Asian Journal of Chemistry Vol. 16, Nos. 3–4 (2004), 1505–1508

Investigation of the RBC Potassium Polymorphism in the Indian Sheep

ALKA ADHIKARI and S.P.S. MEHTA*
Department of Chemistry, Kumaun University, D.S.B. Campus, Nainital-263 002, India
E-mail: s_p_mehta2004@yahoo.com

Two distinct K-types of animals, *viz.*, high potassium (HK) and low potassium (LK), were identified in the Indian Bikaneri sheep. 52.6 were HK type and 47.4% were LK type. The metabolite concentrations in both types of animals were estimated and a comparision of the constituents was done statistically.

Key Words: RBC, Potassium, Polymorphism, Sheep, Metabolites.

INTRODUCTION

Abderhalden[1] had much earlier shown that the red cells of sheep are like those of cats and dogs but unlike most of other animals have low concentration of potassium and high sodium concentration. Kerr[2] reported three groups of sheep according to their sodium and potassium contents. Hallman and Karvonen[3] compared the red cell cation concentrations in foetal and maternal sheep. They reported that the intracellular sodium values of foetal blood were less than those of maternal blood while the corresponding potassium values were higher. This has since been confirmed by many workers[4–9] who examined the blood of either the foetuses or the newborn lambs.

Evans[10] reported that in the British breed sheep the concentration of potassium ranged with mean values of 36 meq/L and 13 meq/L. These were referred to be as high potassium (HK) and low potassium (LK) respectively. He also reported that the whole blood sodium concentration varied inversely with that of potassium concentration.

Taneja and Ghosh[11] worked on body weight and fleece weight in relation to blood potassium types. On the basis of concentration of potassium, sheep were classified into high potassium and low potassium types. The high concentration of potassium was further classified into three sub-types B, r and d on the basis of cellular potassium. Low potassium concentration was termed as a-type.

As reported later[12, 13] when LK type sheep are anaemic, their red cell potassium concentrations are elevated and the high potassium concentrations are confined to the young red cell fractions obtained by differential centrifugation of blood from anaemic sheep. Subsequent experiments[14] confirmed that the reticulocytes

are responsible for the high K values found in anaemic blood. The reticulocytes of anaemic HK type sheep also have higher K concentration than mature HK red cells[13]. Punt and Evans[14] reported that in the red cells of LK type sheep, during anaemia the sodium levels only fell slightly and the ratio of K to Na was greater than normal. The present work is an attempt to study the RBC potassium polymorphism in the Indian sheep.

Simultaneously attempts have also been made with a view to see the correlations if any that exist between the potassium type animals and metabolism. Certain important metabolites were estimated in the blood/serum of these animals. The constituents estimated were: glucose, total protein, non-protein nitrogen (NPN), calcium, inorganic phosphorus, iron and plasma bicarbonates.

EXPERIMENTAL

Maintenance of animals, their groups, collection of blood and estimation of the important metabolites in blood/serum were the same as reported earlier[15].

Estimation of potassium in RBC: Potassium in RBC was studied by flame photometry. Heparinised blood samples were used. Haematocrit value of each sample was first estimated.

Potassium concentration was estimated in whole blood and in plasma. The concentration of potassium in the RBC was calculated from the following formula:

$$K_e = C_p + \frac{(C_{wb} - C_p)}{p.c.v./100}$$

where K_e = concentration of K in erythrocytes; C_{wb} = concentration of K in whole blood; C_p = concentration of K in plasma; p.c.v. = packed cell volume.

Blood samples used for whole blood potassium concentration estimations were diluted to 1 : 400 while the plasma samples were diluted to 1 : 100.

The standard solutions used were prepared as mentioned by Hawk et al.[16]

RESULTS AND DISCUSSION

The results obtained have been given in Tables 1–3.

The sheep could be divided into 2 types, *viz.*, low potassium (LK) and high potassium (HK) according to the concentration of potassium in the RBC. Table-1 shows the per cent distribution of the sheep between LK and HK and the gene frequencies of the two groups.

TABLE-1
R.B.C. POTASSIUM POLYMORPHISM IN SHEEP

Percent distribution		Gene frequency	
HK	LK	HK	LK
52.6	47.4	0.725	0.275

TABLE-2
AVERAGE CONCENTRATIONS OF CERTAIN CONSTITUENTS IN BLOOD/SERUM/PLASMA OF SHEEP OF DIFFERENT K (RBC) POLYMORPHIC TYPES IN mg/100 mL EXCEPTION

K type	Glucose in blood	Total protein in serum	Ca in serum	P in serum (Ino.)	Cl in serum	Bi carbonate in plasma	Fe µg/100mL serum	N.P.N. in serum
HK	70.79±3.77	6.60±0.46	10.06±0.35	5.18±0.27	553.60±24.60	19.20±0.93	33.36±2.43	40.65±2.89
LK	66.83±6.20	7.09±0.52	9.77±0.25	5.24±0.39	596.66±16.15	20.22±0.40	37.78±3.14	37.90±2.52

TABLE-3
SUMMARY OF STATISTICS COMPARING DIFFERENT CHEMICAL CONSTITUENTS IN THE HK AND LK TYPE ANIMALS

Chemical constituent	Type of animal	D.F.	Average	S.F.	't' value
Glucose	HK	17	70.49	3.78	0.5130
	LK		66.82	6.29	
Total protein	HK	17	6.60	0.47	0.7123
	LK		7.09	0.52	
NPN	HK	17	40.65	2.89	0.6854
	LK		37.99	2.52	
Calcium	HK	17	10.06	0.37	0.6057
	LK		9.78	0.25	
Phosphorus	HK	17	5.18	0.27	1.8838
	LK		5.24	0.39	
Chloride	HK	17	553.60	24.60	0.9002
	LK		596.66	16.15	
Bicarbonate	HK	17	19.20	0.93	0.4728
	LK		20.22	0.40	
Iron	HK	17	33.66	2.43	0.0032
	LK		37.78	3.14	

Note: All values of 't' are non-significant.

$$\text{where } t = \frac{\text{Difference in means}}{\text{Estimate of the standard error of mean}}$$

Table-2 illustrates the average concentration of different constituents estimated in blood/serum of sheep under different potassium polymorphs. Table-3 shows the summary of statistics comparing the concentrations of various blood constituents under LK and HK phenotypes. Two clearly separate potassium types of animals could be identified in the Bikaneri breed, *viz.*, HK and LK types as also reported earlier by Widdas[4] and Evans[10]. The erythrocyte potassium concentration of HK group lies between 45.9 meq/L to 84.2 meq/L with an average value of

61.57 meq/L, while in LK type it ranges between 8.74 to 28 meq/L with an average of 20.49 meq/L. Widdas[4] reported mean values of potassium concentration in RBC, at 68.26 meq/L for HK and 16.8 meq/L for LK.

The results indicate that HK animals were predominant (Table-1). The findings are in agreement with those reported by Taneja and Ghosh[11]. All these workers have shown that HK animals are more common in Rajasthan flocks. Khattab[17] reported that in Welsh mountain sheep and in the desert sheep of Sudan there was no distinct bimodality in block potassium types.

Table-2 shows the average concentration of blood glucose, serum total protein, NPN, calcium, inorganic phosphorus, chloride, plasma bicarbonate and serum iron of sheep of different potassium polymorphic type.

Almost all the chemical constituents estimated in sheep blood of the HK and LK type had values close to each other. Some appreciable differences (though non-significant) were in blood glucose and serum iron. Blood glucose values were found to be higher in HK type while the serum iron concentration was higher in LK type. HK type animals are more frequent amongst the mountainous sheep and a higher glucose concentration might be of help in that region.

ACKNOWLEDGEMENT

The authors are grateful to the Head, Department of Physiology, U.P. College of Veterinary Science and Animal Husbandry, Mathura (India) for providing all the necessary facilities for the present work.

REFERENCES

1. E. Abderhalden, *Z. Physiol. Chem.*, **25**, 65 (1898).
2. S.E. Kerr, *J. Biol. Chem.*, **117**, 227 (1937).
3. N. Hallman and M.J. Karvonen, *Annals. Med. Exp. Biol.*, **27**, 221 (1949).
4. W.F. Widdas, *J. Physiol. London*, **125**, 18 (1954).
5. R.D. Wright, T.R. Bradley, J.F. Nelson and J.P. Coghlan, *Nature*, **182**, 1742 (1958).
6. J.N. Blechner, *Am. J. Physiol.*, **201**, 85 (1961).
7. W.J. Koch and R.W. Turner, *Aust. J. Biol. Sci.*, **14**, 79 (1961).
8. J.V. Evans and M.H. Blunt, *Aust. J. Biol. Sci.*, **14**, 87 (1961).
9. A.N. Dury and E.M. Tucker, *Res. Vet. Sci.*, **4**, 568 (1963).
10. J.V. Evans, *Nature*, **174**, 931 (1954).
11. G.C. Taneja and P.K. Ghosh, *Indian Vet. J.*, **44**, 402 (1967).
12. J.V. Evans, *Aust. J. Agric. Res.*, **14**, 540 (1963).
13. J.C. Ellory and E.M. Tucker, *J. Physiol. Lond.*, **208**, 18 (1970).
14. M.H. Blunt and J.V. Evans, *Am. J. Physiol.*, **209**, 978 (1965).
15. A. Adhikari and S.P.S. Mehta, *Asian J. Chem.*, **14**, 471, 1062 (2002); **15**, 311 (2003).
16. P.B. Hawk, B.L. Oser and W.H. Summerson, Practical Physiological Chemistry, McGraw-Hill Book Co. Inc., New York, 13th Edn. (1954).
17. A.G.M. Khattab, *J. Agric. Sci.*, **70**, 95 (1968).

(*Received*: 15 December 2003; *Accepted*: 22 April 2004) AJC-3394