nigerian, local turkey, colour type, blood markers, rectal temperature*

Description of problem

As the demand for animal protein in Nigeria increases, the need to improve animal protein production becomes necessary. Local turkey is becoming few in Nigeria, which are predominantly the black type raised extensively (1). Currently, total poultry population in Nigeria is estimated to be about 172 million poultry in Nigeria, the local chicken is estimated at 160 million, guinea fowl (8.3 million), ducks (1.7 million) and local turkeys (1.05 million) (2). Indigenous poultry species are hardy and generally adapt favourably to the local environment (3). The potential of local turkeys cannot be overlooked, considering the huge foreign exchange implication of the importation of improved exotic stock

(4). Indigenous birds are usually raised as scavengers in open yards, scratching and picking on the grounds (5). Village poultry production systems can be improved and transformed from subsistence to semi-commercial production systems to increase food security and family income especially among the rural populace and disadvantaged members of the community. Turkey (*Meleagris gallopavo*) is becoming popular in Nigeria due to its capacity to expand the poultry subsector and help to supply meat and eggs. In spite of all these attributes, local turkeys have poor growth performance, low egg production and low fertility (6).

Reports on haematological and serum biochemical parameters provide valuable information on the immune status of animals (7). Such information, apart from being useful for diagnostic and management purposes, could equally be incorporated into breeding programmes for the genetic improvement of local turkey. Selection of local breeds has been targeted more at adaptation to tropical harsh environments and resistance to diseases rather than enhanced production (8).

One plausible approach to genetic improvement of animals is selection of individuals based on the presence or absence of markers, which have definite association with quantitative trait loci (QTLs) such as for body weight gain and growth rate. This is the concept of marker-assisted selection (MAS), which is the process of using marker information in the selection of individuals to become parents for future generations. The Marker-assisted selection (MAS) technique is an important application of genetic engineering to animal breeding (9). The objective of the study was to characterize three colour types of the local turkey based on blood markers and rectal temperature.

Material and Methods

The study was conducted at the Poultry Unit of the Teaching and Research Farm of the Michael Okpara University of Agriculture, Umudike, Abia State. Umudike is located on latitude 05^0C 28′ North and 07^0C 32′East and lies at an altitude of 122m above sea level. This area is situated within the tropical rainforest zone of West Africa which is characterized by long duration of rainfall (April-October) and short period of dry season (November-March). Average rainfall is 2169.8mm in 148 – 155 rain days. Average ambient temperature is 26^0C with a range 22^0C and 30^0C. Its relative humidity ranges from 50 to 90%. These meterological data were obtained from the meteorological station at the National Root Crops Research Institute, Umudike, Abia State.

Management of experimental birds

The local turkey eggs were hatched weekly in batches. The numbers of progeny (F_1) poults produced were 86, 74 and 72 for Black, White and Spotted/ Lavender colour types respectively. The poults were properly identified on hatching. Distribution and number of poults hatched per batch is shown in Table 1.

Table 1: Distribution of local turkey poults hatched per colour types

		Hatch					
Mating	**Colour type**	**1**	**2**	**3**	**4**	**5**	**Colour type total**
Black x Black	Black	3	11	10	36	26	**86**
White x White	White	2	6	6	28	30	**72**
Spotted x Spotted	Spotted	2	7	8	26	31	**74**
Total hatch		**7**	**24**	**24**	**90**	**87**	**232**

210 day-old F_1 poults hatched in different batches were used in the study. The three phenotypic groups namely (Black, White and Spotted) local turkey contributed 70 straight-bred poults each for the study. They were brooded in three small metal cages for each hatch for a period of 2 weeks after which they were transferred to small compartments according to their colour type for a period of 4 weeks then to deep litter pens with dry wood shavings at 6 weeks old.

Routine management operations such as washing of the water and feed troughs were carried out on daily basis.

***Vaccination and medication*:** The birds were given routine vaccination as follows: New Castle Disease Vaccine (NDV) i/o at day old, 1st Gumboro at day 7, Lasota at 14th day, 2nd Gumboro at 21st day, Fowl pox at 56th day, 2nd dose NDV at 9th week and 3rd dose NDV during the period of the experiment. Prophylactic antibiotics and anticoccidial drugs were administered to the birds periodically via drinking water. The birds were also dewormed and and acaricide sprayed to check worms and ectoparasites.

The brooding period lasted for 6 weeks.

Feeding: Feed was provided in adequate quantity to the poults twice a day, namely 8.30am and 2.30pm.

Poults (0-6 weeks) was fed *ad libitum* with starter mash containing 28% Crude protein and 2800kcal ME/kg.

Growing turkeys (7-24 weeks) were fed growers mash (20% Crude protein and 3000 kcal ME/kg).

Rearing was between 7 and 24 weeks.

Data collection

Biologic markers: A total of 72 seven weeks old poults of different colour types (black, white and spotted) comprising 24 per colour type were selected and used for Blood markers and rectal temperature.

Collection of blood samples

Blood samples (2ml) were collected aseptically with sterile syringe and needle from the wing vein of the different colour types of poult into labeled test tubes, containing anti-coagulant (heparin) and another test tube with no anti-coagulant for determination of biochemical markers. It was done immediately after the skin had been damped with alcohol to disinfect the area and expose the vein. Determination of markers was done bi-weekly for 20 weeks.

Determination of blood markers

The following blood markers were determined:

Packed cell volume (PCV) was determined by the micro haematocrit method by (10). Haemoglobin (Hb) was determined using the cyanomethaemoglobin method as described by (11). White blood Cell (WBC) was determined using a microscope with improved Neubauer haemacytometer as described by (11). Red Blood Cell (RBC) was determined using a

microscope with improved Neubauer haemacytometer as described by (11). The total plasma protein was measured by using the standard Biuret method as described by (12). Blood glucose (BGC) determination was by the process described by (13). The rectal temperature of the turkeys was measured via the rectum using a digital thermometer (0.1^0C) inserted into the rectum of the birds for a minute as previously described by (14).

Experimental design

The experiment was designed as randomized completely randomized design (CRD), with phenotypic class as factor of interest. The statistical model is given below.

$Y_{ijk} = \mu + C_j + e_{ijk}$

Where

Y_{ijk}= k^{th} observation in the j^{th} colour type and in the j^{th} colour type, μ = Overall mean, C_j = effect of j^{th} colour type (j=1, …, 3), e_{ijk} = Random error, assumed to be independently, identically and normally distributed with zero mean and constant variance [iind $(0,\sigma^2)$].

Statistical analysis

Data obtained were statistically analyzed with (15). Analysis of variance (ANOVA) procedure appropriate for CRD was used to analyse the data on biologic markers. Duncan's Multiple Range Test (16) was used to compare means of biologic markers of the three colour types of local turkey.

Results and Discussion

Effect of colour type on rectal temperature of F_1 local turkeys

Rectal temperature: Mean rectal temperatures of the three colour types of local Turkey are presented in Table 2.

The rectal temperature (RT) was significantly different ($p<0.05$) in weeks 9, 13, 17, 19 and 23, with the black colour having highest RT values. There were no significant differences ($p>0.05$) in RT of the turkeys in weeks 7, 11, 15 and 21. The RT obtained in this study was higher than the values (37–38^0C) reported for domestic birds (17). This may be due to breed difference.

Table 2: Mean rectal temperature (^{0}C) from week 7-23 of the various colour types of local Turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	40.76±0.28	40.24±0.18	39.60±0.33
9	40.92±0.22 [a]	40.10± 0.40 [b]	39.68 ± 0.28 [b]
11	41.24 ±0.45	40.24±0.27	40.20±0.24
13	41.26±0.28 [a]	40.52±0.21[ab]	40.00±0.11[b]
15	41.04±0.40	40.30±0.17	40.07±0.08
17	40.68±0.23 [a]	40.52±0.23 [a]	40.06±0.15 [b]
19	41.00±0.18 [a]	40.02±0.09 [b]	40.34±0.19 [b]
21	41.48±0.25	40.58±0.30	40.18±0.23
23	41.12±0.50 [a]	38.02±0.43 [b]	40.56±0.37 [b]

*[a-c] Means in the same row with different superscripts are significantly different ($p<0.05$). *S.E= Standard error of Means*

Effect of colour type on blood markers of F_1 local turkeys

Packed cell volume

Mean packed cell volume (PCV) of the various colour types of local turkey is given in Table 3.

The PCV was significantly different ($p<0.05$) among the colour types in weeks 7 and 11, with highest value in black and white in week 7, and black and spotted colour type in week 11, respectively. PCV values are dependent on the physiological and nutritional status of animals (18), and therefore are beneficial in assessing the protein status and possible prediction of the degree of protein supplementation to animals at different physiological condition. However, PCV did not differ significantly ($p>0.05$) for all other weeks among the colour types. The values of PCV in this study are within the normal range (22 – 35%) reported by (19) and 31.8 – 40.2% by (20). Also there is a trend of increase in the values of PCV with age. This is in agreement with the assertion that PCV increases with age (19).

Table 3: Mean packed cell volume (%) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	27.58±1.74 [a]	27.66 ±1.69 [a]	26.48±1.68 [b]
9	30.72±1.93	27.76±1.46	28.20±1.79
11	30.54±2.43 [a]	29.56±1.53 [b]	30.20±2.25 [a]
13	27.02±3.22	25.68±2.10	29.28±2.97
15	33.08±2.92	31.28±3.16	31.50±3.28
17	33.64±2.38	32.97±2.73	33.35±2.69
19	39.84±1.77	36.92±1.05	35.58±1.36
21	36.00±3.65	33.28±3.28	34.28±3.84
23	32.90±1.30	29.40±1.38	30.84±0.47

[a-b] Means in the same row with different superscripts are significantly different ($p<0.05$)
**S.E= Standard error of Means*

Haemoglobin concentration: Mean haemoglobin concentrations (Hb) of the various colour types of local turkey are presented in Table 4.

The Hb counts were significantly different ($p<0.05$) among the colour types in weeks 7 and 23, with highest value in black and white in week 7, and black phenotype in week 23. The appreciable amount of Hb in black turkeys indicates high efficiency of oxygen transportation, cellular metabolism and tissue respiration (21). There were no significant differences ($p>0.05$) among the colour types in other weeks. The haemoglobin concentration in this study ranged from 8.54±0.83 to 13.16±0.72g/dL, 8.50±0.71 to 12.14±0.48g/dL, and 8.66±0.64 to 11.88±0.35g/dL for black, white and spotted colours respectively. The values of Hb in this study are within the normal range, 8.44 – 12.10g/dLreported by (22) and within the range 7 - 13 g/dL by (19) for turkeys.

White blood cells: Mean white blood cell counts **(**WBC) of the various colour types are presented in Table 5. The WBC was significantly different ($p<0.05$) among the phenotypes in weeks 11, 13, 19 and 23, with highest values obtained in spotted colour. WBC was not significantly ($p>0.05$) different in other weeks among

the phenotypes. The WBC values in this study ranged from 1.41 to 9.54/Lx10^9, 1.84to 8.33/Lx10^9, and 1.25to 8.48/Lx10^9 for black, white and spotted colours respectively. An increase in WBC counts suggests a severe microbial infection. This response is a defensive mechanism against infection. The range of the WBC obtained in this study was higher than that (16.163 – 19.165 x 10^3) reported by (20) for turkeys. Higher count of WBC in the spotted colour may indicate disease presence, protective mechanism, and provision of rapid and potent defense against infectious agents. However, the high percentages of WBC may be associated with the ability of spotted colour to perform well under very stressful conditions (23).

Table 4: Mean haemoglobin concentration (g/dL) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	9.10±0.59 [a]	9.10±0.55 [a]	8.66±0.64 [b]
9	9.64±0.52	9.13±0.46	9.22±0.61
11	9.68 ±0.71	9.48±0.46	9.88±0.79
13	8.54±0.83	8.50±0.71	9.82±1.11
15	11.14±1.27	9.46±1.03	10.74±1.23
17	11.52±0.95	10.72±0.90	11.42±0.92
19	13.16±0.72	12.14±0.48	11.88±0.35
21	11.80±1.24	10.92±1.01	11.60±1.29
23	12.15±0.85 [a]	10.27±0.49 [b]	9.92 ±0.12 [b]

[a-b] Means in the same row with different superscripts are significantly different (p<0.05).
**S.E= Standard error of Means*

Table 5: Mean white blood cell counts (WBC/Lx10^9) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	1.62 ±0.16	2.16 ±0.31	1.41±0.24
9	1.61±0.31	2.63±0.55	1.71±0.21
11	1.85±0.07 [b]	1.84±0.14 [b]	1.93±0.07 [a]
13	1.41±0.19 [b]	2.44±0.60 [a]	1.25±0.18[ab]
15	5.40±1.01	4.78±1.07	5.06±0.89
17	6.07±1.15	5.12±1.06	5.63±0.95
19	1.98±0.05 [b]	3.23±0.68 [b]	4.78±0.44 [a]
21	9.54±1.62	8.33±1.57	8.48±1.67
23	1.97±0.23 [b]	2.03±0.40 [b]	3.40±0.50 [a]

[a-b] Means in the same row with different superscripts are significantly different (p<0.05).
**S.E= Standard error of Means*

Red blood cell count: Mean Red blood cell counts **(**RBC) of the various colour types are as shown in Table 6. The RBC was significantly different (p<0.05) among the colour types in weeks 7, 11 and 23 with highest values in black and white turkeys in week 7, and spotted in week 11and black colour types in week 23.

Table 6: Mean red blood cell counts (RBC/Lx10^{12}) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	1.95±0.15[a]	1.96±0.22[a]	1.92±0.08[b]
9	2.20±0.23	2.64±0.61	2.25±0.37
11	2.57±0.19[b]	2.04±0.06[b]	5.18±0.50[a]
13	3.40±0.37	2.49±0.27	1.98±0.21
15	2.65±0.21	2.34±0.24	2.41±0.23
17	3.06±0.21	2.81±0.13	2.78±0.17
19	2.65±0.16	2.22±0.25	2.35±0.18
21	2.90±0.26	2.62±0.26	2.88±0.24
23	3.19±0.17[a]	2.39±0.22[b]	1.97 ±0.10[b]

[a-b] Means in the same row with different superscripts are significantly different (p<0.05).
**S.E= Standard error of Means.*

RBC was not significantly (p>0.05) different in other weeks among the colour types. Red blood cell counts are very important in the transport of oxygen from the lungs to the tissues and carbon (iv) oxide from tissues to the lungs for excretion. RBC is highly dependent upon glucose as its energy source (24). However, the values of RBC were higher than the normal range (1.85–2.37 x 10^6/dL) reported by (25) for turkeys. The increased level of erythrocyte in spotted turkey in week 11 and in black turkey in week 23 may be attributed to reduction in energy in such periods (26), which linked up with the high WBC indicating stressful periods.

Blood protein: The mean blood protein (BPT) of various colour types is given in Table 7. There were no significant differences (p>0.05) between the colour types in mean values of blood protein in weeks 9, 11, 13, 15, 17, 19 and 21. However, BPT showed significant difference (p<0.05) in weeks 7 and 23 with spotted and black colour types. The significant difference could be attributable to variation in temperature. The values of blood protein (3.92 – 6.27g/dL) in this study were higher than the normal range (4.0 – 4.6 mg/dL) reported by (20). The increased concentrations of total protein may be explained by the very quick somatic growth that could occur in growing turkey.

Table 7: Mean blood protein (g/dL) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	3.92±0.22[b]	4.35±0.50[a]	4.20 ±0.23[a]
9	4.07±0.29	4.16±0.34	4.38±0.39
11	4.78±0.31	4.07±0.22	4.17±0.25
13	5.46±0.21	4.70±0.41	4.66±0.29
15	4.67±0.29	4.97±0.43	5.86±0.30
17	4.94±0.36	5.53±0.47	6.27±0.35
19	5.62±0.42	4.64±0.72	4.35±0.22
21	4.51±0.42	4.64±0.27	3.99±0.05
23	5.04±0.06[a]	4.24±0.11[b]	4.05±0.06[b]

*[a-b] Means in the same row with different superscripts are significantly different (p<0.05). *S.E= Standard error of Means*

Blood glucose: Mean of blood glucose (BGC) of various colour types is given in Table 8.

The BGC was significantly different ($p<0.05$) among the colour types in weeks 7, 11 and 23, with highest values in black phenotype in weeks 7 and 11, and black and white colour types in week 23. BGC was not significantly ($p>0.05$) different in other weeks among the colour types. The BGC values in this study ranged from 4.51 to 11.89g/100ml, 4.64 to 10.55g/100ml, and 3.99 to 11.36g/100ml for black, white and spotted colour types, respectively. These values, however, were lower than the normal range 168.56 – 179.44g/ml reported for turkeys (27).

The differences in BGC may be due to the carbohydrate utilization of the feed given to the birds. This is supported by (24) who stated that dietary carbohydrates influence blood glucose.

Table 8: Mean blood glucose (g/100ml) from week 7-23 of the various colour types of local turkey

	Colour types		
Age (weeks)	**Black**	**White**	**Spotted**
7	10.41±0.44 [a]	9.32±1.00 [b]	8.67±0.98 [c]
9	9.46±1.32	9.22±1.01	9.01±1.18
11	9.17±0.85 [a]	8.52±0.72 [b]	9.57±0.57 [a]
13	8.70±0.69	9.29±0.27	9.21±0.36
15	10.46±0.92	10.19±0.30	10.18±1.02
17	10.91±0.85	10.55±0.38	11.17±0.72
19	10.87±0.31	11.14±0.36	11.36±0.41
21	4.51±0.42	4.64±0.27	3.99±0.05
23	11.89±0.22 [a]	10.25±0.37 [a]	7.60±0.96 [b]

*[a-c] Means in the same row with different superscripts are significantly different ($p<0.05$). *S.E= Standard error of Mean*

Conclusion and Applications

1. High values of Hb in black turkeys indicate high efficiency of oxygen transportation, cellular metabolism and tissue respiration.
2. The characteristic performance of the Nigerian local turkey studied reveals certain qualities of blood markers that can be tapped in strategic improvement programme of the poultry industry.
3. Long-term genetic improve-ment programme for turkey production in Nigeria using the marker bank for Marker-assisted selection could be designed.
4. Based on present study, black colour should be selected by breeders to achieve improved produc-tion, using the markers RT, PCV, HB, WBC and RBC.

References

1. Oluyemi, J.A. and Roberts, F. A. (2000). *Poultry production in warm wet climate*, Rev. ed. Ibadan, Nigeria; Spectrum Book Ltd.
2. FAOSTAT (2011). Food and Agricultural Organization of the United Nations **http:// faostat. fao. org/default.aspx. Accessed July 19**, 2011.
3. Ikeobi, C. O. N. (2003). *Family Poultry Production.* An invited paper presented at the World Food Day /

Open Day Celebration of the World Poultry Science Association, Nigeria Branch held at the University of Agriculture, Abeokuta on October 16, 2003.

4. Ibe, S.N. (1990). Utilising local poultry gene resources in Nigeria. *Proceedings of the 4th World Congress on Genetics Applied to Livestock Production,* 14:51-53.
5. Ravi-Kumar, M., Bothra, T. and Ashok, K. (2002). Backyard poultry for socio-nutritional security of rural and tribal masses. *Poult. Planner* 4:10-11.
6. Zahrudden, O., Ahemen, T. and Aliyu, P.I. (2011). Breeding characteristics of turkeys (*Meleagris gallapavo*) in parts of Jos Plateau. *Proc. 36th Confr. Nig. Soc. Anim. Prod.* 13-16th March, 2011. Univ. of Abuja, Nig. Pp 29-32.
7. Král, I. and Suchý, P. (2000). Haematological studies in adolescent breeding cocks. *Acta Vet Brno*69: 189-194.
8. Minga, U., Msoffe, P.L. and Gwakisa, P.S. (2004). Biodiversity (variation) in disease resistance in pathogens within rural chicken: *CD proceedings, World Poultry Congress, Istanbul.*
9. Montaldo, H.H. (2006). Genetic engineering applica-tions in animal breeding. PontificiaUniversidedCatólica de Valparaiso-Chile. *Electronic Journ. of Biotechnology. http://www.ejbiotechnology.info/content/vol9/issue2/full/4/index.html.*
10. Dacie, J.V. and Lewis (1999*): Practical haematology* (7th Ed) ELBS with Churchill Livingstone, England.
11. Jain, C.N. (1986). *Shalms?? Veterinary haematology* 4th ed. Lea and Feabriger, Philadephia.
12. Lawrence, M. S.(1986). *Amino acids and proteins*. *In: Textbook of Clinical Chemistry.* Tiezt, N. W. *(editor).* W. B. Saunders Company, US. Pp. 519-618.
13. Barker, F.J. and Silverton, R.E. (1976). *Introduction to medical laboratory techno-logy*, 5th Edition. Butterworth and Co. Publishers Ltd, London. Pp. 540-621.
14. Yahav, S. and McMurty, J. P. (2001). Thermotolerance acquisition in broiler chickens by temperature conditioning early in life- the effect of timing and ambient temperature. *Poultry Science,* 80: 1662-1666.
15. SPSS (2011). Statistical Package for Social Sciences. SPSS Inc. (16.0), 444 Michigan Avenue, Chicago.
16. Duncan, D.B. (1955). *Multiple Range and Multiple F-tests. Biometrics* 11: 1-42.
17. Boleli, I.C., (2003). Estresse, mortalidade e malformaçãoembrionária In: M. Macari e E. Gonzáles. *Manejo da Incubação, FACTA*. p537.
18. 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.
19. Bounous, D.I. and Stedman. N.L. (2000). *Normal avian haematology in chicken and turkey*. In: Fieldman, B. F., Zinkl, J.G. and Jain, N.C. (Eds). Schalm's Veterinary Haematology. Lippincott, Williams and Wilikins, Philadephia.

20. Quist, D.F., Bounous, D.I., Kilburn, V.J., Nettles, V.F. and Wyatt, R.D. (2000). The effect of dietary afflatoxin on wild turkey poults. *Journal of wildlife Diseases* 36 (3): 436-444.
21. Solomon, M. B., Campbell, R. G. Steele, N. C. and Caperna, T. J. (1991). Effects of exogenous porcine somatotropin administration between 30 and 60 kilograms on longissimus muscle-fiber morphology and meat tenderness of pigs grown to 90 kilograms. Journal of Animal Science 69:641–645.
22. Oyewale, J.O. and Ajibade, H.A. (1990). Osmotic fragility of erythrocytes of the white Pekin duck. *Veterinary Archive* 60: 91-100.
23. Mitruka, B.M. and Rawnsley, H.M. (1997). *Clinical Biochemisty and Haematological Reference values in Normal experimental Animal*. Masson Publishing Company, New York, Pp. 35-55.
24. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (1993). *Harper's Biochemisty* (23rd ed). Prentice Hall International Inc. Pp 28-30.
25. Olayemi, F.O., Alaka, O.O. and Sanni, A.A. (2002). Effects of infectious coryza disease in growing turkeys on some erythrocyte parameters. *African Journal of Biomedical Research* 5:83-86.
26. Ayanwale, B.A. (2005). The effect of thiamin and pyridoxine deficiencies on haematological values and some enzymatic activities in broiler chickens. *Journal of Sustainable Tropical Agriculture Research* 15: 100-103.
27. Isidahomen, C.E., Njidda, A.A. and Amaza, I.B. (2013). Effect of genotype on haematology and serum chemistry values of turkeys (*Meleagris gallapavo*) reared in Southern Nigeria. *International Journal of Agricultural Bioscience* 2 (5): 297-301.