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Age and Sex Influences on the Haematology and Erythrocyte Osmotic Fragility of the Nigerian Turkey

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ABSTRACT

This study was conducted to evaluate the haematological parameters and the erythrocyte osmotic fragility of the Nigerian turkeys, reared under intensive management and to determine the influence of age and gender. Data obtained are expected to serve as reference values for adult Nigerian turkeys during disease diagnosis and general health status assessment in this strain of turkey. Ten each of adult male, female and young 8 weeks old Nigerian turkeys raised under intensive management in a local farm were used for the study. Blood samples were collected from apparently healthy birds reared under intensive management in a local farm in Ibadan, South West, Nigeria. The Red Blood Cell (RBC) count was significantly higher in the adult female turkeys than in the male while the MCV (mean corpuscular volume) was lower. The Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Mean Corpuscular Haemoglobin (MCH) and the Mean Corpuscular Haemoglobin Concentration (MCHC) as well as the total White Blood Cell (WBC) count were similar in both sexes. The erythrocyte osmotic fragility was also higher in the female than in the males. The Hb, RBC, MCH, MCHC and WBC values were also found to be higher in the young 8 weeks old turkeys than in the adults. The erythrocyte osmotic fragility was also higher in the young turkeys than in the adults. This study shows that age and gender variations in haematological parameters exist in the turkeys despite rearing under intensive management system. It also shows that the erythrocytes in the female and young turkeys are more susceptible to osmotic lysis. This is an indication that the erythrocytes from young and female turkeys are less resistant to oxidative stress.

Key words: Packed cell volume, RBC, leukocyte count, erythrocyte indices, turkeys, intensive management

INTRODUCTION

Determination of haematological parameters or indices has been a veritable tool in disease diagnosis and assessment of health status in animals and man. This is because; blood often gives specific indication of the ongoing events in the body, serving as an aid to diagnosis and health status assessment (Theml *et al.*, 2004; Tibbo *et al.*, 2004). Factors such as age (Oyewale and Durotoye, 1988; Azeez *et al.*, 2009a), gender (Peters *et al.*, 2010), environmental factors including season (Olayemi and Arowolo, 2009), diurnal changes (Azeez *et al.*, 2009b) and the stress to which the animals have been exposed, before sampling (Adenkola and Ayo, 2009) have been shown to

influence haematological parameter. Some of these factors even demonstrate considerable variations among the same species but different strains, despite identical age, sex and management.

The underlying mechanisms employed by each of the factor are as diverse as the factors themselves. In ageing for example, age related changes have been associated with degenerative changes caused by imbalance in redox signaling and generation of free radicals at rates that cannot be matched by endogenous antioxidants such as glutathione and superoxide dismutase, among others (Sheikh *et al.*, 2005; Oyagbemi *et al.*, 2009). Other stress factors such as captivity, handling, transportation etc. are also involved in increased generation of reactive oxygen species and other free radicals (Newman *et al.*, 2006; Adenkola and Ayo, 2009). Seasonal variation in haematological parameter on the other hand have been associated with the both the ambient temperature and availability of adequate feed and water during a particular season than the others (Oladele *et al.*, 2001). Diurnal variations in haematological parameters, according to Piccione *et al.* (2005) are usually due to changes in activities of the animal according to the light and dark cycle of the day.

Indigenous turkeys have become a good source of income and protein, especially among small, subsistent farmers in South West Nigeria. These birds are however managed at best under semi-intensive system (Olayemi and Ojo, 2007). Because of the relatively low weight gain under these extensive and semi-intensive management systems, farmers have intensified efforts at raising these birds under intensive management system for better productivity. This therefore, poses a challenge for base line data for reference purposes in disease diagnosis and health status evaluation in indigenous turkeys raised under purely intensive management system. Previous studies have reported the haematological parameters of the White England turkeys in the hot humid tropical environment (Makinde and Fatunmbi, 1985; Oyewale and Durotoye, 1988) and bronze turkeys (Schmidt *et al.*, 2009) which are the most common turkey breeds bred for commercial meat production especially, in Nigeria; this study was conducted to investigate the haematological parameters and the erythrocyte osmotic fragility of the indigenous turkeys under intensive management system and the effects of age and sex on these parameters.

MATERIALS AND METHODS

Blood samples (5 mL each) were collected into heparinized tubes, from 10 six weeks old, 10 adult male and 10 adult female local turkeys from a flock, in a commercial poultry farm in Ibadan, South West Nigeria in July 2010. From the samples collected, the Packed Cell Volume (PCV) was determined by microhaematocrit method. Red Blood Cells (RBC) and White Blood Cells (WBC) were counted using the haemocytometer method (Jain, 1986). Haemoglobin concentration (Hb) was determined by the cyanmethaemoglobin method (Jain, 1986). The Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated from the PCV, RBC and Hb values according to Jain (1986), Erythrocyte osmotic fragility was determined according to the method described by Oyewale (1992).

Statistical analysis: All results were compared statistically by Student's t-test using GraphPad Prism version 4.00 for Windows (GraphPad Software, San Diego California USA, www.graphpad.com). The value of $p<0.05$ was considered significant.

RESULT

The haematological parameters of the Nigerian turkeys are presented in Table 1, showing the effects of age and sex. The Packed Cell Volume (PCV) did not show any significant age or sex

Table 1: Haematological parameters of the Nigerian turkey showing the effects of age and sex

Parameters	Adult male turkeys (10)	Adult female turkeys (10)	Young 6 weeks old turkeys (10)
PCV (%)	40.20±4.47	39.95±3.55	37.33±3.74
Hb (g dL^{-1})	13.79±2.66[a]	13.09±2.22[b]	16.77±4.64[ab]
RBC×10^6 μL^{-1}	1.99±0.38[ab]	2.26±0.28[a]	2.37±0.52[b]
MCV (fL)	207.64±40.66[ab]	179.86±11.21[a]	162.51±26.94[b]
MCH (pg)	72.38±22.46	58.66±11.98[a]	72.83±21.64[a]
MCHC (g dL^{-1})	34.50±6.75[a]	32.92±6.09[b]	45.14±12.04[ab]
WBC×10^3 μL^{-1}	10.22±2.15[a]	10.80±2.55[b]	16.34±4.93[ab]

Values are Mean±SD. No. of birds in parenthesis. Values with the same superscript along the same row are significantly different at $p<0.05$

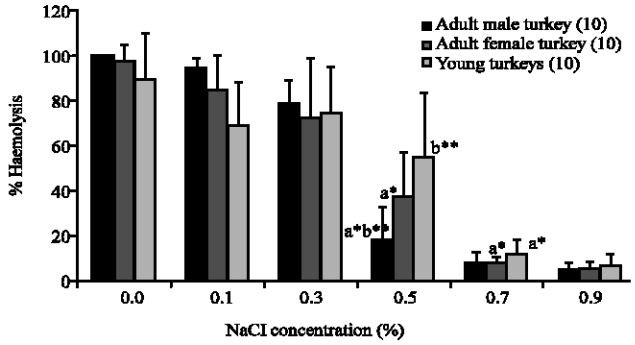

Fig. 1: Erythrocytes osmotic fragility of the Nigerian turkeys showing age and sex variations. Values are means while vertical bars represent SD. Number of birds shown in parenthesis values with the same superscript alphabets are significantly different. *$p<0.05$; **$p<0.01$

variation in the turkeys whereas the Hb value in the young turkeys was significantly higher ($p<0.05$) than that of either the adult male or female turkeys. The Red Blood Cell (RBC) count on the other hand showed significant sex and age variations in the Nigerian turkeys. For instance, the RBC count in the male was lower ($p<0.05$) than that of the female, it was also lower than the value obtained in the young turkeys. The Mean Corpuscular Volume (MCV) of the adult male turkeys was higher than that of either the adult female or young turkeys while those of the adult female and young turkeys were similar. The Mean Corpuscular Haemoglobin (MCH) of the female turkey was lower ($p<0.05$) than that of the young turkeys. Mean Corpuscular Haemoglobin Concentration (MCHC) in the young turkeys was also significantly higher ($p<0.05$) than those of the adults. Finally, the young turkeys also had higher White Blood Cell (WBC) count than those of the adult, while those of the adults were similar.

As shown in Fig. 1, the erythrocyte osmotic fragility of the Nigerian turkeys also demonstrated considerable sex and gender variation. The erythrocyte fragility of the adult female turkey was lower than that of the male at 0.1% NaCl concentration. However, the reverse was the case at 0.5% NaCl concentration where the erythrocyte fragility of the female was higher than that of the male turkeys. In terms of the gender variations, the erythrocyte fragility of the young turkeys was lower than that of either the adult male or female turkeys at 0.1% NaCl concentration. Conversely however, the erythrocytes of the young turkeys appeared to be more fragile than those of the adult male and female when suspended in 0.5 and 0.7% NaCl, respectively.

DISCUSSION

In the present study, the RBC count was higher in the adult female turkeys than in their male counterparts while the MCV value was higher in the male than in the females but no significant gender variation were observed in the PCV, Hb, MCH and MCHC as well as the WBC of the Nigerian turkey. This is similar to the observations in the adult, 32 week-old bronze turkeys, in which the females were reported to have higher RBC counts than the males (Schmidt *et al.*, 2009). It is however in contrast with the observations of Olayemi and Ojo (2007), also in the Nigerian local turkeys in which no significant sex variation was observed in the RBC count and MCV. Other parameters such as PCV, Hb concentration, MCH and MCHC and WBC values did not show any gender variation in the present study and in previous study in the same environment (Olayemi and Ojo, 2007). In a like manner, the PCV, Hb and WBC of the bronze turkey also did not exhibit any significant sex variation (Schmidt *et al.*, 2009). Gender variation in the RBC and MCV in the turkey in the present study is in contrast with previously reported sex variations in the haematological parameter in avian species. For instance, Oyewale and Ajibade (1990) reported a higher RBC, PCV and Hb values in the adult male turkeys than in the females, Higher values were also reported in these parameters in adult male than in the females in the domestic chicken (Oyewale and Durotoye, 1988), pigeons (Oladele *et al.*, 2001), pheasants (Hauptmanova *et al.*, 2006) and even in the Japanese quail (Nirmalan and Robinson, 1971). Although, the values of most of the haematological parameters obtained in the present study were lower than those reported by Olayemi and Ojo (2007) for the Nigerian turkeys, also in a similar hot humid environment, those values were still higher than those reported by Oyewale and Ajibade (1990) in the white England turkeys and those reported by Schmidt *et al.* (2009) in the bronze turkeys.

Significant sex variation in the RBC and MCV in the adult turkeys in our study as compared to previous studies by Oyewale and Ajibade (1990) and Olayemi and Ojo (2007) is an indication that routine evaluation of haematological parameters should be done regularly to validate previously obtained reference haematological values. The higher RBC in the females than in the males might not be unconnected with elevated oestrogen levels in the blood associated with cyclic changes in the females leading to excitement and increased erythropoiesis (Tibbo *et al.*, 2004). In actual fact, erythropoietin has been reported to increase with concomitant increase in estradiol levels in women (Widness *et al.*, 1984; Cotes *et al.*, 1983). This will inadvertently lead to increased erythtropoiesis during the follicular phase of oestrous cycle when plasma estrogen levels are high (Guyton and Hall, 2006). The erythrocytes of the adult female turkey appeared less resistant to osmotic lysis than those of the males in this study. This may be as a result of the higher MCV in the male than in the female. According to Jain (1986), erythrocytes with high MCV values usually have higher osmotic fragility because of higher resilience of the membrane. Olayemi *et al.* (2009) also reported similar higher erythrocyte osmotic fragility in female Nigerian indigenous mongrel dogs than in their male counterparts. This is however contrary to the observations in the domestic chicken, guinea fowl and the white England turkey in which the male shows higher erythrocyte osmotic fragility than the females (Oyewale and Durotoye, 1988; Oyewale and Ajibade, 1990).

As would be expected, there were significant age variation in the haematological parameters of the Nigerian turkeys in present study. The RBC, Hb, MCH, MCHC and WBC values were higher in the young immature turkeys than in the adults (Table 1). But the MCV was lower than that of the adults. Haematological parameters have been widely reported to increase as animals advance in age (Islam *et al.*, 2004; Pavlak *et al.*, 2005). But the parameters studied in the Nigerian turkey were higher in the young than in the adults whereas, the contrary have been reported in the

domestic chicken (Islam *et al.*, 2004), pigeon (Pavlak *et al.*, 2005), pheasant (Schmidt *et al.*, 2007) and buzzards (Howlett *et al.*, 2002) in which the PCV, RBC, haemoglobin values were reported to increase with age. It therefore appears that higher RBC, Hb, MCH and MCHC values in the young than in the adult turkeys is a peculiarity of this avian species because, Oyewale and Ajibade (1990) had obtained similar result in the white England turkeys. This observation may mean that the rate of erythropoietin production per unit body mass is higher in the young turkey than in the adults. It may also be an indicator of a lower plane of nutrition in the adults than in the young turkeys since availability of food may affect haematological parameters (Oladele *et al.*, 2001). The total WBC count was also higher in the young turkeys than in the adults, an indication of higher cell mediated immunity against infections in the young turkeys.

The erythrocytes of the young turkeys were also more fragile in hypotonic solution than were those of the adults. This is also similar to previous reports in the white England turkeys (Oyewale and Ajibade, 1990). This might be due to the lower mean corpuscular volume of erythrocyte in the young turkeys. This mean that young Nigerian turkeys are more susceptible to oxidative stress than the adults, because erythrocyte osmotic fragility has been shown to increase during stress, such as transportation (Adenkola and Ayo, 2009), restraining (Sahin *et al.*, 2004) or even excessive heat (Ozturk and Gumuslu, 2004) which may increase their susceptibility to opportunistic pathogens and infections like *E. coli* (Huff *et al.*, 2005). Oxidative stress generally results in the generation of free radical which leads to lipid peroxidation and destruction of erythrocytes membrane proteins (Droge, 2002) and subsequent increase in erythrocyte destruction and sequestration (An and Mohandas, 2008).

CONCLUSION

We can infer from this study that sex and age differences occur in haematological parameters of the turkeys. This must be taken into consideration when haematology results from turkeys are being interpreted during disease diagnosis. The erythrocyte membrane resistance to osmotic lysis also varies according to sex and age. This means that female and young turkeys are less resistant to stress than the adult male turkeys.

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