ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 12 (5): 277-279, 2013
ISSN 1682-8356

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

B. Habibu[1], L.S. Yaqub[1], I.A. Ahmed[4], M.U. Kawu[1], H.U. Buhari[3], M. Tauheed[2] and H.I. Isa[2]
[1]Department of Veterinary Physiology, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Veterinary Pharmacology and Toxicology, Ahmadu Bello University, Zaria, Nigeria
[3]Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Zaria, Nigeria
[4]Department of Animal Health and Husbandry, Audu Bako College of Agriculture, Danbatta, Kano State, Nigeria

Abstract: The difference in Erythrocyte Osmotic Fragility (EOF) and haematologic parameters among two pure (Marshal 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 Marshal 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 (Gowe and Fairfull, 2008). Thus, it is important to determine the haemotologic 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 haemotologic parameters of broiler chickens is scanty. The present study was aimed at demonstrating the effect of breed on osmotic fragility and haemotologic 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, Marshal 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 libitu*m. 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).

Corresponding Author: B. Habibu, Department of Veterinary Physiology, Ahmadu Bello University, Zaria, Nigeria

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 other previous studies in birds (March *et al*., 1966; Oyewale and Durotoye, 1988). This may be associated with difference 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-Rossinni, 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), age and sex of the birds (Azeez *et al*., 2011).

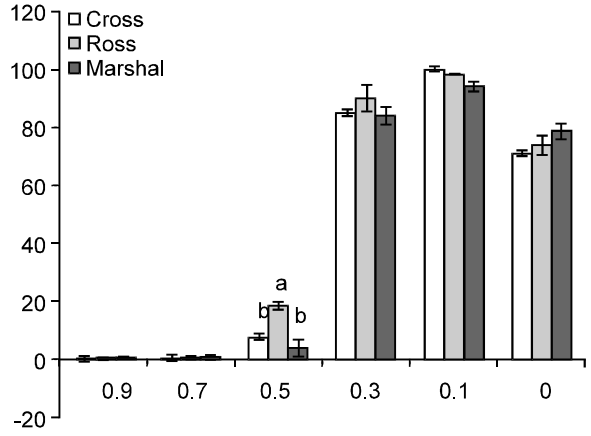

Fig. 1: EOF of Anak-Hubbard cross, Marshal and Ross breeds of broiler chickens at 9-week-old

Table 1: Haematologic parameters of Anak-Hubbard cross, Marshal and Ross breeds of broiler chickens at 9-week-old

Haematologic parameters	Breed of chickens		
	AHC	Marshal	Ross
PCV (%)	23.67±2.03	24.00±2.00	25.33±1.85
Hb (g/dl)	7.87±0.69	7.95±0.65	7.80±0.74
RBC (10^6/µL)	1.95±0.12	1.98±0.16	1.97±0.26
MCV (fL)	120.40±0.40	121.60±0.38	120.50±0.28
MCH (pg)	40.00±0.00	40.19±1.9	40.00±0.0
MCHC (g/dL)	30.10±0.10	30.27±0.09	30.12±0.07
Neutrophils (%)	7.33±1.33	6.33±2.60	6.33±2.60
Lymphocytes (%)	92.67±1.33	92.67±2.90	88.50±3.20
Eosinophils (%)	0.0±0.0	1.00±0.57	0.50±0.50
Monocytes(%)	0.0±0.0	0.10±0.10	0.0±0.0

AHC: Anak-Hubbard cross

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, 2009; 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 haemotologic 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

Abdul Wahab, A., M.A. Mabrouk, J.O. Ayo, S.F. Ambali, M. Shittu, A.A. Yahaya and S.E. Oluwatobi, 2010. Effects of co-administration of antioxidants on erythrocyte osmotic fragility of wistar rats during the hot-dry season. Eur. J. Sci. Res., 46: 073-079.

Adenkola, A.Y. and J.O. Ayo, 2009. Effect of road transportation on erythrocyte osmotic fragility of pigs administered ascorbic acid during the harmattan season in Zaria, Nigeria. J. Cell Anim. Biol., 3: 4-8.

Aguirre, F., I. Martin, D. Grinspon, M. Ruiz, A. Hager, T. De Paoli, J. Ihlo, H.A. Farach and C.P Poole, 1998. Oxidative damage, plasma antioxidant capacity and glucemic control in elderly NIDDM patients. Free Radic. Biol. Med., 24: 580-585.

Al-Eissa, M.S., 2011. Effect of gestation and season on the haematological and biochemical parameters in domestic rabbit *(Oryctolagus cuniculus)*. Br. Biotech. J., 1: 10-17.

Al-Mansour, S., A. Al-Khalf1, I. Al-Homidan and M.M. Fathi, 2011. Feed efficiency and blood hematology of broiler chicks given a diet supplemented with yeast culture. Int. J. Poult. Sci., 10: 603-607.

Ambali, S.F., A.T. Abubakar, M. Shittu, L.S. Yaqub, P.I. Kobo and A. Giwa, 2010. Ameliorative effect of zinc on chlorpyrifos-induced erythrocyte fragility in wistar rats. New York Sci. J., 3: 117-122.

Azeez, O.I., A.A. Oyagbemi and J.O. Oyewale, 2009a. Diurnal fluctuation in haematological parameters of the domestic fowl in the hot humid tropics. Int. J. Poult. Sci., 8: 247-251.

Azeez, O.I., F.O. Olayemi and J.R. Olanrewaju, 2011. Age and sex influences on the haematology and erythrocyte osmotic fragility of the Nigeria turkey. Res. J. Vet. Sci., 4: 43-49.

Azeez, O.I., J.O. Oyewale and O.O. Okunola, 2009b. Erythrocyte osmotic fragility of Nera Black fowls of two-age groups. Int. J. Poult. Sci., 8: 192-194.

Brunet-Rossinni, A.K., 2004. Reduced free-radical production and extreme longevity in the little brown bat *(Myotis lucifugus)* versus two non-flying mammals. Mech. Ageing Dev., 125: 11-20.

Brzezinska-Slebodzinska, E., 2001. Erythrocyte osmotic fragility test as the measure of defense against free radicals in rabbits of different ages. Acta Vet. Hung., 49: 413-419.

Dacie, J.V. and S.M. Lewis, 1995. Practical hematology, 7th Edn. Churchill Livingstone Edinburg, London, pp: 12-17.

Dukes, H.H., 1975. Physiology of domestic animals, 8th Edn. (M.J. Swenson, editor). Cornell University Press Limited, UK.

Gowe, R.S. and R.W. Fairfull, 2008. Breeding for resistance to heat stress. In: Poultry Production in Hot Climates, 2nd Edn. (Nuhad J. Daghir, editor). Cab international, Oxfordshire UK.

Hebbel, R.P., 1986. Erthrocyte anti-oxidant and membrane vulnerability. J. Lab. Clin Med., 107: 401-404.

Islam, M.S., N.S. Lucky, M.R. Islam, A. Ahad, B.R. Das, M.M. Rahman and M.S.I. Siddiui, 2004. Haematological parameters of Fayoumi, Assil and local chickens reared in Sylhet region in Bangladesh. Int. J. Poult. Sci., 3: 144-147.

Jain, N.C., 1986.Schalm 's Veterinary Haematology, 4th Edn., Lea and Febiger, Philadelphia.

Kumar, S., 2002. An analogy for explaining erythrocyte fragility: concepts made easy. Advan. in Physiol. Edu., 26: 134-135.

Kwari, I.D. S.S. Diarra, B. Saleh, P.R. Bovoa, O.A. Ramat and D. Tochukwu, 2011. Growth, hematology and serology of broiler chickens fed different cultivars of sorghum as replacement for maize in the semi-arid zone of Nigeria. Int. J. Poult. Sci., 10: 608-612.

March, B.E., V. Coates and J. Biely, 1966. The effects of estrogen and androgen on osmotic fragility and fatty acid composition of erythrocytes in the chicken. Can. J. Physiol. Pharmacol., 44: 379-387.

Muhammad, N.O. and O.B. Oloyede, 2009. Haematological parameters of broiler chicks fed. *Aspergillus nigeria*-fermented *Terminalia catappa* seed meal-based diet. Global J. Biotech. Biochem., 4: 179-183.

Oladele, S.B., S. Ogundipe, J.O. Ayo and K.A.N. Esievo, 2001. Effects of season and sex on packed cell volume, haemoglobin and total proteins indigenous pigeons in Zaria, Northern Nigeria. Vet. Arhiv., 71: 277-286.

Oladele, S.B., J.O. Ayo, S.O. Ogundipe and K.A.N. Esieo, 2003. Seasonal and species variations in erythrocytes osmotic fragility of indigenous poultry species in Zaria, Northern guinea savannah zone of Nigeria. Bull. Anim. Hlth. Prod. Afr., 51: 204-214.

Oyewale, J., T. Dzenda, L. Yaqub, D. Akanbi, J. Ayo, O. Owoyele, N. Minka and T. Dare, 2011. Alterations in the osmotic fragility of camel and donkey erythrocytes caused by temperature, pH and blood storage.Vet. Arhiv, 81: 459-470.

Oyewale, J.O. and L.A. Durotoye, 1988. Osmotic fragility of erythrocytes of two breeds of domestic fowl in the warm humid tropic. Lab. Anim., 22: 250-254.

Oyewale, J.O., 1992. Effect of temperature and pH on osmotic fragility of erythrocytes of the domestic fowl *(Gallus domesticus)* and guinea-fowl *(Numida meleagris)*. Res. Vet. Sci., 52: 1-4.

Shanmugam, A.A., J.K. Kumar, I. Selvaraj and V. Selvaraj, 2008. Hematology of sloth bears (*Melursus ursinus ursinus*) from two locations in Indian. J. Wildlife Dis., 44: 509-518.

Sinkalu, V.O., J.O. Ayo, A.B. Adelaiye and J.O. Hambolu, 2010. Effects of heat stress on leucocyte and haematocrit values of broiler chickens administered with melatonin during the hot-dry season. 47th Book of Proceeding, Nig. Vet. Med. Ass.

Wakenell P.S., 2010. Hematology of chicken and turkey. In: Shalm's veterinary hematology 6th Edn. (D.J. Weiss and K.J. Wardrop, editors). Wiley Blackwell, pp: 958-968.