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Frequency of Appearance of low and high Potassium types and Mineral Concentrations in Whole Blood of Sheep

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Summary

Some mineral concentrations in whole blood and potassium types of blood were investigated in eighty seven crossbred sheep (Suffolk, Corriedale and Finnish Landrace) in Tohoku University farm.

The frequencies of appearance of each type sheep were 73.6 and 26.4% and the estimated gene frequencies were 0.51 and 0.49 for low potassium (LK) and high potassium (HK) type, respectively. The mean potassium and sodium concentrations in whole blood were 44.5 and 234.5 mg/dl in LK and 126.6 and 206.3 mg/dl in HK sheep, respectively. Remarkable differences in calcium and magnesium concentrations were not recognized between LK and HK types.

It is known that sheep are classified into two types, low potassium (LK) and high potassium (HK) type according to the concentration of potassium in red blood cell, although no difference is in blood plasma potassium concentrations between those types (1, 2). The potassium concentration in whole blood is normally about 50.7 in LK and 136.5 mg/dl in HK type sheep, and sodium concentration in whole blood varies inversely with the potassium concentration. It is also known that red blood cell potassium types are controlled by a single allelic pair and that HK is recessive character and LK is either homozygous or heterozygous for gene affecting the red blood cell types (4). In no case, the red blood cell potassium type of sheep changes from HK to LK or LK to HK (3).

In spite of these findings by Evans *et al.* (1, 3, 4) and Widdas (2) we have little information on the existence of these two potassium types of sheep in Japan. Consequently, we investigated potassium type and some mineral concentrations in whole blood of sheep carried in Tohoku University farm.

Materials and Methods

Eighty seven crossbred sheep (Suffolk, Corriedale and Finnish Landrace, 2-5 years old) in Tohoku University farm were used. Blood samples were collected from the jugular vein. 0.1 ml of the whole blood was immediately put into screw-capped bottles containing 4.9 ml of distilled water using micropipette and hemolyzed. Potassium, sodium, calcium and magnesium concentrations in whole blood were determined by atomic absorption spectrophotometer.

The significance of the difference between two sheep types was examined by T-test.

Results and Discussion

The relationship between potassium and sodium concentrations in whole blood of sheep is shown in Fig. 1. An inverse relationship was observed in concentration between the two cations and points plotted potassium against sodium formed two groups. Namely these were distinguished into HK for the upper left group and LK type sheep for the lower right group.

Table 1 shows number of animals, frequency of appearance, gene frequency and mean mineral concentrations in whole blood of LK and HK sheep in the university farm. Numbers of LK and HK sheep were 64 and 23, and the fre-

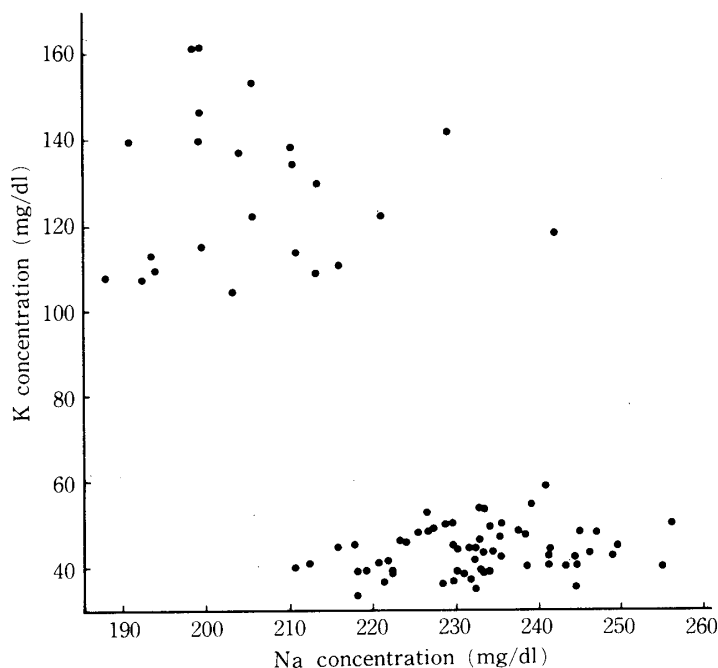


FIG. 1. The relationship between K and Na concentrations in the whole blood of sheep.

TABLE 1. Number of animals, gene frequency and mean concentrations of minerals in whole blood of LK and HK type sheep

	Potassium type		
	LK	HK	Total
No. of animals	64	23	87
% of total	73.6	26.4	100
Gene frequency	0.49	0.51	1
Mineral concentration (mg/dl, mean value \pm S.E.)			
K	44.5 \pm 5.2 ^a	126.6 \pm 16.9 ^b	
Na	234.5 \pm 10.3	206.3 \pm 13.1 ^b	
Ca	7.3 \pm 0.8	7.2 \pm 0.9	
Mg	2.8 \pm 0.2	2.9 \pm 0.3	
Na/K	5.25	1.63	

a and b : Significant at 1% level.

quencies of appearance were 73.6 and 26.4% for LK and HK type, respectively. The estimated gene frequencies of LK and HK sheep were 0.51 and 0.49, respectively. The discussion of the gene frequency among the breeds was impossible because all of animal investigated were crossbred among three breeds, Suffolk, Corriedale and Finnish Landrace and the strain of individual sheep was uncertain. Evans *et al.* (55) and Watanabe *et al.* (6) reported that the gene frequency of HK was high, 0.64-0.90, in Finnish Landrace and low, 0-0.18, in Suffolk and Corriedale. The gene frequency of HK sheep in this farm showed an intermediate value among those of three breeds.

Potassium concentration in whole blood of LK sheep ranged from 34 to 59 mg/dl and the mean value was 44.5 mg/dl. The mean potassium concentration of HK sheep was 126.6 mg/dl, ranging from 105 to 159 mg/dl. The mean sodium concentrations in whole blood were 234.5 and 206.3 mg/dl for LK and HK and the Na/K ratios were 5.25 and 1.63 for LK and HK type sheep, respectively. Remarkable differences in calcium and magnesium concentrations were not recognized between LK and HK types.

It was known that the frequency of the appearance of LK and HK type differed markedly between mountain and lowland breeds and these potassium types would be closely related with adaptability to the environment (7, 8). Evans (9) also reported that the differences of water intake and urine output were identified between LK and HK sheep.

Many physiological differences are supposed between two types of sheep and, in particular, studies on metabolism of minerals such as potassium, sodium and magnesium are expected.

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References

- 1) Evans, J.V., *Nature*, **174**, 931 (1954)
- 2) Widdas, W.F., *J. Physiol.*, **125**, 18 (1954)
- 3) Evans, J.V. and King, J.W.B., *Nature*, **176**, 171 (1955)
- 4) Evans, J.V., King, J.W.B., Cohen, B.L., Harris, H. and Warren, F.L., *Nature*, **178**, 849 (1956)
- 5) Evans, J.V., Harris, H. and Warren, F.L., *Nature*, **182**, 320 (1958)
- 6) Watanabe, S., Nakajima, K., Saegusa, H., Iwasaki, S. and Kikkawa, S., *Jpn. J. Sheep Sci.*, **17**, 13 (1980)
- 7) Evans, J.V., Harris, H. and Warren, F.L., *Biochem. J.*, **65**, 42 (1957)
- 8) Evans, J.V., Harris, H. and Warren, F.L., *Proc. R. Soc. Ser. B.*, **149**, 249 (1959)
- 9) Evans, J.V., *Nature*, **180**, 756 (1957)