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Research Article

Effect of Different Housing Systems and Sex on the Haematological and Serum Biochemical Indices of Locally Adapted and Exotic Turkeys

***Sabo, M. N., Usman, H. B., Mbakwe, C. C., Jibia, Z. S. and Sulaiman, A.**

Department of Animal Science, Federal University Dutsin-Ma, Katsina State, Nigeria
****Corresponding Author's email*: msabo@fudutsinma.ng**

ABSTRACT

The study was conducted to evaluate the effect of breed, different housing systems and sex on haematological and serum biochemical indices of locally adapted and exotic turkeys. A total of 100 unsexed day old poults (50 each of locally-adapted (LA) and Nicholas white (NC) turkeys) were sourced and brooded for eight weeks. The poults were then allocated randomly to the experimental layout of 2x2x2 factorial arrangement that contained two the two breeds of turkeys, the two sexes (male and female) and two housing systems (deep litter (DL) and deep litter with outdoor access (DLFR)). Each treatment was replicated 3 times with 5 turkeys each. At the 16th week of the experiment, 2 birds were randomly selected from each replicate for blood collection. About 5mls of blood was collected from each bird for determination of haematological and serum biochemical indices. All data generated were subjected to statistical analysis. The results of the of the study show that the haematological indices considered were not influenced (P>0.05) by sex or housing. Breed only affected white blood cell count with NC turkeys having a higher count (P<0.05) than the LA. Alanine aminotransferase was higher (P<0.05) in turkeys reared with outdoor access compared to the DL group. Conversely, total protein and globulin are higher (P<0.05) in the DL compared to the outdoor group. It can be recommended that housing types that give outdoor access can be used to rear turkeys without adverse effects on their haematological or serum biochemical parameters.

Keywords: Turkeys; Sex; Housing; Haematological; Serum

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INTRODUCTION

Turkey (*Meleagris gallopavo*) is a choice meat bird raised all over the world for their tasty and high quality meat as well their broad adaptability to a vast range of climatic and rearing conditions (Gattani *et al.,* 2016; Safiyu *et al.,* 2020). However, during commercial production, turkeys may be exposed to several different types of stressors related to environmental conditions and management practices (Bartz *et al.,* 2020). Turkeys in Nigeria are mostly reared in backyard poultry rearing systems and serve as a major source of income for rural farmers (Safiyu *et al.,* 2020). The utilization of husbandry practices such as indoor production in conventional houses has been recommended under commercial systems (Safiyu *et al.,* 2020). Birds' rearing systems has influence on their welfare, health, and production efficiency especially under heat stress conditions (Ghanima *et al.,* 2020).

According to previous studies, improved performance of both male and female indigenous poultry species can be achieved through an improved rearing system. Reports about the comparison of blood parameters of birds especially local turkeys reared under different rearing system are limited. Though researchers have evaluated biochemical and haematological parameters for local chicken with different plumage colours, a dearth of information still exists on the blood analysis of local turkey breeds. Thus, in order to further

understand and improve the potential of local turkeys, the haematological and biochemical

parameters of these birds need to be monitored and documented (Abdi-Hachesoo *et al*., 2013). These parameters have been shown to be markers of on-going events within the body of the animals which can be used as a diagnostic tool to assess the health status and provide valuable information on the immune status of animals (Tibbo *et al*., 2004). Thus, establishing an accurate set of reference values is critical in the interpretation of results of clinical
pathology. This study was conducted to determine the haematological and serum biochemical parameters of locally adapted and Nicholas white turkeys.

MATERIALS AND METHODS

Experimental Site

The research was conducted at the Teaching and Research Farm, Department of Animal Science of Federal University Dutsin-Ma. Dutsin-Ma LGA lies on latitude 12°26'N and longitude 07°29'E. Rainfall is between May and September with a peak in August. The average annual rainfall is about 700 mm. The mean annual temperature ranges from 29°C – 31°C. The highest air temperature normally occurs in April/May and the lowest in December through February.

Experimental Birds, Design and Management

A total of 100 unsexed day old poults (50 each of locally-adapted and Nicholas white turkeys) were purchased from a reputable hatchery. The poults were intensively brooded together for eight weeks on floor pens. At the end of the eighth week, each breed of poults was on weighed on equalization basis and according to sex, allocated randomly to eight treatments in a 2x2x2 factorial arrangement that contained two housing systems (DL and DLFR), two breeds of turkeys (LA and NC) and two sexes (Male and female).

The treatments are thus;

1. Male NC on DL
2. Female NC on DL
3. Male NC on DLFR
4. Female NC on DLFR
5. Male LA on DL
6. Female LA on DL
7. Male LA on DLFR
8. Female LA on DLFR

Each treatment was replicated 3 times with 5 turkeys each. The DL group were reared indoors on concrete floors without access to outdoors. Each DLFR group had indoor pen that opened onto 5 separate yards, which were surrounded by net fencing. The indoor area of each pen measured 2 × 2 m. Birds of DLFR group will be allowed access to the outdoors during daytime hours. The indoor portion of each pen will have 1 fount-type or bowl drinker and a hanging conical feeder. The outdoor portion of each DLFR pen will be 2 x 20m^2 (4m2 per bird according to Comert *et al*. (2016) have 1 drinker and a feeder.

Routine and occasional management practices in turkey production were carried out as at when due. Feeders and drinkers were cleaned daily and fresh feed and water will be supplied daily. Litter materials (wood shavings) were changed fortnightly and as at when due throughout the experimental period. The birds were fed prepared turkey diets containing 26.6% CP and 12.1 MJ/kg ME at weeks 3 to 8 (starter phase), and 19.15% CP and 12.54 MJ/kg ME at weeks 9 to 16 (grower phase) (Ogundipe *et al*., 2022).

Data Collection

At the 16th week of the experiment, between the hours of 7:00am – 9:00am 2 birds were randomly selected from each replicate (10 poults per treatment) for blood collection. About 5mls of blood was collected from the sub-clavicular vein of each bird using a scalp vein needle set after swabbing with mentholated spirit. The blood was placed into sterilized glass tubes/bottles containing ethylene diamine tetra-acetic acid (EDTA) for haematological studies. Blood samples for serum biochemical studies were collected in plain containers (i.e. without anticoagulant) for serum separation.

Statistical Analysis

Data from both experiments was analysed using the general linear models (GLM) procedure of SAS software (SAS Institute Inc., 1994) according to a completely randomized design. Data were subjected to analysis of variance. Where the analysis of variance was significant, Duncan's multiple range test was used to separate the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Effect of breed, sex and housing on haematological parameters of Nicholas White and locally adapted turkeys

The haematological parameters of different breeds and sexes of turkeys reared under different housing types are shown in table 1. PCV, haemoglobin, monocytes, heterophils, lymphocytes and eosinophil were not influenced (P>0.05) by breed, sex or housing. The WBC count of the turkeys influenced (P<0.05) by breed with the NC turkeys having higher WBC count (P<0.05) than the locally adapted turkeys. However, WBC was also not affected (P>0.05) by either sex or housing.

The evaluation of the haematological profile of animals usually furnishes vital information on the body's response to its internal and external environment. This is relevant since blood

constituents' change in relation to the physiological conditions of animals and that blood conveys nutrients and materials to different parts of the body and hence whatever affects the blood will certainly affects the entire body. The PCV and haemoglobin values observed in this study were within the normal range of 31-42 and 10.42-15.20 respectively as reported by Agina *et al.* (2015). The total white blood cell count (32.00-39.41), monocytes (0.25-0.75) and eosinophil (0.00-0.33) were also within the normal range of 10.4-46.5, 0-4.0 and 0-0.4 reported by Bounous *et al.* (2000). Contrary to the higher WBC count in exotic compared to local turkeys seen in this study, Isidahomen *et al.* (2013) reported that local turkeys had higher WBC count compared to exotic turkeys. They also reported lower PCV and higher WBC and Hb in males compared female turkeys. Similar to observations in this study, sex did not influence RBC count, total and differential leukocyte counts in ring-necked pheasants (Schmidt et al., 2007) and free-range helmeted guinea fowl (Nalubamba et al., 2010). However, Adedibu et al. (2014) reported a slight increase in PCV and RBC counts in males compared to female birds which they suggest could be a function of high levels of testosterone in adult male birds and mammals which stimulate erythropoiesis. PCV values vary with the ambient temperature at which birds are reared and therefore, exposure of chickens to high temperatures might cause decrease in PCV values (Diktas *et al*., 2015). Contrary to the results obtained in this study, PCV values of slow growing broilers were lower for free range portable housing compared to deep litter housing while similar to this study heterophil, eosinophil, lymphocyte and monocyte were not altered by housing systems (Diktas et al., 2015). Sekeroglu et al. (2009) reported that housing system did not affect leucocytes, erythrocytes, haemoglobin and haematocrit levels of birds reared under different housing systems. The variation in the environment temperature and photoperiod is considered as the most important factor that affects the erythrocyte count, Hb, and PCV values. A decline in environmental temperature resulted in significant alterations of the circulatory system. These variations were not observed in this study possibly due the sufficient shade present in the outdoor area which had reduced variation in ambient temperature between the indoor and outdoor areas. Generally, lymphocytes, eosinophil, monocytes counts and haematocrit values decrease and basophil and heterophil counts increase under stress conditions (Mutibvu et al., 2017). The values obtained in this study therefore suggest that the turkeys reared with outdoor access were likely not under stress.

Effect of breed, sex and housing on serum biochemical parameters of Nicholas White and locally adapted turkeys

The results of the serum biochemical parameters of Nicholas White and locally adapted turkeys as influenced by breed, sex and housing is shown in Table 2. The total bilirubin, aspartate aminotransferase, alkaline phosphatase, urea, creatinine, glucose and albumin were all not influenced by breed, sex or housing. Alanine aminotransferase, total protein and globulin were affected by housing with alanine aminotransferase being higher ($P<0.05$) in turkeys reared with outdoor access compared to DL group. Conversely total protein and globulin are higher ($P<0.05$) in the DL compared to the outdoor group. The levels of certain plasma metabolites offer an objective measure, into the physiological status of an animal (Crespo and Grimes, 2024). Evaluation of blood chemistry parameters can be used to assess animal health (IJLR, 2023).

In line with the findings of this study, Gattani et al. (2016) observed similar ALT and AST activity in both male and female turkeys. Contrary to the results from this study, Isidahomen et al. (2013) observed higher total protein albumin, globulin, glucose and urea were higher in exotic compared to local breeds. They also reported higher total protein and globulin in males compared to females.

On the contrary females had higher albumin, glucose and urea than male turkeys (Isidahomen et al. 2013). Gattani et al. (2016) also observed higher glucose in males compared to female turkeys. They however reported higher total protein, albumin globulin concentration in female turkeys than their male counterpart. Daniel-Igwe and Okwara (2018) reported similar serum biochemical parameters except for cholesterol and triglycerides between male and female indigenous turkeys. The male had higher cholesterol and triglycerides than female turkeys (Daniel-Igwe and Okwara, 2018). The blood glucose value of 99.10mg/dl for local turkey observed in this study is lower than the 126.40 t0 177.50mg/dl reported by Adebowale et al. (2015). The higher value they observed is likely due to the maize and macaroni waste based diet they used compared to millet based utilized in this study. The ALT and ALP values observed in this study (8.50-9.33IU/L and respectively) were within the normal range of 2-12.25 and 35-410 respectively as reported by Daniel-Igwe and Okwara (2018) and LAVC (2009) respectively. The urea and creatinine levels (4.35-4.73 and 0.91-0.94 respectively) observed in this study fall within the ranges of 3-17 and 0.5-2.0 respectively for normal turkeys (Agina

et al., 2015; Bounous *et al.,* 2000). The serum creatinine value for female turkeys and serum globulin value for male turkeys observed in this study were similar to those reported by Ibrahim et al. (2012). Similar to the findings of this study, Ibrahim et al. (2012) reported no sex-related differences in serum total protein, creatinine, albumin, globulin, ALP, AST and ALT. The creatinine value of 0.94mg/dl is similar to values of 0.90 t0 1.23mg/dl observed by Adebowale et al. (2015). Similar serum protein between male and female turkey obtained in this study is contrary to the assertion that adult female birds have an increase in blood protein induced by oestrogen (Ibrahim, et al., 2012). This might likely be due to the fact that the turkeys have not attained maturity at the time of sampling. Irfan et al. (2017) observed variations in serum chemistry with increase in age. Also contrary to the findings of this study, Irfan et al. (2017) reported higher cholesterol and ALT were recorded in turkeys reared under confinement rearing system while globulin, creatinine and urea were higher in birds reared under outdoor rearing systems. However, similar to this study, they reported non-significant variations in albumin, ALP and AST between the rearing systems. Olaniyi et al. (2012) also reported non-significant variations in albumin among confined and free range reared turkeys. However, Olaniyi et al. (2012) contrary to the findings of this study observed similar serum total proteins between indoor and outdoor rearing systems. Similar to the findings of this study, Usman et al. (2020) reported no variation in albumin level of chickens under different production systems. TP and ALB concentrations are often used to assess the hydration status of birds, with high levels indicating dehydration, because of concentration in a reduced volume of plasma (Chikumba et al., 2013). Also contrary to the findings of this study, Rehman (2016) observed that chickens under confinement rearing system (deep litter) indicated the high level of plasma glucose and protein compared to those under semi intensive and free range. However, corroborating this study, he obtained similar albumin level under the different rearing systems. He opined that relatively more exercise in birds under FR caused reduction in plasma glucose level. During exercise, activity of insulin is greater, which accelerates glucose metabolism in blood. The similar blood glucose observed in this study might be due to the reduced activity in turkeys compared chickens. Changes in body conformation caused by genetic selection for fast-growth and broad breast as well as hypothyroidism observed in birds selected for fast growth especially in the Nicholas white turkeys have been observed to lower physical activity (Edgar, 2009).

CONCLUSION

The results of this study have shown that sex and housing did not influence the haematological parameters of the turkeys. Similarly breed only influenced the white blood cell counts with Nicholas White having higher counts than the locally adapted turkeys. Sex did not influence serum biochemical parameters of turkeys. Locally adapted turkeys had higher conjugated bilirubin than the Nicholas white turkeys. Outdoor or range access increase serum alanine aminotransferase while indoor housing increases total protein and globulins.

Based on the outcome of this study it can be recommended that housing types that give outdoor access can be used to rear turkeys without adverse effect on their haematological or serum biochemical parameters.

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Table 1: Effect of breed, sex and housing on haematological parameters of NC and LA turkeys

Parameters	PCV (%)	Hb (g/dl)	WBC (10^3/µl)	M (%)	H (%)	L (%)	E (%)
Breed							
Nicholas White	42.33	14.07	39.41[a]	0.67	43.17	56.00	0.17
Locally adapted	41.58	13.83	32.00[b]	0.33	42.83	56.83	0.17
SEM	0.64	0.21	1.10	0.31	1.80	1.77	0.17
Sex							
Male	42.08	13.98	33.58	0.25	39.25	59.83	0.00
Female	41.83	13.92	37.83	0.75	46.75	53.00	0.33
SEM	0.64	0.21	1.08	0.31	1.79	1.77	0.17
Housing							
Indoor	41.83	13.91	34.42	0.75	44.42	54.83	0.00
Outdoor	42.08	13.99	37.00	025	41.58	58.00	0.33
SEM	0.64	0.21	1.08	0.31	1.79	1.77	0.17
Interaction							
Breed*Sex * Housing	NS	NS	NS	NS	NS	NS	NS

SEM – standard error of mean

[a, b, c] means in a column with different superscript(s) differ significantly (P<0.05)

PCV – Packed cell volume, Hb – Haemoglobin, WBC – White blood cell, M – Monocytes, H - Heterophils L – Lymphocytes, E - Eosinophil

Table 2: Serum biochemical parameters of Nicholas White and locally adapted turkeys as affected by breed, sex and housing

Parameters	TB (mg/dl)	CB (mg/dl)	AST (IU/L)	ALT (IU/L)	ALP (IU/L)	Urea (mg/dl)	Creatinine (mg/dl)	Glucose (mg/dl)	TP (g/dl)	Alb (g/dl)	Glo (g/dl)
Breed											
Nicholas White	1.28	0.44[b]	11.42	8.83	183.75	4.41	0.91	96.10	7.10	5.03	2.07
Local	1.20	0.53[a]	11.00	9.00	188.58	4.67	0.94	99.10	7.18	5.08	2.10
SEM	0.03	0.02	0.30	0.30	2.86	0.19	0.01	3.00	0.05	0.09	0.10
Sex											
Male	1.22	0.47	11.92	9.33	189.33	4.35	0.92	98.90	7.10	5.08	2.03
Female	1.26	0.50	10.50	8.50	183.00	4.73	0.93	90.63	7.18	5.03	2.15
SEM	0.03	0.02	0.25	0.26	2.86	0.19	0.01	2.9	0.05	0.09	0.10
Housing											
Indoor	1.24	0.50	11.00	8.50[b]	184.33	4.62	0.93	95.40	7.23[a]	4.96	2.28[a]
Outdoor	1.23	0.47	11.42	9.33[a]	188.00	4.46	0.92	99.80	7.05[b]	5.15	1.90[b]
SEM	0.03	0.02	0.25	0.36	2.86	0.19	0.01	2.90	0.05	0.09	0.10
Interaction											
Breed*Sex* Housing	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

SEM – standard error of mean

[a, b, c] means in a column with different superscript(s) differ significantly (P<0.05)

TB - total bilirubin, CB - conjugated bilirubin, AST - aspartate aminotransferase, ALT - alanine aminotransferase, ALP - alkaline phosphatase, TP – total protein, Alb – albumin, Glo - globulin