Erythrocyte Osmotic Fragility and Haematologic Parameters of Three Breeds of 9-Week-Old Broiler Chickens

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Abstract: The difference in Erythrocyte Osmotic Fragility (EOF) and haematologic parameters among two pure (Marshall and Ross) and a Hubbard-Anak cross breeds of 9-week-old broiler chickens were evaluated in this study. There was a statistically significant (P < 0.05) decrease in EOF in Marshall breed at NaCl concentrations of 0.5% when compared to other breeds. However, Ross breed had the highest EOF at this NaCl concentration. Haematologic parameters of Packed Cell Volume (PCV), haemoglobin concentration, Red Blood Cell (RBC) count, erythrocytic indices and differential leucocyte counts were not significantly different (P > 0.05) among the three breeds. In conclusion, this result revealed a breed difference in EOF and that erythrocyte membranes are osmotically more stable in Marshall breed of broiler chickens.

Key words: Haematologic parameters, erythrocyte osmotic fragility, breeds

INTRODUCTION
Osmotic fragility which describes the sensitivity to changes in osmotic pressure an erythrocyte is exposed to, has been shown to vary within different breeds of birds (Oyewale and Durotoye, 1988). Different factors have been reported to affect erythrocyte osmotic fragility. These include age (Azeez et al., 2011), sex (Oladele et al., 2001) storage, temperature, pH (Oyewale et al., 2011), season (Oladele et al., 2003) and transportation (Adenkola and Ayo, 2009). Erythrocyte osmotic fragility has been used as an indicator of oxidative stress in animals (Adenkola and Ayo, 2009; Abdul Wahab et al., 2010; Ambali et al., 2010). Haematological parameters provide reliable information on the health status of animals (Kwari et al., 2011). The haematological parameters of animals are influenced by several factors that affect blood cellular components such as age and sex of the animal (Azeez et al., 2011), breed (Islam et al., 2004), geographical location (Shanmugam et al., 2008), season (Al-Eissa, 2011) and diurnal fluctuation (Azeez et al., 2009a). Commercially reared chicken in the tropics are usually bred in temperate countries. In the tropics, these chickens are confronted with adverse climatic conditions characterised by high ambient temperature and humidity (Gowve and Fairfull, 2008). Thus, it is important to determine the haematologic alterations that may result from the effect of heat stress on broiler chickens raised in the tropics. Information on breed difference in erythrocyte osmotic fragility and other haematologic parameters of broiler chickens is scanty. The present study was aimed at demonstrating the effect of breed on osmotic fragility and haematologic parameters of three breeds of broiler chickens reared in a tropical environment.

MATERIALS AND METHODS
Experimental protocol: Twenty-four 9-week-old broiler chickens were used for the study, with each breed having 8 chickens each. The breeds of broiler chickens used were Ross, Marshall and Anak-Hubbard cross breeds. The broiler chickens were obtained from different hatcheries within Nigeria. They were apparently healthy chickens. The chickens were housed in the deep litter pens of Audu Bako College of Agriculture, Dambatta, Kano State, Nigeria. They were fed balanced poultry feed and water was provided ad libitum. The blood sample collection was done at slaughter point into a vacutainer containing KEDTA. The samples were then stored in an ice-packed cooler and transported to the laboratory for analysis in the Department of Veterinary physiology, Ahmadu Bello University Zaria, Nigeria. The PCV, RBC, erythrocytic indices, absolute and differential leukocytes counts were determined as described by Dacie and Lewis (1995). Haemoglobin concentration (Hb) was determined by the cyanmethaemoglobin method (Jain, 1986) and erythrocyte osmotic fragility was determined as described by Oyewale (1992).

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277
Data analysis: Values obtained were expressed as mean (±SEM). The data were subjected to one-way analysis of variance. The statistical package used was Graph Pad Prism Windows (2003). Values of P<0.05 were considered significant.

RESULTS
At 0.5% NaCl the EOF of Ross breed was significantly higher (P<0.05), while that of Marshal was lowest (P<0.05) when compared to other breeds (Fig. 1). Haematologic parameters of packed cell volume, red blood cell count and differential leucocyte counts were not statistically significant between breeds. Erythrocyte indices of Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were similar in all the breeds, except for Mean Corpuscular Volume (MCV). Higher MCV value was recorded in the Marshal breed but this was not statistically significant when compared to other breeds (Table 1).

DISCUSSION
This study indicates that Marshal breed erythrocytes appeared to be osmotically more resistant followed by the Anak-Hubbard cross, while Ross breed had the highest fragility. This may indicate that Marshal breed has an adaptive advantage for survival in the tropics compared to the other breeds. Breed difference in EOF as observed in this study is in agreement with previous studies in birds (March et al., 1966; Oyewale and Durotuye, 1988). This may be associated with differences in metabolic rate among the breeds of the broiler chickens used for this study. Increased metabolic activity in the cell will result in elevation in the production of free radicals (Brunet-Rossini, 2004). Due to the higher level of polyunsaturated fatty acids in their plasma membrane and intracellular oxygen and haemoglobin content, erythrocyte tend to be quite sensitive to oxidative stress (Aguirre et al., 1998; Hebbel, 1986). Peroxidation of unsaturated chain of membrane lipids increases the susceptibility of erythrocyte to osmotic haemolysis (Brzezinska-Slebodzinska, 2001). MCV is the average volume of individual RBC (Dacie and Lewis, 1995). Since the MCV of all the breeds were almost similar, the surface area-to-volume ratio (SAVR) could presumably be similar. Considering the fact that SAVR determines the intra-erythrocytic pressure (Kumar, 2002), when in a hypotonic solution, the increase in intra-erythrocytic pressure observed in the erythrocytes of all the breeds will be approximately equal. Hence, any discrepancy in EOF among the breeds may be associated to changes in plasma membrane.

While breed difference in haematologic parameters was not demonstrated in this study, other researchers have reported breed difference in haematologic parameters in chickens (Islam et al., 2004). This difference may be attributed to differences in nutrition (Kwari et al., 2011), season (Azeez et al., 2009a), and sex of the birds (Azeez et al., 2011).

Fig. 1: EOF of Anak-Hubbard cross, Marshal and Ross breeds of broiler chickens at 9-week-old

<table>
<thead>
<tr>
<th>Breed of chickens</th>
<th>AHC</th>
<th>Marshal</th>
<th>Ross</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>23.67±2.03</td>
<td>24.00±2.00</td>
<td>25.30±1.86</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>7.87±0.89</td>
<td>7.65±0.66</td>
<td>7.80±0.74</td>
</tr>
<tr>
<td>RBC (x10^6/µl)</td>
<td>1.95±0.12</td>
<td>1.98±0.16</td>
<td>1.97±0.26</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>120.80±0.40</td>
<td>121.50±0.38</td>
<td>120.50±0.28</td>
</tr>
<tr>
<td>MCH (pgi)</td>
<td>40.00±0.00</td>
<td>40.19±1.00</td>
<td>40.00±0.00</td>
</tr>
<tr>
<td>MCHC (g/dl)</td>
<td>30.10±0.10</td>
<td>30.27±0.09</td>
<td>30.12±0.07</td>
</tr>
<tr>
<td>Neutrophils (%)</td>
<td>7.3±0.33</td>
<td>6.33±2.80</td>
<td>6.33±2.80</td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>92.67±1.33</td>
<td>92.07±2.80</td>
<td>89.50±0.20</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
<td>0.0±0.0</td>
<td>1.00±0.57</td>
<td>0.50±0.50</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>0.0±0.0</td>
<td>0.10±0.10</td>
<td>0.0±0.0</td>
</tr>
</tbody>
</table>

Though the PCV, MCV, MCH, MCHC, haemoglobin concentration (Wakenell, 2010) and RBC counts (Azeez et al., 2009b) obtained were within the normal range, the lymphocyte counts of all the breeds were relatively high, when compared to those of chickens in temperate countries (Dukes, 1975). However, studies in broilers particularly in the tropics have revealed higher values of lymphocyte count (Muhammad and Oloyede, 2000; Sinkalu et al., 2010; Al-Mansour et al., 2011).

Conclusion: Considering the fact that Marshal and Anak-Hubbard cross breeds tended to have erythrocytes that are more osmotically resistant and that they had shown similarity in haematologic parameters, it can be assumed that they have adapted in the same pattern to the tropical environment. It is hoped that the result of this study will be used in interpretation of research work and decision making by broiler breeders in the tropic.

REFERENCES


