

The impacts of rearing system, sex and plumage colour on haemato-biochemical indices of Nigerian local turkey breeds (*Meleagris gallopavo*)

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In this study, 768 day-old poult were used to determine the effects of rearing system, sex and plumage colour on haematological and serum biochemical parameters of local turkey breeds in Nigeria. Poults were brooded for 4 weeks followed by an acclimatization period of 2 weeks in two rearing systems (indoor and outdoor systems). The study was composed of three factors; rearing system, sex (male and female) and plumage colour (white and black). Each of the eight treatment combinations consisted of 96 birds for an experimental period of 10 weeks. Each treatment was further subdivided into six replicates of 16 birds each. The experiment was arranged in a $2 \times 2 \times 2$ factorial layout and data obtained were subjected to analysis of variance. Rearing system had no significant ($p > 0.05$) effect on all haemato-biochemical parameters measured. However, haemoglobin concentration was significantly ($p \leq 0.05$) higher (14.10 g/dl) in turkey hens, while monocytes count was significantly ($p \leq 0.05$) higher (1.88%) in turkey toms. Serum globulin was higher ($p \leq 0.05$) in turkey hens (2.33 mg/dl). Also, black-plumaged turkeys had significantly ($p \leq 0.05$) higher (1.88%) monocyte count than 0.88% recorded in turkeys with white plumage. Rearing system, plumage colour and sex interaction significantly ($p \leq 0.05$) influenced monocyte counts. Higher serum cholesterol ($p \leq 0.05$) was recorded in black-plumaged turkeys and lower in white-plumaged turkeys. Therefore, it was concluded that black-plumaged toms reared in the indoor system had the highest monocyte counts.

Keywords: Nigerian local turkey, rearing system, sex, plumage colour, haematology, serum biochemistry

Turkey (*Meleagris gallopavo*) breeds in the tropics are gaining much attention due to their better adaptability to a wide range of climatic conditions and their products are highly preferred because of taste, leanness and suitability for special dishes (Odutayo et al. 2015). Local poultry species are available with a wide variety of genetic lines of feather and plumage colours (Ajayi 2010), but there is no discrimination against any particular plumage colour. The occurrence of a few off-colour poults in turkey flock is often considered of minor importance (Andersson 1994). The birds are mostly reared in rural backyard poultry rearing systems and serve as a major source of income for rural farmers (Padhi 2016). But despite the growing preference for products

from indigenous birds, their productive potential is yet to be fully exploited. Hence, the utilization of best husbandry practices such as indoor production in conventional houses has been recommended (Case et al. 2010).

According to previous studies (Sarkar and Golam 2009; Okeno et al. 2012), 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 (Pampori and Igbal 2007; Ladokun et al. 2008) 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 ongoing 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 therefore aimed to determine the effects of rearing system, sex and plumage colour on haematological and serum biochemical parameters of local turkey breeds.

Materials and methods

Experimental site

The study was carried out at the Experimental Poultry Unit of the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria which lies approximately on latitude 7° 30' N and longitude 3° 54' E. Blood analyses were carried out in the Laboratory of the Department of Veterinary Pathology, Federal University of Agriculture, Abeokuta.

Experimental birds and management

A total of 768 day-old poults of two different plumage colours (white and black) from local turkey breeds were purchased from a reputable hatchery and brooded for 4 weeks followed by an acclimatization period of 2 weeks in two different rearing systems (indoor and outdoor systems). In the indoor system, barns with litter floor and stocking density of 0.4 m² per turkey were used, while the outdoor system included mini-shelter with stocking density of 0.4 m² per turkey and an outside run (4 m² per turkey) for birds to scavenge, forage and dust bath. Afterwards, the birds were differentiated on sex and plumage colour basis into eight treatments consisting of 96 birds per treatment for an experimental period of 10 weeks as depicted in Figure 1. Each treatment was further sub-divided into six replicates of 16 birds. Birds in each replicate were randomized for weight with each replicate having a mean weight of approximately 750 g. Birds had access to *ad libitum* supply of feed (Table 1) and water throughout the experimental period. The practices regarding the care and use of animals for research purposes were in accordance with the laws and regulations of Nigeria and approved by the Animal Use and Ethics Committee of Federal University of Agriculture, Abeokuta (Approval Number 2014-05/12).

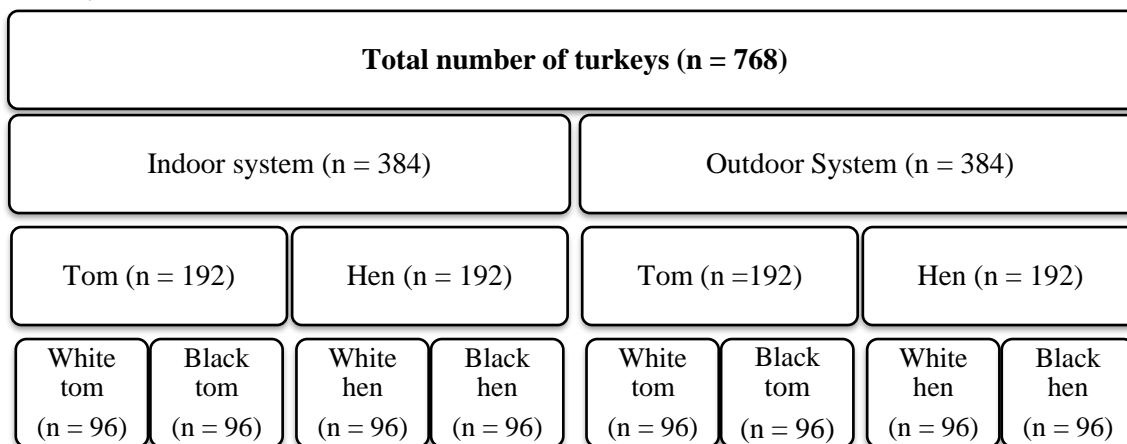


Figure 1: Description of Experimental Design

Table 1: Ingredient composition of diet

Ingredient	Quantity (%)
Maize	44.00
Soyabean meal	31.00
Wheat offal	10.00
Fish meal (65% crude protein)	5.00
Bone meal	5.60
Oyster shell	3.00
Salt (NaCl)	0.40
DL-methionine	0.40
Lysine	0.20
Premix	0.40
Total	100.00
Calculated analysis	
Metabolizable energy (MJ/kg)	11.07
Crude protein (%)	28.00
Ca (%)	1.2
P (%)	0.8

Blood collection and analyses

On the last day of the study (16 week-old turkeys), 5 ml of blood was collected from the brachial vein of 3 selected birds per replicate into heparinised tubes. All samples were collected in the morning before feeding (between 07:00 am to 09:00 am). Blood samples collected were kept in cool containers and transported to the laboratory within 2 hours of blood withdrawal.

Haematological parameters measured were analysed according to the procedures described by Sood (2016). Packed cell volume was determined using microhaematocrit capillaries. Haemoglobin concentration was determined using cyanmethaemoglobin method which involves mixing 5 ml of Drabkin's solution (1000 ml of deionised water was mixed with 400 mg of potassium ferricyanide, 280 mg of potassium dihydrogen phosphate, 100 mg of potassium cyanide and 1 ml of non-ionic detergent) with 20 µl of blood sample. The mixture was read in a photocolourimeter at 540 nm (green filter). Blood counts were determined using the

improved Neubauer's chamber (area of 9 sq/mm and depth of 0.1 mm) manufactured by Marien Field. Platelet count was determined using Rees-Ecker method using a diluting fluid that consist of 3.8 gm of Trisodium citrate, 0.2 ml of Neutral formaldehyde, 0.1 gm of Brilliant cresyl blue and 100 ml of Deionised water.

Serum biochemical parameters (total protein, albumin, globulin, creatinine, alanine transaminase (ALT) and aspartate transaminase (AST), uric acid, cholesterol, triglycerides) were analyzed using commercially available test kits by Randox laboratories, United Kingdom (Model BT294QY).

Statistical analysis

The haemato-biochemical data were analyzed with analysis of variance (ANOVA) using the GLM procedure of statistical analysis software Minitab® version 17.1.0 (Minitab, 2013). Rearing system (indoor and outdoor), sex (tom and hen) and plumage colours (white and black) were the factors and the factorial layout was a 2×2×2 arrangement. Significant (p≤0.05) differences among treatment means were determined by Tukey Test.

Model of the study

$$Y_{ijkl} = \mu + \alpha_i + \beta_j + g_k + (\alpha\beta)_{ij} + (\alpha g)_{ik} + (\beta g)_{jk} + (\alpha\beta g)_{ijk} + \Sigma_{ijkl}$$

Where:

- Y_{ijkl} = individual observation
- μ = population mean
- α_i = main effect of rearing system
- β_j = main effect of sex
- g_k = main effect of plumage colour
- (αβ)_{ij} = interaction between rearing system and sex
- (αg)_{ik} = interaction between rearing system and plumage colour
- (βg)_{jk} = interaction between sex and plumage colour
- (αβg)_{ijk} = rearing system, sex and plumage colour interaction
- Σ_{ijkl} = residual error

Results

The main effects of rearing system, sex and plumage colour on haemato-biochemical parameters of local turkey breed are presented in Table 2. Rearing system had no significant ($p>0.05$) effect on all parameters measured. However, haemoglobin concentration was significantly ($p\leq 0.05$) higher in turkey hens while monocytes count was significantly ($p\leq 0.05$) higher in turkey toms. Values for serum globulin were also significantly ($p\leq 0.05$) higher in turkey hens. In addition, monocyte count and serum cholesterol levels significantly ($p\leq 0.05$) differed between turkeys with different plumage colours.

Significantly ($p\leq 0.05$) higher monocyte count and serum cholesterol were obtained in black-plumaged turkeys when compared to turkeys with white plumage.

The effects of rearing system by plumage colour interaction (Table 3) and rearing system by sex interaction (Table 4) on haemato-biochemical parameters measured were not significantly ($p>0.05$) different. However, significantly ($p\leq 0.05$) higher monocyte counts were recorded in black-plumaged toms (Table 5). Furthermore, significantly ($p\leq 0.05$) highest monocyte counts were recorded in black-plumaged toms reared in indoor system as influenced by the rearing system, plumage colour and sex interaction (Table 6).

Table 2: Main effects of rearing system, sex and plumage colour on haemato-biochemical parameters of local turkey breed

	Rearing system				Tom	Sex			White	Plumage colour		
	Indoor	Outdoor	\pm SEM	P		Hen	\pm SEM	P		Black	\pm SEM	P
	value				value			value				
Haematological parameters												
Packed cell volume (%)	42.63	41.38	1.38	0.538	40.13	43.88	1.38	0.090	41.38	42.63	1.37	0.538
Haemoglobin concentration (g/dl)	13.58	13.31	0.38	0.635	12.79 ^b	14.10 ^a	0.38	0.039	13.11	13.78	0.38	0.248
Red blood cell count ($\times 10^3/\mu\text{l}$)	3.03	3.33	0.13	0.149	3.09	3.26	0.13	0.379	3.13	3.23	0.13	0.609
White blood cell counts ($\times 10^3/\mu\text{l}$)	13.41	12.50	0.71	0.391	13.48	12.38	0.71	0.281	12.41	13.50	0.71	0.311
Heterophil (%)	32.38	30.88	1.53	0.507	30.75	32.50	1.53	0.441	33.00	30.25	1.53	0.238
Lymphocytes (%)	65.38	67.00	1.08	0.318	67.00	65.38	1.08	0.318	65.13	67.25	1.08	0.201
Eosinophil (%)	0.50	0.63	0.27	0.747	0.38	0.75	0.27	0.347	0.50	0.63	0.27	0.747
Basophil (%)	0.50	0.50	0.25	1.000	0.50	0.50	0.25	1.000	0.50	0.50	0.25	1.000
Monocyte (%)	1.75	1.00	0.31	0.122	1.88 ^a	0.88 ^b	0.31	0.048	0.88 ^b	1.88 ^a	0.31	0.048
Platelets ($\times 10^3/\mu\text{l}$)	24.75	26.00	1.38	0.540	23.88	26.88	1.38	0.163	26.50	24.25	1.38	0.282
Serum biochemical parameters												
Total protein (g/dl)	4.49	4.40	0.29	0.837	4.21	4.68	0.29	0.295	4.65	4.24	0.29	0.347
Albumin (g/dl)	2.35	2.29	0.22	0.846	2.29	2.35	0.22	0.846	2.36	2.28	0.22	0.786
Globulin (mg/dl)	2.14	2.11	0.12	0.886	1.93 ^b	2.33 ^a	0.12	0.046	2.29	1.96	0.12	0.092
Creatinine (mg/dl)	1.05	0.99	0.14	0.762	0.85	1.19	0.14	0.129	0.96	1.08	0.14	0.588
Cholesterol (mg/dl)	136.25	143.13	5.53	0.405	135.25	144.13	5.53	0.289	128.25 ^b	151.13 ^a	5.53	0.019
Triglycerides (mg/dl)	69.30	83.80	11.00	0.380	76.00	77.00	11.00	0.951	80.60	72.40	11.00	0.612
AST (U/L)	64.00	68.50	3.54	0.396	71.50	61.00	3.54	0.070	64.00	68.50	3.54	0.396
ALT (U/L)	18.63	17.63	2.27	0.763	18.00	18.25	2.27	0.940	19.50	16.75	2.27	0.417
Uric acid (mg/dl)	3.21	3.00	0.13	0.263	3.15	3.06	0.13	0.633	3.26	2.95	0.13	0.114

AST = Aspartate transaminase, ALT = Alanine transaminase

^{ab} Means in the same row having different superscript are significantly ($p\leq 0.05$) different.

Table 3: Interaction effect of rearing system and plumage colour on haemato-biochemical parameters of local turkey breed

Rearing system Plumage colour	Indoor		Outdoor		SEM	P value
	White	Black	White	Black		
Haematological parameters						
Packed cell volume (%)	43.75	41.50	39.00	43.75	1.94	0.110
Haemoglobin concentration (g/dl)	13.70	13.45	12.53	14.10	0.53	0.124
Red blood cell count ($\times 10^3/\mu\text{l}$)	3.15	2.90	3.10	3.55	0.19	0.100
White blood cell counts ($\times 10^3/\mu\text{l}$)	13.03	13.80	11.80	13.20	1.01	0.764
Heterophil (%)	34.25	30.50	31.75	30.00	2.16	0.655
Lymphocytes (%)	63.50	67.25	66.75	67.25	1.53	0.318
Eosinophil (%)	0.50	0.50	0.50	0.75	0.38	0.747
Basophil (%)	0.50	0.50	0.50	0.50	0.35	1.000
Monocyte (%)	1.25	2.25	0.50	1.50	0.43	1.000
Platelets ($\times 10^3/\mu\text{l}$)	26.75	22.75	26.25	25.75	1.95	0.396
Serum biochemical parameters						
Total protein (g/dl)	4.70	4.28	4.60	4.20	0.41	0.977
Albumin (g/dl)	2.40	2.30	2.33	2.25	0.31	0.969
Globulin (mg/dl)	2.30	1.98	2.28	1.95	0.17	1.000
Creatinine (mg/dl)	1.00	1.10	0.93	1.05	0.20	0.952
Cholesterol (mg/dl)	128.25	144.25	128.25	158.00	7.82	0.405
Triglycerides (mg/dl)	64.50	74.00	96.80	70.80	15.60	0.288
AST (U/L)	59.50	68.50	68.50	68.50	5.01	0.396
ALT (U/L)	21.00	16.25	18.00	17.25	3.21	0.551
Uric acid (mg/dl)	3.53	2.90	3.00	3.00	0.18	0.114

AST = Aspartate transaminase, ALT = Alanine transaminase

Table 4: Interaction effect between rearing system and sex on haemato-biochemical parameters of local turkey breed

Rearing system Sex	Indoor		Outdoor		SEM	P value
	Tom	Hen	Tom	Hen		
Haematological parameters						
Packed cell volume (%)	41.00	44.25	39.25	43.50	1.94	0.804
Haemoglobin concentration (g/dl)	12.85	14.30	12.73	13.90	0.53	0.802
Red blood cell count ($\times 10^3/\mu\text{l}$)	2.93	3.13	3.25	3.40	0.19	0.897
White blood cell counts ($\times 10^3/\mu\text{l}$)	15.03	11.80	12.05	12.95	1.01	0.074
Heterophil (%)	31.25	33.50	30.25	31.50	2.16	0.823
Lymphocytes (%)	66.25	64.50	67.75	66.25	1.53	0.937
Eosinophil (%)	0.25	0.75	0.50	0.75	0.38	0.747
Basophil (%)	0.75	0.25	0.25	0.75	0.35	0.195
Monocyte (%)	2.50	1.00	1.25	0.75	0.43	0.282
Platelets ($\times 10^3/\mu\text{l}$)	25.00	24.50	22.75	29.25	1.95	0.111
Serum biochemical parameters						
Total protein (g/dl)	4.08	4.90	4.35	4.45	0.41	0.405
Albumin (g/dl)	2.28	2.43	2.30	2.28	0.31	0.786
Globulin (mg/dl)	1.80	2.48	2.05	2.18	0.17	0.143
Creatinine (mg/dl)	0.98	1.13	0.73	1.25	0.20	0.375
Cholesterol (mg/dl)	132.50	140.00	138.00	148.25	7.82	0.865
Triglycerides (mg/dl)	74.3	64.3	77.8	89.8	15.6	0.501
AST (U/L)	68.00	60.00	75.00	62.00	5.01	0.631
ALT (U/L)	19.75	17.50	16.25	19.00	3.21	0.459
Uric acid (mg/dl)	3.30	3.13	3.00	3.00	0.18	0.633

AST = Aspartate transaminase, ALT = Alanine transaminase

Table 5: Interaction between plumage colour and sex on haemato-biochemical parameters of local turkey breed

Plumage colour Sex	White		Black		SEM	P value
	Tom	Hen	Tom	Hen		
Haematological parameters						
Packed cell volume (%)	38.50	44.25	41.75	43.50	1.94	0.334
Haemoglobin concentration (g/dl)	12.23	14.00	13.35	14.20	0.53	0.409
Red blood cell count ($\times 10^3/\mu\text{l}$)	3.03	3.23	3.15	3.30	0.19	0.897
White blood cell counts ($\times 10^3/\mu\text{l}$)	13.50	11.32	13.57	13.42	1.01	0.343
Heterophil (%)	31.00	35.00	30.50	30.00	2.16	0.328
Lymphocytes (%)	67.50	62.75	66.50	68.00	1.53	0.075
Eosinophil (%)	0.25	0.75	0.50	0.75	0.38	0.747
Basophil (%)	0.50	0.50	0.50	0.50	0.35	1.000
Monocyte (%)	0.75 ^b	1.00 ^b	3.00 ^a	0.75 ^b	0.43	0.020
Platelets ($\times 10^3/\mu\text{l}$)	23.50	29.50	24.25	24.25	1.95	0.163
Serum biochemical parameters						
Total protein (g/dl)	4.26	5.03	4.15	4.33	0.41	0.506
Albumin (g/dl)	2.30	2.43	2.28	2.28	0.31	0.846
Globulin (mg/dl)	1.98	2.60	1.88	2.05	0.17	0.221
Creatinine (mg/dl)	0.78	1.15	0.93	1.23	0.20	0.856
Cholesterol (mg/dl)	124.50	132.00	146.00	156.25	7.82	0.865
Triglycerides (mg/dl)	71.80	89.50	80.30	64.50	15.60	0.315
AST (U/L)	70.50	57.50	72.50	64.50	5.01	0.631
ALT (U/L)	20.25	18.75	15.75	17.75	3.21	0.601
Uric acid (mg/dl)	3.33	3.20	2.98	2.93	0.18	0.837

AST = Aspartate transaminase, ALT = Alanine transaminase

^{ab} Means in the same row having different superscript are significantly ($p \leq 0.05$) different.

Table 6: Rearing system, plumage colour and sex interaction on haemato-biochemical parameters of local turkey breed

Rearing system Plumage colour Sex	Indoor				Outdoor				SEM	P value
	White		Black		White		Black			
	Tom	Hen	Tom	Hen	Tom	Hen	Tom	Hen		
Haematological parameters										
Packed cell volume (%)	40.50	47.00	41.50	41.50	36.50	41.50	42.00	45.50	2.75	0.538
Haemoglobin concentration (g/dl)	12.65	14.75	13.05	13.85	11.80	13.25	13.65	14.55	0.75	0.733
Red blood cell count ($\times 10^3/\mu\text{l}$)	3.05	3.25	2.80	3.00	3.00	3.20	3.50	3.60	0.27	0.897
White blood cell counts ($\times 10^3/\mu\text{l}$)	15.80	10.25	14.25	13.35	11.20	12.40	12.90	13.50	1.42	0.228
Heterophil (%)	32.00	36.50	30.50	30.50	30.00	33.50	30.50	29.50	3.05	1.000
Lymphocytes (%)	66.50	60.50	66.00	68.50	68.50	65.00	67.00	67.50	2.16	0.482
Eosinophil (%)	0.00	1.00	0.50	0.50	0.50	0.50	0.50	1.00	0.53	0.347
Basophil (%)	0.50	0.50	1.00	0.00	0.50	0.50	0.00	1.00	0.50	0.195
Monocyte (%)	1.00 ^{ab}	1.50 ^{ab}	4.00 ^a	0.50 ^b	0.50 ^b	0.50 ^b	2.00 ^{ab}	1.00 ^{ab}	0.61	0.122
Platelets ($\times 10^3/\mu\text{l}$)	26.00	27.50	24.00	21.50	21.00	31.50	24.50	27.00	2.76	0.622
Serum biochemical parameters										
Total protein (g/dl)	4.00	5.40	4.15	4.40	4.55	4.65	4.15	4.25	0.58	0.506
Albumin (g/dl)	2.20	2.60	2.35	2.25	2.40	2.25	2.20	2.30	0.44	0.563
Globulin (mg/dl)	1.80	2.80	1.80	2.15	2.15	2.40	1.95	1.95	0.24	0.572
Creatinine (mg/dl)	0.90	1.10	1.05	1.15	0.65	1.20	0.80	1.30	0.28	0.952
Cholesterol (mg/dl)	121.50	135.00	143.50	145.00	127.50	129.00	148.50	167.50	11.10	0.373
Triglycerides (mg/dl)	54.00	75.00	94.50	53.50	89.50	104.00	66.00	75.50	22.10	0.388
AST (U/L)	64.50	54.50	71.50	65.50	76.50	60.50	73.50	63.50	7.09	0.923
ALT (U/L)	23.00	19.00	16.50	16.00	17.50	18.50	15.00	19.50	4.54	1.000
Uric acid (mg/dl)	3.35	3.70	3.25	2.55	3.30	2.70	2.70	3.30	0.25	0.113

AST = Aspartate transaminase, ALT = Alanine transaminase

^{ab} Means on the same row having different superscript are significantly ($p \leq 0.05$) different.

Discussion

This study established that there were no differences in haematological parameters of local turkey reared in indoor and outdoor systems. This indicated that the birds were in a good state of health during the period of the study. These results confirmed earlier reports by Olaniyi et al. (2012) and Cömert et al. (2016) that rearing system had no influence on blood characteristics of meat-type poultry species. Similarly, Sogunle et al. (2008) observed similarities in haematological values in birds reared in different housing systems.

The packed cell volume, haemoglobin concentration, red and white blood cell counts obtained in the present study were within ranges reported for indigenous (Daniel-Igwe and Okwara 2017) and crossbred (Isidahomen et al. 2013) turkeys. In contrast, earlier studies by Addass et al. (2012) and Etim et al. (2014) reported higher haematological indices in chickens reared indoors than those reared outdoors. These disparities could be attributed to differences in poultry species and housing welfare conditions in the respective studies. Turkey hens had greater haemoglobin concentration than turkey toms in this study. This is in accordance with earlier reports (Myrcha and Kostelecka-Myrcha 1980; Kaliński et al. 2012) where haemoglobin concentration was found to be higher in female than male birds. However, it seems that any observed difference in haemoglobin concentrations between sexes is not only specie-specific but due to physiological processes associated with sexual maturity. According to Milenkaya et al. (2013), differences in haemoglobin concentrations may appear between male and female birds during specific reproductive stages. On the other hand, the present study revealed black-plumaged toms reared in the indoor system had highest monocyte counts. Most often, elevated monocyte counts are associated with infections and autoimmune disorders but the values recorded for monocyte count in this study fell

within the range reported for healthy poultry species by Morita et al. (2009).

The biochemical properties between local turkeys reared in indoor and outdoor systems were similar in this study. This corroborates the findings of Diktas et al. (2015) who observed no difference in total protein, cholesterol and triglycerides levels of slow-growing broilers under different housing systems. Rearing system did not influence total protein in this study; according to Eggum (1989), protein content in the blood is related to amount and quality of protein intake. Other studies Pavlik et al. 2007; Sekeroglu et al. 2009) also reported negligible effect of housing systems on serum cholesterol. Erisir et al. (2009) also found no significant changes between housing systems on serum triglyceride levels of pekin ducks.

In agreement with the findings of this present study with regard to serum albumin, Rehman et al. (2017) found similar albumin levels in birds under different rearing systems. Contradicting reports were made by Gunes et al. (2002) who found variations in serum total protein of hens in different housing systems and Sekeroglu et al. (2009) who reported that the effect of housing system significantly influenced serum triglyceride concentration of broiler chickens. This discordant submission could be attributed to variation in factors such as season and geographical region which differed among studies reviewed.

The present study indicated that, sex effect did not influence all serum biochemical indices except serum globulin which was higher in turkey hens than toms. Higher globulin level would indicate that local turkey hens had better cell-mediated immune response than their male counterparts. Ibrahim et al. (2012) observed no significant difference between the sexes in mean values of total protein, creatinin, albumin, ALT and AST for turkeys reared in a semi-arid environment. The findings of Uduak et al. (2013) also indicated that sex had no impact on the serum biochemical values of turkeys. Priya and Gomathy (2008) reported no

changes in serum cholesterol between male and female turkeys within the age range of 12-18 weeks but the values varied significantly in many other age groups. However, serum globulin levels were similar between male and female turkeys in these studies which contradict our findings. In this study biochemical values fell within normal physiological ranges for turkeys as reported by Bounous et al. (2000). However, serum cholesterol levels were greater in turkeys with black plumages than white-plumaged birds. Cholesterol is essential for the normal function of all animal cells and is a fundamental element of cell membranes. It is also a precursor of various critical substances such as adrenal and gonad steroid hormones and bile acids. Our findings contradicted the report of Ladokun et al. (2008), who observed no difference in serum biochemical parameters between brown and white-plumaged cocks. They further stressed that results of blood parameters from two plumage colour variants as the true representation of the genetically distinct sub-populations is not convincing enough since indigenous poultry species appear to be genetically heterogeneous with no specific colour pattern. In spite of that, the present result is in agreement with the study of Uduak et al. (2013); who reported black turkey breeds recorded higher serum cholesterol than white breeds. This attest to the fact that the effect of plumage colour on blood parameters varies distinctly in different poultry species.

In conclusion, the rearing of black-plumaged toms under indoor system tends to increase monocyte counts of local turkeys.

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