International Journal of
AGRICULTURE AND BIOSCIENCES
www.ijagbio.com P-ISSN: 2305-6622 E-ISSN: 2306-3599 editor@ijagbio.com

RESEARCH ARTICLE

# Effect of Genotype on Haematology and Serum Biochemistry Values of Turkeys (*Meleagris gallopavo*) Reared in Southern Nigeria

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**ARTICLE INFO**

Received: August 18, 2013
Revised: September 19, 2013
Accepted: October 12, 2013

**Key words:**
Biochemistry
Birds
Erythrocyte indices
Genotype
Haematological profile
Strain

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**ABSTRACT**

The present study was conducted to evaluate haematological profile and serum biochemistry in different genotype of Turkey. The study was carried out using 30 birds in each genotype of turkey. All the turkey birds were reared in pens under uniform standard management conditions. The mean values for RBC (x $10^6$/µl) differed significantly (P<0.05) between different genotypes of the bird. Mean values for hemoglobin (g/dl) differed significantly (P<0.05) between different genotype of poultry. In turkey, highest hemoglobin was recorded in local (15.09 g/dl), followed by Exotic (14.31g/dl and least in crossbred (12.42 g/dl). The mean values for PCV (%) were significantly (P<0.05) different with highest in exotic (36.00) followed by crossbred (33.01) and least in local turkey (32.62). Mean values for MCV (fl) were significantly (P<0.05) highest in crossbred (160.23) followed by exotic (156.24) and least in local (146.71). The mean values for MCH (pg) were significantly (P<0.05) highest in exotic (73.83), followed by local (69.33) and least in crossbred (59.47). The mean value of MCHC (g/dl) were significantly (P<0.01) highest in exotic (48.13) followed by local (47.05) crossbred (41.51). There was significant (P<0.05) differences between the genotypes in the total protein, albumin, globulin, cholesterol, urea, sodium(Na+) , potassium (K+), calcium and phosphorus of the genetic groups. The crossbred and exotic genotype however, had the highest significant albumin (1.43 and 1.41 ml) and lower globulin values (3.87 ml) were observed in the crossbred compared to the other turkey genotypes. Variation in these results may be due to difference in breeds. It is concluded that significant differences in haematological value and erythrocyte indices and serum biochemistry among different genotype of turkey could be considered as a references values and this may serve as a guide to assess the state of health in the monitored birds.

**Cite This Article as:** Isidahomen CE, AA Njidda and IB Amaza, 2013. Effect of genotype on haematology and serum biochemistry values of Turkeys (*Meleagris gallopavo*) reared in Southern Nigeria. Inter J Agri Biosci, 2(5): 297-301. www.ijagbio.com

## INTRODUCTION

Turkeys (*Meleagris gallopavo*) are reared all over the world for their tasty and high quality meat (Prabakaran. 2003). It originates from North America and has been introduced nearly worldwide including Nigeria. The massive production of these poultry species is increasing in many countries as an important source of animal protein due to its comparatively high percentage of protein and low percentage of fat (Nixey and Grey, 1985). Though the turkey posses the ability to acclimatize in various types of climate, are very much sensitive to sudden climatic changes during the early life. Physiological tolerance of organisms is strong determinant of the environmental conditions in which they inhabit. At certain range of environmental temperature the organisms maintain a normal body temperature with least involvement of thermoregulatory mechanism. This range of ambient temperature is called a zone of thermo-neutrality. The environmental temperature beyond the upper and lower limit of thermo-neutral zone is supposed to produce heat or cold stress in animals. Physiological stress that originates from adverse climatic condition may have profound effect on reproductive or productive

efficiency including health and disease resistant capacity. Adverse climatic conditions may occur as random events or as unusual changes. Exposure of poultry to extreme temperature stressor modulates the immune responsiveness and haemato-biochemical parameters of birds (Hangalapura *et al.,* 2004). As Turkey birds mostly thrive in tropical climate, this study is aimed at assessing the impact of environment on biochemical and hematological parameters in turkeys in order to evaluate their efficiency of survival under these climatic conditions.

## MATERIALS AND METHODS

### Study area

The research was carried out at the Poultry Unit of the Livestock Teaching and Research Farm of Ambrose Alli University Ekpoma, Edo State. The farm lies between Lat 6.44$^{o}$N and Log 6.8$^{o}$E in Esan West Local Government Area of Edo State, Nigeria. Ekpoma is within the South-South geo-political zone of Nigeria and has a prevailing tropical climate with a mean annual rainfall of about 1556 mm. The mean ambient temperature ranges from 26$^{0}$C in December to 34$^{0}$C in February, relative humidity ranges from 61% in January to 92% in August with yearly average of about 82%. The vegetation represents an interface between the tropical rainforest and the derived savanna.

### Feeding and Management of the birds

A total of 90 hens were used for this study. These consisted of 30 birds each of Exotic, crossbred and local turkey genotypes. The birds were fed *ad libitum* with starter marsh containing 20% crude protein, 2996Kcal/kg Metabolizable Energy from Dayold-4weeks of age, Growers marsh containing 15.86% crude protein, 2716Kcal/kg Metabolizable Energy was fed from 4-15weeks of age. Breeder's marsh containing 16.80% crude protein, 2823Kcal/kg metabolizable energy was fed from 15-28 weeks of age. Clean water was supplied *ad libitum* throughout the experimental period. All turkeys were wing tagged for proper identification and subjected to the same management practice throughout the experimental period. Medication and vaccinations were carried out accordingly against stress and disease.

### Blood sample collection

Blood sample was collected before and after the end of the experiment. The birds were fasted over night and blood was collected from the Jugular veins. Specimen for haematological studies were collected separately in a bottle containing dipotassium salts of ethylene diamine tetra-acetic acid (EDTA) as anticoagulant while, anticoagulant free tubes were used for collecting blood samples for biochemical analyses. The blood samples were analyzed using routinely available clinical methods. These include packed cell volume (PCV) or haematocrit, red blood cell (RBC) count and white blood cell (WBC) count and haemoglobin concentration (Hb), using Witrob's micro-haematocrit, improved Neubaur haemocytometer and cyanomethaemoglobin methods, respectively. The erythrocyte indices, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCHC) were computed according to Jain (1986). Serum protein, albumen, globulin and urea were analyzed using sigma assay kits, while glucose and creatinine were determined according to Slot (1965), uric acid according to Henry *et al.* (1957) and cholesterol according to Roschlan *et al.* (1974).

Blood sample were collected from the jugular veins using sterile disposable needles (21-guage) and syringes. Before the blood collection, the birds were fasted over night for 12 h and samples were collected the following morning to avoid excessive bleeding. Samples for biochemical indices analysis were collected into anti-coagulant free tubes and allowed to clot. Serum was obtained after the blood samples had been allowed to stand for two hours at room temperature and centrifuged for ten minutes at 2000.rpm to separate the cell from the serum.

### Experimental design and statistical analysis

All data obtained were subjected to analysis of variance using the General Linear Model of SAS (1999). Duncan's Multiple Range Test was used to separate the means that are significantly difference (Gomez and Gomez, 1984).

## RESULTS

The result of the haematological indices is presented in Table1.There was significant difference ($P<0.05$) among genotypes in the mean values for the white blood cell count (WBC) which ranged from 6.88×103/ µ in crossbred to 9.32×103/µ in Local turkey. The results of the hematological values for the packed cell volume (PCV) was significantly different ($P<0.05$) between breeds with Exotic turkey having the highest (36.00%) volume. The heaemolobin (Hb) values ranged from (12.42 to 15.05 g/ dl) with Local turkey having the highest value (15.09g/ dl). The highest value of 2.21g/ dl was observed in Local turkey for red blood cell count (RBC) while crossbred had the least ($2.01\times10^{6}$/µ). MCH values ranged from 59.47crossbred to 73.83pg in Exotic turkey. Exotic and local was observed to have the highest mean corpuscular haemoglobin concentration (MCHC) and crossbred had the least mean value.

The result of the serum biochemistry indices for turkeys is shown in Table 2. Generally all parameters observed showed significant difference ($P<0.05$) between breeds and sexes. The value for serum sodium ranged from 153.34 in Exotic to 159.44 m/dl in Crossbred turkey. The values for serum potassium were highest in Crossbred (2.25 mmol/l). Urea shows higher values (7.45mmol/l) for Exotic than other breeds. Glucose ranged from 174 to 207.11 ml for all the breeds. Total protein (5.91ml) was higher in Exotic turkeys while the least in Crossbred (5.12ml). The globulin was also higher in Exotic (5.08 ml). All the serum biochemical parameters observed in this study showed significant difference ($P<0.05$) for all the breeds.

The result of the haematological values as affected by sex are presented in Table 3.There were significant difference ($P<0.05$) among sex in the mean values for the white blood cell count (WBC) values which ranged from 8.01 in male to 7.76×103/µ in female turkey. The results of the hematological values for the packed cell volume

**Table 1:** Least squares means and standard errors of mean for haematologcal parameters as affected by Genotype

| Parameters | Local | Crossbred | Exotic |
|---|---|---|---|
| White blood cell (×103/µ) | 9.32±0.17[a] | 6.88±0.07[c] | 7.68±0.09[b] |
| Red blood cell(×10$^6$/µ) | 2.21±0.06[a] | 2.01±0.00[b] | 2.06±0.01[b] |
| Hemoglobin (g/dl) | 15.09±0.32[a] | 12.42±0.22[c] | 14.31±0.02[b] |
| Packed cell volume (%) | 32.62±1.03[b] | 33.01±0.33[b] | 36.00±0.93[a] |
| Mean Corpuscular Volume(fl) | 146.71±1.38[c] | 160.23±0.83[a] | 156.24±0.49[b] |
| Mean Corpuscular Hemoglobin(pg) | 69.33±3.07[b] | 59.47±1.62[c] | 73.83±0.74[a] |
| Mean Corpuscular Hemoglobin Concentration (g/dl) | 47.05±2.23[a] | 41.51±0.92[b] | 48.13±1.30[a] |

WBC= white blood cell; Hb = Haemoglobin; PCV= pack cell volume; RBC = red blood cells; MCHC = mean corpuscular haemoglobin concentration; MHC = mean haemoglobin concentration; a, b, c, d; Means in the same row with different superscripts are significantly different (P<0.05).

**Table 2:** Least Squares Means and standard errors of mean for serum biochemical parameters as affected by Genotype

| Parameters | Local | Crossbred | Exotic |
|---|---|---|---|
| Total protein(ml) | 5.60±0.20[b] | 5.12±0.17[c] | 5.91±0.12[a] |
| Albumin (g/dl) | 1.10±0.08[b] | 1.43±0.05[a] | 1.41±0.03[a] |
| Globulin(g/dl) | 4.44±0.25[b] | 3.87±0.15[c] | 5.08±0.05[a] |
| Glucose (ml) | 174.00±5.44[b] | 207.11±4.66[a] | 206.63±3.95[a] |
| Urea(mg/dl) | 5.86±0.23[b] | 7.31±0.24[a] | 7.45±0.12[a] |
| Potassium (mmol/L) | 1.96±0.86[b] | 2.25±0.02[a] | 2.18±0.04[a] |
| Calcium(mg/dl) | 8.53±0.13[b] | 8.88±0.12[a] | 8.74±0.17[ab] |
| Phosphorus(m/dl) | 3.31±0.21[b] | 5.09±0.20[a] | 4.98±0.26[a] |
| Sodium(m/dl) | 153.69±0.48$_a$ | 159.44±5.70[a] | 153.34±0.20[a] |

a, b ,c ,d; Means in the same row with different superscripts are significantly different (P<0.05)

**Table 3:** Least squares means and standard errors of mean for haematological parameters as affected by sex

| Parameters | Male | Female |
|---|---|---|
| White blood cell (×103/µ) | 8.01±0.22[a] | 7.76±0.22[b] |
| Red blood cell(×10$^6$/µ) | 2.04±0.00[b] | 2.18±0.05[a] |
| Hemoglobin (g/dl) | 14.20±0.28[a] | 13.34±0.27[b] |
| Packed cell volume (%) | 32.75±0.46[b] | 35.63±0.59[a] |
| Mean Corpuscular Volume(fl) | 154.05±1.42[a] | 155.57±1.14[a] |
| Mean Corpuscular Hemoglobin(pg) | 71.01±1.56[a] | 61.03±2.18[b] |
| Mean Corpuscular Hemoglobin Concentration (g/dl) | 47.91±1.23[a] | 41.31±1.03[b] |

WBC= white blood cell; Hb = Haemoglobin; PCV= pack cell volume; RBC = red blood cells; MCHC = mean corpuscular haemoglobin concentration; MHC = mean haemoglobin concentration; a, b ,c ,d; Means in the same row with different superscripts are significantly different (p<0.05); a, b: Means in the same row with different superscripts are significantly different (P<0.05).

**Table 4:** Least squares means and standard errors of mean for serum biochemical parameters as affected by sex

| Parameters | Male | Female |
|---|---|---|
| Total protein(ml) | 5.66±0.14[a] | 5.31±0.14[b] |
| Albumin(ml) | 1.19±0.05[b] | 1.52±0.03[a] |
| Globulin | 4.56±0.15[a] | 4.23±0.18[b] |
| Glucose(ml) | 189.84±4.80[b] | 207.00±5.16[a] |
| Urea(ml) | 6.43±0.19[b] | 7.64±0.15[a] |
| Potassium | 2.03±0.04[b] | 2.31±0.03[a] |
| Calcium(mg/dl) | 8.44±0.07[b] | 9.20±0.12[a] |
| Phosphorus(mg/dl) | 4.27±0.22[b] | 4.83±0.26[a] |
| Sodium (mg/dl) | 153.81±0.22[b] | 158.68±05.47[a] |

(PCV) was significantly different (P<0.05) between sex with female turkey having the lowest (32.75%) volume. The heaemolobin (Hb) values ranged from (13.34 to 14.20 g/ dl with Female turkey having the highest value (14.20g/ dl). The highest value of 2.18g/dl was observed in Female turkey for red blood cell court (RBC) while Male had the least (2.04g/ dl) MCH values ranged from 71.01 in Male to 61.03pg in Female turkey. Male turkey was observed to have the highest mean corpuscular haemoglobin concentration (MCHC) and Female had the least mean value.

The result of the biochemical indices is found in table 4. All the serum biochemical parameters observed in this study showed significant difference (P<0.05) for the sexes. The values for serum sodium ranged from 15.8.68 in female to 153.81 m/dl in male turkey. The values for serum potassium and urea followed similar trend with the highest value of (2.31mmo/l and 7.64mmo/ l) recorded for serum potassium and urea in female turkey respectively. Glucose value recorded ranged from 207.11 to 184.84 ml for both sex. The value for total protein (5.66 ml) and globulin (4.56ml) recorded for male turkey was higher than the values of (5.31ml) and (4.23ml) for female turkey.

## DISCUSSION

The total White Blood Cell (WBC) count was lower in this study than values obtained for turkey (Bolu *et al*., 2011). The lower values obtained in this study suggest well develop immune system of all the breeds of turkeys. The lower values of the WBC observed may also be attributed to environmental challenges which the birds are exposed to. However, the values obtained in this study fell within the range recorded for turkeys. The result also reveals a significant effect on breed which indicates that the breed has effect on the health status of these turkey breeds. However, the local strain had significantly (P<0.05) higher WBC (9.32Vs6.88×103/ µ) and did not agrees with the reports of Ladokun *et al*. (2008) but was within range (Anon 1980). Packed cell volume (PCV) in this study was higher than 30.66±0.91% obtained for Indian turkeys (Pandian *et al.,* 2012). Earlier reports in mature turkey (Mayr and Gomathy. 2008) and Indian turkey (Pandian *et al.,* 2012) showed PCV values of 39.77 ± 0.46 and 30.66 ± 0.91, respectively. The findings of this study support that PCV varies among breeds of turkeys. Increase in PCV values in this study may be attributed to increase in environmental temperature (Ovais and Mahapatra, 2013). High PCV haematocrit values indicate either an increase in the number of circulating RBC or reduction in circulating plasma volume (Campbell, 1995). Haematological traits especially PCV and Hb were correlated with nutritional status of the animal (Jain, 1986). However, the primary functions of the erythrocyte are to serve as a carrier of haemoglobin. The higher PCV values observed in this study might likely be a sign of healthier turkeys. There were significant difference (P≤0.05) among strain in the mean values for red blood

cells counts, hemoglobin concentration, Packed, Mean Corpuscular Volume, Mean Corpuscular Hemoglobin and Mean Corpuscular Hemoglobin Concentration. The mean values obtained falls within the normal physiological range reported by (Ikhimioya *et al*, 2000; Islem *et al*., 2004; Simarak *et al.,* 2004). The higher HB and RBC values obtained in the local strain are not in agreement with the findings of EL-safty *et al.* (2006) who reported the superiority of the naked neck genes in PCV compared to that of the fully feathered genotype. This could be a boost to the growth and productive life of the former. However, the results are also inconsistent with the RBC and Hb values reported by Oke *et al.* (2007), where no significant (P>0.05) genotype effect was observed. These variations could be attributed to environment and season (Ladokun *et al*., 2008). The physiological importance of erythrocyte in the domestic livestock has prompted studies that lead to the establishment of some indices with which the health and performance of the animal can be monitored. More importance among such health conditions in animals, which can be monitored using these indices anemia, dehydration, infection and Aspergillosis etc. The hematological blood picture can give significant hints for the avian practitioner about (Campbell, 1995). Due to the importance of hematological blood parameters in early detection of diseases (Theml *et al*., 2004: Tibbo *et al.*, 2004).The values of mean corpuscular volume (MCV) significantly increased while MCHC indicate macrocytic and hypochronic anaemia (Theml *et al*., 2004), probably due to the increased activity of bone marrow and deficiency of some hemopoietic factors. MCHC is very significant in the diagnosis of anemia and also serve as a useful index of the capacity of bone marrow to produce red blood cells. Increased MCV may also be observed in regenerative anemia due to hemolysis and haemorrhages (Eilier, 2004).

The mean values of total protein, albumin, urea, cholesterol, creatinine, full blood count, calcium and phosphorus of the genetic group were influenced by strain. However, the crossbred genotype had a significantly higher (P<0.05) albumin content values. The present findings are inconsistence with the report of earlier workers (Mitruka and Rawnsley, 1977; Clubb and Schubot, 1991; El-Safty *et al.,* 2006). Serum parameters are important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between the blood and cells could be facilitated (Campbell, 1995). Moreso it also contributed to the viscosity and maintenance of the normal blood pressure and pH. The lower creatinine which is a waste Product formed in the muscle from a high energy storage compound, Creatinine phosphate is also an indication of higher muscle mass (Ladokun *et al*., 2008). All the values obtained from the minerals were all within range Anon (1980) and Iheukwumere and Herbert (2003). The implication is that breeds/strain may affect the electrolyte values. Serum parameters are important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between the blood and cells could be facilitated (Campbell, 1995). They also contributed to the viscosity and maintenance of the normal blood pressure and PH. All the values obtained from the minerals were all within range Mary and Gomathy (2008). The implication is that breeds/strain may affect the electrolyte values.

The significant sex differences found for haematological and serum biochemical values are suggestive of the existence of genetic variation. The higher values of calcium, phosphorus, urea and albumin in females than males might be attributed to various physiological factors associated with females. For examples, during egg formation and egg-laying, females are in restless and excited condition (Tambuwal *et al*., 2002). The results of the haematological and serum parameters as affected by sex are presented in Table 3 and 4.Glucose concentrations in plasma were 189.84 and 207.00 mg/dl in males under control and cold stress groups, respectively. The analysis of variance showed that sex had significant effect on glucose and total protein levels. This result corroborate with findings of Mary and Gomathy (2008). It was depicted from analysis of variance that sex had significant effect on total protein concentration .Albumin concentrations in plasma of males are lower than females the values. This indicate that sex have significant (P<0.05) effect on plasma albumin concentration of birds. Globulin concentrations were significantly (P<0.05) in males than females. This indicates that sex had significant effect on globulin concentration.

The present study reveals that there is marked increase in total protein, albumin and globulin concentrations. These findings agree with those reported by Blahova *et al.* (2007) and Ibrahinm *et al.* (2012) but they contradict the findings of Daneshyar *et al.* (2009). The increase in protein concentration in blood is partially contributed by raised albumin concentration but mainly due to increase in the globulin concentration during the cold stress. The increase in the albumin concentration might be due to effect of cortisol activity because increased cortisol level has catabolic action on muscles, skin, lymphatic tissue and bone (Eiler, 2004). Cortisol affects T-Cell functions and alters the ability of macrophages (Eiler, 2004) so it might not have any effect on B-lymphocytes as the total lymphocyte number increased during the cold stress.PCV in males were lower than the values in females .The analysis of variance showed that sex have significant (P<0.05) effect on PCV,. The values of PCV agrees with the report of Mary and Gomathy (2008) but lower than that reported by Pandian *et al.* (2012) which is an indication of tissue hypoxia due to suppressed respiration rate and subsequent increase in the erythropoiesis (Deaton *et al*., 1969)

**Conclusion**

Based on these findings genotype and sex showed a remarkable influence on the haematology and serum chemistry parameters in turkeys and it could be considered as preliminary reference values, which are particularly important for turkey diagnosis, breeding and production. The values obtained are comparable to values recorded elsewhere. Therefore, all haemato-biochemical parameters should be measured carefully prior to interpretation for precise diagnosis and research analysis. Further it is evident from the study that birds can also thrive well in the humid environment of Nigeria

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