HAEMATO-BIOCHEMICAL PROFILE OF APPARENTLY HEALTHY DOMESTIC TURKEYS (*Meleagris gallopavo*) IN NSUKKA, ENUGU STATE, NIGERIA

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ABSTRACT

Performing comprehensive health assessment on turkey populations enables one to determine their responses to physiological factors such as sex, breed and environmental stressors. The haemato-biochemical parameters of 58 apparently healthy domestic turkeys of varying breeds and sexes, raised by small scale turkey farmers in Nsukka metropolis, Enugu State, Nigeria and the physiological factors (sex and breed) that influence them were determined. All haemato-biochemical procedures were carried out following standard procedures. The mean for the haemato-biochemical parameters were as follows: packed cell volume 30.70 ± 0.63 %; red blood cell count 3.75 ± 0.22 x 10^6/µl; hemoglobin concentration 12.95 ± 0.62 g/dl; total leukocyte count 3.67 ± 0.09 x 10^3 /µl; heterophil 2.24 ± 10^3/µl; lymphocyte 1.36 ± 0.06 x 10^3/µl; monocyte 0.03 ± 0.00 x 10^3/µl; eosinophil 0.10 ± 0.02 x 10^3/µl; basophil 0.01 ± 0.00 x 10^3/µl; aspartate aminotransferase 73.99 ± 5.40 IU/L; alanine aminotransferase 11.00 ± 2.12 IU/L; alkaline phosphatase 165.19 ± 15.77 IU/L; total proteins 4.64 ± 0.17 g/dl; albumin 2.54 ± 0.12 g/dl; globulin 2.11 ± 0.12 g/dl; cholesterol 157.83 ± 12.81 mg/dl; creatinine 0.98 ± 0.11 mg/dl; uric acid 5.62 ± 0.45 mg/dl. There were no sex-related variations in all the studied haematological and biochemical parameters. It was also found that the local breed had significantly higher ($p<0.05$) monocyte numbers than the foreign breed (Nicholas large white). This study shall form a basis for establishing haemato-biochemical reference range of values for clinical and scientific uses by avian clinicians for turkey populations in Nsukka.

Keywords: Haematology, Biochemicals, Domestic turkeys, Nsukka metropolis

INTRODUCTION

Domestic turkey (*Meleagris gallopavo*) (Crawford, 1993) which originated from North America has been domesticated worldwide including Nigeria, and serves as an important source of animal protein (Nixey and Grey, 1985). It is reared for its tasty and high quality meat (high in protein and low in cholesterol) and for egg production in the rural and urban areas of Nigeria (Prabakaran, 2003). Currently, there are different breeds/varieties of turkeys which include white turkey (Nicholas large white, Beltsville small white, White Holland turkey), black turkey, (Narragansett - predominantly white with interspersed white, royal palm - predominantly white with few black feathers, slate - ash coloured/ashy blue and sometimes dotted with black, Bourbon red - predominantly black with white tail, bronze - shimmering green-bronze that appears metallic under sunlight, Czech wild white-braided turkey, Dindon Rouge des Ardennes of France and the Zargorje of Croatia). In Nigeria, our local breed

usually includes the black and lavender varieties.

Turkey production is one of the most important and probably most profitable form of poultry production as it can be the sole means of livelihood for backyard poultry farmers (Adene, 1990). The economic significance of turkey production varies considerably, although it has become increasingly specialized and integrated into a dynamic industry of national and international importance. The importance of turkey production in the national economy of developing countries and its role in improving the nutritional status and income of many small communities has been very significant.

However, production levels of turkeys in many African countries are far below desirable levels mainly due to the menace of infectious diseases and poor management (FAO, 1997). Important factors in the continued growth of the poultry industry in many countries include the efficiency of poultry in converting vegetable protein into animal protein, the attractiveness and acceptability of turkey meat and eggs to many people, their competitive cost, the perceived healthfulness of turkey meat in human diets, acceptability to all religions, and the relative ease with which new technologies can be transferred between countries (FAO, 1997).

In veterinary practice, the assessment of the haematology and biochemical profile is important as it is used to evaluate the physiological and pathological status of birds and animals (Carter, 1996; Yaqub *et al*., 2013). Evaluation of the haemato-biochemical parameters in birds is also important in ascertaining response to its internal and external environments (Sparling *et al*., 1999; Esonu *et al*., 2001). Haematological assessments are used as basis for diagnosis of avian diseases (Tibbo *et al*., 2004), monitoring recovery during treatment and assessment of the health status of a single bird or entire flock (Messer, 1995). Quantitative determination of a wide variety of substances (substrates, enzymes and hormones) in plasma or serum helps to assess the present functional status of the vital body organs especially the pancreas, heart, muscles, liver and the kidney. Therefore, an evaluation of the haematology and biochemical parameters is important in arriving at a definitive diagnosis, assessing the efficacy of instituted therapy, determine the toxicity of drugs and chemical substances and to make a prognosis (Coles, 1986; Stockham and Scott, 2008). Factors affecting haematological values include the age, species, breeds, sex, nutritional state and management, environmental factors such as temperature, humidity, altitude and day length, the type of anticoagulant used and sample handling (Sparling *et al*., 1999; Stockham and Scott, 2008).

It has been established that there are differences in the haematological and biochemical parameters of different breeds of turkeys and because of this every laboratory or clinic need to establish reference values for the turkey population in its environment (Coles, 1986; Stockham and Scott, 2008). Because of the scanty information on the haematological and biochemical profile of domestic turkeys, the need for sufficient information for diagnostic and management purposes and the increase in demand for turkey production in Nsukka, this present study therefore, evaluated the haematological and biochemical profile of domestic turkeys and determined the influence of sex and breed on these parameters.

MATERIALS AND METHODS

The study was carried out on 58 apparently healthy domestic turkeys of varying breed (local and Nicholas large white) and sexes for a period of 6 months. These turkeys were raised by backyard/small scale poultry farmers in Nsukka metropolis. Nsukka is situated within the derived savanna belt of the state between latitude 5° 50' and 7° 00' North and longitude 6° 50' and 7°54'. It is also located at the Northern part of Enugu State. History (vaccination, nutrition and management system) was also obtained from the farmers before blood samples were collected for haematology and biochemical analysis. The turkeys were all raised on free range system. These turkeys were bled through the jugular vein and 3 ml of blood was collected. Blood sample (1 ml) for haematology was collected into appropriately labeled sample

bottles containing ethylene diamine tetra acetic acid (EDTA) (1 mg/ml of blood). Blood samples were placed on ice for transport to the laboratory.

Blood Collection: Two (2) ml of blood was put into plain glass test tubes and allowed to clot at room temperature within one hour of collection. Serum was obtained by spinning the clotted blood at 3000 rpm for 10 minutes using a clinical table centrifuge (Ajmer, India). Both haematological and biochemical parameters were evaluated immediately upon sample collection. None of the samples were stored.

Haematology: The haematological determinations were carried out following standard procedures. The packed cell volume (PCV) was determined by the micro-haematocrit method (Thrall and Weiser, 2002), haemoglobin concentration (Hbc) was determined by the cyanomethemoglobin method (Higgins *et al.*, 2008). Red blood cell (RBC) counts and total leukocyte counts (TLC) were carried out by haemocytometer method (Thrall and Weiser, 2002), while blood smear made on clean glass slides for differential leukocyte count were stained following the Leishman technique and were enumerated by the battlement counting method (Thrall and Weiser, 2002). The mean corpuscular values; mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) were calculated using the standard formulae (Schalm *et al.*, 1975; Coles, 1986).

Serum Biochemistry: The serum biochemistry determinations were carried out using commercial test kits, Quimica Clinica Aplicada (QCA) test kits (QCA, Spain) and a digital colorimeter (Lab-tech, India). The serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) activities were determined by the Reitman-Frankel method (Reitman and Frankel, 1957). The serum alkaline phosphatase (ALP) activity was determined by the phenolphthalein monophosphate method (Klein *et al.,* 1960; Babson *et al.,* 1966), while the serum total protein (TP) was determined by the direct Biuret method (Lubran, 1978) and the serum albumin was determined by the Bromocresol green method (Doumas *et al.*, 1971). The serum globulin was calculated as the difference between the serum TP and serum albumin (Colville, 2002). The serum uric acid was determined by the Uricase-POD method (Trinder, 1969), while the serum creatinine was determined by the modified Jaffe method (Blass *et al.,* 1974). The serum cholesterol was determined by the enzymatic colorimetric method (Allain *et al.,* 1974).

Data Analysis: Data generated from the study was subjected to descriptive statistics using SPSS 17.0. The differences between the haematological and biochemical parameters of the apparently healthy male and female turkeys were analyzed using students t – test, while the differences between the haematological and biochemical parameters of apparently healthy local and foreign breeds were also analyzed using students t-test. The data were presented as means and standard errors of means, and the minimum and maximum values for each parameter. Significant difference was accepted at $p<0.05$.

RESULTS

The values obtained for the haematological and serum biochemistry parameters of apparently healthy domestic turkeys, with their minimum and maximum values are presented in Tables 1 side by side with the reference values and ranges for these parameters as reported in literature. There were no significant sex-related differences ($p>0.05$) in all the haematological parameters though the mean red blood cell, total leukocyte, heterophil, monocyte, and eosinophil counts were numerically higher in males than in females (Table 2). The mean haemoglobin concentration and lymphocyte count were numerically higher in the females than in the males (Table 2). There were also no significant sex-related differences ($p>0.05$) in all the serum biochemical parameters but the mean total cholesterol and creatinine values were numerically higher in males than in females

(Table 2). The serum aspartate aminotransferase, alanine aminotransferase, alkaline phosphatase, total protein, albumin, globulin and uric acid values were numerically higher in females than in males (Table 2).

There were no significant breed differences ($p>0.05$) in all the haematological and serum biochemistry parameters, except in the monocyte count which was significantly ($p<0.05$) higher in the local breed than in the foreign breed (Table 3). The mean red blood cell, haemoglobin concentration, heterophil and eosinophil counts, serum aspartate aminotransferase, alkaline phosphatase, total protein, globulin, creatinine and uric acid values were lower (but not significant) in local breed than foreign breed (Tables 3). In foreign turkeys, the total leukocyte and lymphocyte counts, serum albumin and total cholesterol values were numerically lower but not significantly different ($p>0.05$) when compared to those of local turkeys.

DISCUSSION

The haematological and serum biochemistry parameters of domestic turkeys recorded in this study were within ranges as reported by Gylstroff (1983), LAVC (2009) and Ajaonuma *et al.* (2013), both in mean and reference range of values. However, the report of this study contradicts that of Bounous *et al.* (2000) who recorded higher values for total leucocyte, heterophil and lymphocyte counts. The not significant increase in PCV and RBC counts in males than females could be a function of high levels of testosterone in adult male birds and mammals (Sturkie, 1986), which stimulate erythropoiesis (Villers and Dunn, 1998). The present study also showed that there were no significant sex differences in RBC count, total and differential leukocyte counts and thus agreed with the report on a study on ring-necked pheasant (Schmidt *et al.,* 2007) and free-range helmeted guinea fowl (Nalubamba *et al.,* 2010).

In this study, it was established that heterophil is the most abundant white blood cell in turkeys. This is not in agreement with that of other avian species such as budgerigars (Harper and Lowe, 1998), helmeted guinea fowl (Nalubamba *et al.,* 2010), ducks (Okeudo *et al*., 2003), Muscovy ducks (Sulaiman *et al*., 2010) and Juvenile wild turkeys (Bounous *et al*., 2000) where lymphocyte was found to be the most abundant white blood cell. Ibrahim *et al.* (2012) reported no sex-related differences in serum TP, creatinine, albumin, globulin, ALP, AST and ALT. This was in agreement with the findings of this study. Also, the serum AST, ALT and ALP values obtained in this study for both male and female turkeys were much higher than reported values by Ibrahim *et al*. (2012). The serum creatinine value for female turkeys and serum globulin value for male turkeys were similar to that documented by Ibrahim *et al.* (2012). No significant sex variation in serum TP concentration was observed in local ducks (Oladele *et al*., 2001a) and pigeons (Oladele *et al*., 2001b). This finding was in agreement with the findings of this study where sex had no influence on the serum TP concentration. The high but not significant serum creatinine concentration in males could be attributed to increase muscle mass of male turkeys than females. The recorded increase but not significant uric acid concentration for adult female turkeys may be attributed to ovulatory activity of female birds (Ritchie *et al.*, 1994; Ibrahim *et al.,* 2012), and it has also been suggested that concentration of estrogen and protein diet may influence plasma uric acid concentration in chickens (Sturkie, 1961). The mean serum AST value obtained in this study for female turkeys were lower than that reported by Schmidt *et al*. (2010), while the serum TP, albumin and globulin values were similar to the report of Schmidt *et al.* (2010). It is suggested that laying season in female pigeons (Gayathri and Hedge, 2006) and wild turkeys (Martin *et al*., 1981) may lead to an increase in blood proteins induced by estrogen.

Table 1: Haematological and serum biochemical profiles of apparently healthy domestic turkeys compared to reference range of values in available literature

Parameters	This study[a]	LAVC (2009)	Mehner and Hartfiel (1983) (Turkey)	Bounous *et al.* (2000) (Wild turkey)	Ajuonuma *et al.* (2013) (Domestic turkey)
Haematology		**Haematological profile**			
Packed cell volume (%)	30.70 ± 0.63 (20.00 – 39.00)	-	36 – 41	31 – 42	31.75
Red blood cell count ($x10^6$/µl)	3.75 ± 0.22 (2.41 – 8.23)	-	2.3 – 2.8	-	2.03
Haemoglobin concentration (gldl)	12.95 ± 0.62 (10.42-15.20)	-	10.3 – 15.2	-	10.57
Total leukocyte count ($x10^3$/µl)	3.67 ± 0.09 (2.40 – 4.35)	-	2.35 – 2.68	10.4 – 46.5	-
Heterophil count ($\times10^3$ /µl)	2.24 ± 0.08 (1.33 – 3.00)	-	-	4.06 – 27.61	-
Lymphocyte count ($x10^3$/µl)	1.36 ± 0.06 (0.68 – 1.90)	-	-	4.22 – 34.27	-
Monocyte count ($x10^3$ /µl)	0.03 ± 0.00 (0.00 – 0.12)	-	-	0 – 4.0	-
Eosinophil count ($x10^3$/µl)	0.10 ± 0.02 (0.00 – 0.28)	-	-	0 – 0.4	-
Basophil count ($x10^3$/µl)	0.01 ± 0.00 (0.00 – 0.07)	-	-	0 – 2.2	-
Serum Biochemistry		**Serum biochemical profile**			
Aspartate aminotransferase (IU/l)	73.99 ± 5.40 (55.50 – 120.21)	100 - 400	-	255 – 499	117.50
Alanine aminotransferase (IU/l)	11.00 ± 2.12 (3.08 – 37. 99)	-	-	-	10.00
Alkaline phosphatase (IU/l)	165.19 ± 15.77 (108.95 – 370.20)	35 – 410	-	-	-
Total Proteins (g/dl)	4.64 ± 0.17 (3.04 – 6.21)	-	-	3.6 – 5.5	4.56
Albumin (g/dl)	2.54 ± 0.12 (1.26 – 3.90)	-	-	1.1 – 2.1	1.91
Globulin (g/dl)	2.11 ± 0.12 (1.12 – 3.14)	1.2 – 3.2	-	-	2.65
Total Cholesterol (mg/dl)	157.83 ± 12.81 (63.00 – 366.67)	139 -202	-	60 – 220	101.00
Creatinine (mg/dl)	0.98 ± 0.11 (0.50 – 2.00)	0.1 – 0.5	-	-	-
Uric acid (mg/dl)	5.62 ± 0.45 (2.50 – 466.67)	6	-	3 – 17	-

[a]*Mean ± SE, with minimum and maximum values in bracket, n = 58*

Table 2: Sex differences in the haematological and serum biochemical profiles of apparently healthy domestic turkeys

Parameters	Males (n = 19)	Females (n = 39)
Haematology	**Haematological profile**	
Packed cell volume (%)	31.08 ± 1.03 (25.00 – 39.00)	30.50 ± 0.80 (20.00 – 37.00)
Red blood cell count (x10^6/µl)	4.04 ± 0.53 (2.41 – 8.23)	3.56 ± 0.14 (2.95 ± 5.35)
Haemoglobin concentration (g/dl)	11.10 ± 0.68 (10.42 – 11.78)	12.95 ± 0.62 (10.42 – 15.20)
Total leukocyte count (x10^3/µl)	3.75 ± 0.14 (2.60 – 4.10)	3.62 ± 0.12 (2.40 – 4.35)
Heterophil count (×10^3/µl)	2.37 ± 0.15 (1.33 – 3.00)	2.15 ± 0.08 (1.47 – 2.65)
Lymphocyte count (x10^3/µl)	1.24 ± 0.11 (0.68 – 1.89)	1.45 ± 0.07 (1.02 – 1.90)
Monocyte count (x10^3 /µl)	0.03 ± 0.01 (0.00 – 0.11)	0.02 ± 0.00 (0.00 – 0.12)
Eosinophil count (x10^3/µl)	0.12 ± 0.03 (0.00 – 0.28)	0.09 ± 0.02 (0.00 – 0.25)
Basophil count (x10^3/µl)	0.003 ± 0.003 (0.00 – 0.03)	0.009 ± 0.005 (0.00 –0.07)
Serum biochemistry	**Serum biochemical profile**	
Aspartate aminotransferase (IU/l)	68.68 ± 3.98 (55.50 – 98.09)	83.79 ± 6.60 (55.50 – 120.21)
Alanine aminotransferase (IU/l)	8.53 ± 1.64 (3.24 – 20.38)	13.02 ± 3.59 (3.08 – 37.99)
Alkaline phosphatase (IU/l)	152.87 ± 19.03 (108.95 -320.00)	175.46 ± 24.54 (110.45 – 370.20)
Total Protein (g/dl)	4.30 ± 0.27 (3.04 – 6.21)	4.87 ± 0.02 (3.07 – 6.01)
Albumin (g/dl)	2.41 ± 0.17 (1.64 – 3.25)	2.63 ± 0.16 (1.26 – 3.90)
Globulin (g/dl)	1.90 ± 0.19 (1.12 - 3.92)	2.25 ± 0.15 (1.30 – 3.14)
Total Cholesterol (mg/dl)	185.72 ± 25.44 (112.50 – 366.67)	141.09 ± 12.49 (63.08 – 222.20)
Creatinine (mg/dl)	1.06 ± 0.19 (0.50 – 2.00)	0.92 ± 0.13 (0.50 - 2.00)
Uric acid (mg/dl)	5.48 ± 0.63 (2.50 – 10.00)	5.74 ± 0.65 (2.50 – 10.00)

Mean ± SE, with minimum and maximum values in bracket, n = 58

Table 3: Breed differences in the haematological and serum biochemical profiles of apparently healthy domestic turkeys

Haematological parameters	Local (n = 41)	Foreign (Nicholas large white) (n = 17)
Haematology	**Haematological profile**	
Packed cell volume (%)	30.78 ± 0.57 (23.00 – 37.00)	30.20 ± 3.12 (20.00 -39.00)
Red blood cell count (10^6/µl)	3.73 ± 0.24 (2.41 – 8.23)	3.92 ± 0.09 (3.83 – 4.01)
Haemoglobin concentration (g/dl)	12.54 ± 0.89 (10.42 – 14.39)	13.50 ± 0.91 (8.42 – 10.78)
Total leukocyte count (10^3/µl)	3.71 ± 0.08 (2.60 – 4.35)	3.19 ± 0.79 (2.40 – 3.98)
Heterophil count (10^3/µl)	2.22 ± 0.08 (1.33 – 3.00)	2.47 ± 0.08 (2.39 – 2.55)
Lymphocyte count (10^3/µl)	1.37 ± 0.07 (0.68 – 1.90)	1.31 ± 0.16 (1.15 – 1.47)
Monocyte count * (10^3/µl)	0.03 ± 0.00 (0.00 – 0.12)	0.00 ± 0.00 (0.00 – 0.00)
Eosinophil count (10^3/µl)	0.09 ± 0.02 (0.00 – 0.07)	0.20 ± 0.08 (0.12 – 0.28)
Basophil count (10^3/µl)	0.01±0.00 (0.00 – 0.07)	0.00 ± 0.00 (0.00 – 0.00)
Serum Biochemistry	**Serum biochemical profile**	
Aspartate aminotransferase (IU/l)	76.81 ± 5.24 (55.50 – 120.21)	77.72 ± 6.31 (63.37 – 92.12)
Alanine aminotransferase (IU/l)	11.34 ± 2.57 (3.08 – 37.99)	11.34 ± 2.57 (3.45 – 18.23)
Alkaline phosphatase (IU/l)	157.07 ± 15.13 (108.95 – 333.23)	201.75 ± 6.46 (129.21 – 370.20)
Total protein (g/dl)	4.60 ± 0.20 (3.04 – 6.21)	4.90 ± 0.35 (4.21 – 5.64)
Albumin (g/dl)	2.55 ± 0.14 (1.26 – 3.90)	2.45 ± 0.13 (2.12 – 2.76)
Globulin (g/dl)	2.04 ± 0.13 (1.12 – 3.14)	2.45 ± 0.26 (1.92 – 2.89)
Total Cholesterol (mg/dl)	165.14 ± 13.78 (87.50 – 366.67)	121.25 ± 31.67 (63.08 – 208.28)
Creatinine (mg/dl)	0.92 ± 0.11 (0.50 – 2.00)	1.50 ± 0.50 (1.00 – 2.00)
Uric acid (mg/dl)	5.48 ± 0.45 (2.50 – 10.00)	7.37 ± 2.38 (5.00 – 9.75)

*Mean ± SE, with minimum and maximum values in bracket, n = 58, *Asterisk superscript on any parameter indicates significant difference between the local and foreign breeds, p<0.05*

The values for the haemato-biochemical parameters of the local and foreign breeds recorded in this study were the same (except for the monocyte number) and this could be attributed to the fact that foreign turkeys acclimatized in our locality as turkeys are known to have the ability to acclimatize in various types of climate (Isidahomen *et al*., 2013). Previous studies in Indian turkeys (Pandian *et al.,* 2012) and other breeds of turkeys (Isidahomen *et al*., 2013) revealed that PCV values vary among breeds of turkeys and thus contrasts with the

findings of this study where there were no breed differences in PCV values. Significant differences in erythrocytic indices, total leukocyte, heterophil, lymphocyte, basophil and eosinophil numbers documented by Isidahomen *et al*. (2013) contrast with the findings of this study except in the monocyte numbers but agreed with that of Oke *et al.* (2007) in red blood cell number and haemoglobin concentration. The finding of a significantly higher monocyte number and its biological significance in local than Nicholas large white is not understood. The findings of this study disagreed with the work of Isidahomen *et al*. (2013) who found significant breed differences in serum concentrations of TP, albumin, cholesterol and creatinine, and agreed with that of El-Safty *et al*. (2006). The serum creatinine levels of Nicholas large white were numerically higher but not significant when compared to the local breed. This may be attributed to the high amount of phosphocreatine (a precursor of creatinine) found in muscle cells of foreign turkey when compared to that in the local turkeys. As a result of this, the muscle mass of the Nicholas large white is larger than that of local turkeys (Stockham and Scott, 2008).

Conclusion: Based on the results of this study, it was concluded that no statistical sex differences were recorded for all haemato-biochemical parameters of apparently healthy adult turkeys studied. It was also found that there were no statistical breed differences in all the haemato-biochemical parameters except for the monocyte numbers that were significantly higher in local than foreign breeds. Therefore, it is suggested that large sample size for male turkeys and Nicholas large white breed of turkeys be used for further studies. However, the present study will guide future use of this reference range of values for diagnostic and management purposes by veterinarians and avian specialists.

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