

The potassium level in the blood of sheep and their productivity

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ABSTRACT

The production value of sheep having a high or low blood potassium level were investigated. The K level in the whole blood of the five month old lambs was determined and classified into the respective phenotype: LH and HK. The study were carried out on 871 lambs and 312 ewes.

In the tested population, the frequency of gene K^H in lambs was 0.427, whereas in ewes 0.540. The average level of potassium in blood in 5 month old lambs was found to be 30.5 mmol/l in the HK phenotype and 9.3 mmol/l in the LH phenotype. The results also showed that potassium-determined phenotypes had similar body weight after birth (5.1 kg), at the age of 28 (13.3) and 100 days (30.0 kg), and at 12 months (72.3 kg). The ewes had also an approximate yield of greasy wool both from the first (about 4.5 kg) and second (6.7 kg) shearing performed at the age of 10 and 22 months. A significantly lower fertility and reproduction performance was found in ewes of the HK phenotype.

KEY WORDS: sheep, blood, potassium level, growth, reproduction

INTRODUCTION

In the previous works it has been stated that the potassium blood level in sheep is genetically controlled by two alleles K^L and K^H , the second one recessive (Agar et al., 1972; Bhat et al., 1981; Bojczuk, 1987; Kumar, 1984; Lazovski and Spiridonov, 1974; Lipecka et al., 1987; 1991). Homozygotes of the K^H gene are characterized by a high potassium level in blood (level HK), while those of the K^L gene and heterozygotes by a low potassium blood level (level LK). These studies have also proved that there is a considerable differentiation between breeds, kinds, and even a differentiation within a breed between flocks in the frequency

of occurrence of genes and phenotypes. Simultaneously the potassium level is reflected in differentiated physiological and biochemical changes (Agar et al., 1972). This can affect the productivity level of animals, constituting a certain selective index.

The aim of the present paper was to determine the influence of potassium blood level in Polish Lowland sheep on the growth of lambs, wool productivity and features of reproduction.

MATERIAL AND METHODS

The studies concerned lambs and their mothers born in the years 1981-1990 in one farm in which the feeding and environmental conditions in each experimental year were similar.

The potassium level in the whole blood of the month old lambs was determined with the use of the atomic absorption spectrophotometer according to the method described by Lipecka et al. (1987). The classification into the respective phenotype: HK or LK was performed simultaneously. All of the individuals having a high potassium blood level (HK) and, in order to diminish the disproportion in the number between the both phenotypes, only their half sibs with a low potassium level (LK) were taken for the analysis. In case of lambs, the animal material had not been selected and comprised all together 1065 lambs (473 rams and 592 ewes). The mothers (312 sheep) originated from the reproduction flock.

To determine the influence of the potassium level on the performance traits, separately for the sexes, the analysis of variance according to the least squares was made (Harvey, 1989). In the statistical model the age group, the type of birth and the potassium level phenotype was regarded.

RESULTS

The potassium level in the investigated population of lambs ranged from 6.88 to 43.5 mmol/l in the rams, and from 5.87 to 38.75 mmol/l in the ewes (Fig. 1). Generally, for all the age groups of rams and ewes the average potassium level for the LK phenotype was 9.74 ± 4.98 and 8.86 ± 3.59 mmol/l, respectively for the sexes, while the values for the HK phenotype were 30.74 ± 8.03 and 30.35 ± 7.55 mmol/l.

The body weight of rams controlled after birth, as well as at the age of 28 and 100 days and 12 months did not differ significantly between the groups of low and high potassium level in the blood. Significant differences were not found for

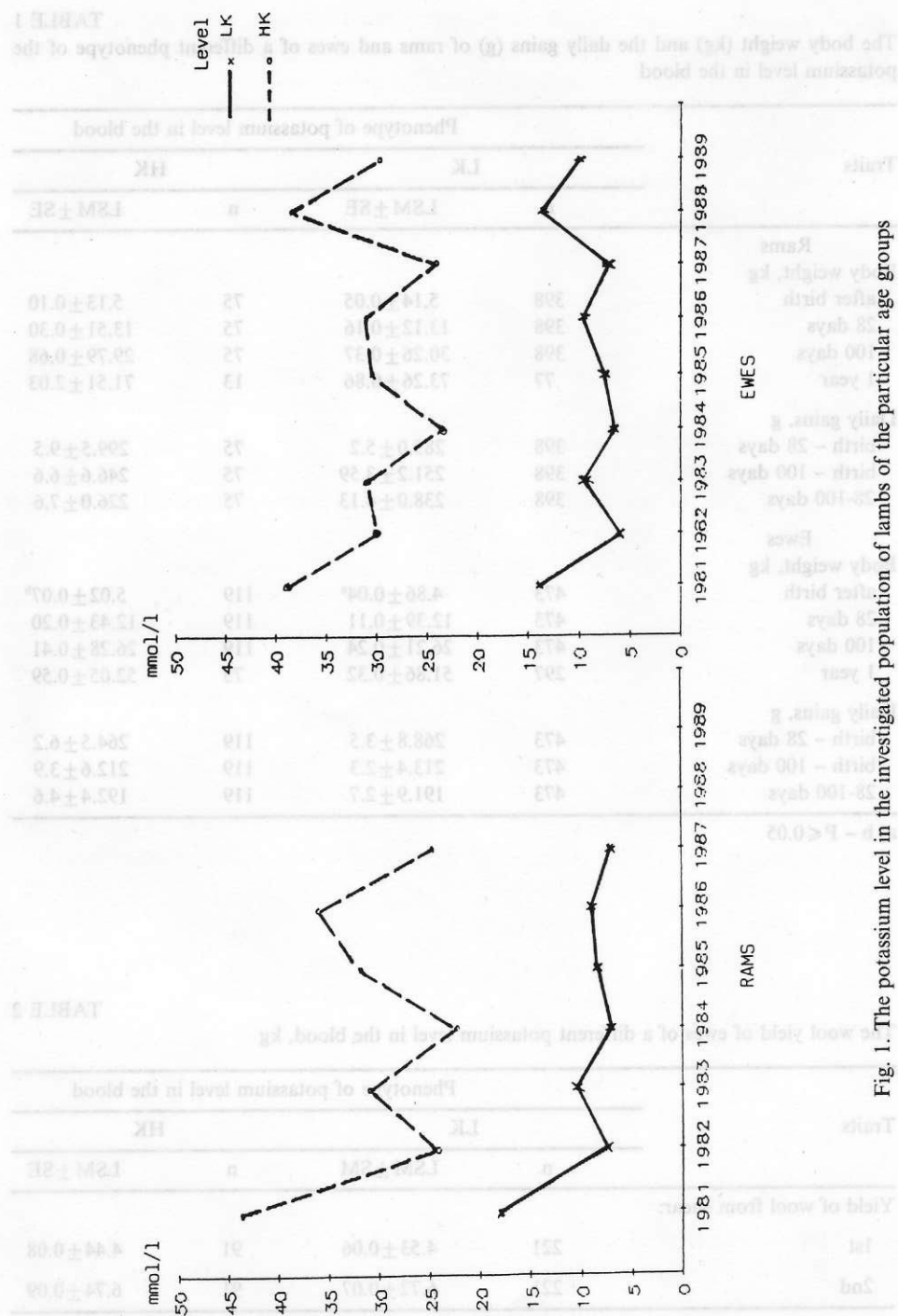


Fig. 1. The potassium level in the investigated population of lambs of the particular age groups

TABLE 1

The body weight (kg) and the daily gains (g) of rams and ewes of a different phenotype of the potassium level in the blood

Traits	Phenotype of potassium level in the blood			
	LK		HK	
	n	LSM ± SE	n	LSM ± SE
Rams				
Body weight, kg				
after birth	398	5.14 ± 0.05	75	5.13 ± 0.10
28 days	398	13.12 ± 0.16	75	13.51 ± 0.30
100 days	398	30.26 ± 0.37	75	29.79 ± 0.68
1 year	77	73.26 ± 0.86	13	71.51 ± 2.03
Daily gains, g				
birth - 28 days	398	285.0 ± 5.2	75	299.5 ± 9.5
birth - 100 days	398	251.2 ± 3.59	75	246.6 ± 6.6
28-100 days	398	238.0 ± 4.13	75	226.0 ± 7.6
Ewes				
Body weight, kg				
after birth	473	4.86 ± 0.04 ^a	119	5.02 ± 0.07 ^b
28 days	473	12.39 ± 0.11	119	12.43 ± 0.20
100 days	473	26.21 ± 0.24	119	26.28 ± 0.41
1 year	297	51.86 ± 0.32	75	52.05 ± 0.59
Daily gains, g				
birth - 28 days	473	268.8 ± 3.5	119	264.5 ± 6.2
birth - 100 days	473	213.4 ± 2.3	119	212.6 ± 3.9
28-100 days	473	191.9 ± 2.7	119	192.4 ± 4.6

a, b - $P \leq 0.05$

TABLE 2

The wool yield of ewes of a different potassium level in the blood, kg

Traits	Phenotype of potassium level in the blood			
	LK		HK	
	n	LSM ± SM	n	LSM ± SE
Yield of wool from shear:				
1st	221	4.53 ± 0.06	91	4.44 ± 0.08
2nd	221	6.72 ± 0.07	91	6.74 ± 0.09

the daily gains, either. Similar results were obtained for the the ewes, except that the body weight after birth turned to be higher in the individuals with a high potassium level in the blood (Table 1).

The mothers of both potassium level phenotypes had an approximate yield of greasy wool, both from the 1st and 2nd shear (Table 2). Fecundity – FC (the number of born lambs in relation to the number of lambed ewes), as well as reproductive performance – RP (the number of reared lambs in relation to the number of mated ewes) in the three successive reproduction cycles did not differ significantly between the groups. A lower fertility – FT (the number of lambed mothers in relation to the number of the mated ones) was characteristic for the mothers with the HK phenotype in relation to the half sisters of the LK phenotype in the 1st and 2nd lambing (Fig. 2). The analysis of the whole-life reproduction indices has shown that lower fertility was characteristic for the ewes with the K^H recessive in the homozygotic form – 87.4% in relation to those with K^L gene, both in homo- and heterozygotic form – 95.8%. Also the reproductive performance of the ewes of the HK phenotype was lower by 8.9 per cent units (Table 3).

DISCUSSION

The studies carried out have proved that lambs of both potassium level phenotypes had approximate body weight in all the analyzed growth periods. The daily gains were also similar. These findings confirm the data described by Kumar (1984). Atroshi (1979) stated that the lambs of both phenotypes, despite their similar weight at birth, differ in their daily gains; slightly higher daily gains were recorded in lambs of the LK phenotype. Watson and Khattab (1964) found that lambs of the LK phenotype have higher body weight after birth and they grow faster. On the other hand, Atroshi (1979) points to a higher wool

TABLE 3

A total-life reproductive traits of ewes with different potassium level in the blood

Traits	Phenotype of potassium level in the blood			
	LK		HK	
	n	LSM ± SE	n	LSM ± SE
Fertility	221	95.8 ± 1.7 ^A	91	87.4 ± 2.2 ^B
Fecundity	221	131.9 ± 3.5	91	128.6 ± 4.6
Reproductive performance	221	118.2 ± 3.6 ^a	91	109.3 ± 4.7 ^b

a,b – P ≤ 0.01; A,B – P ≤ 0.05

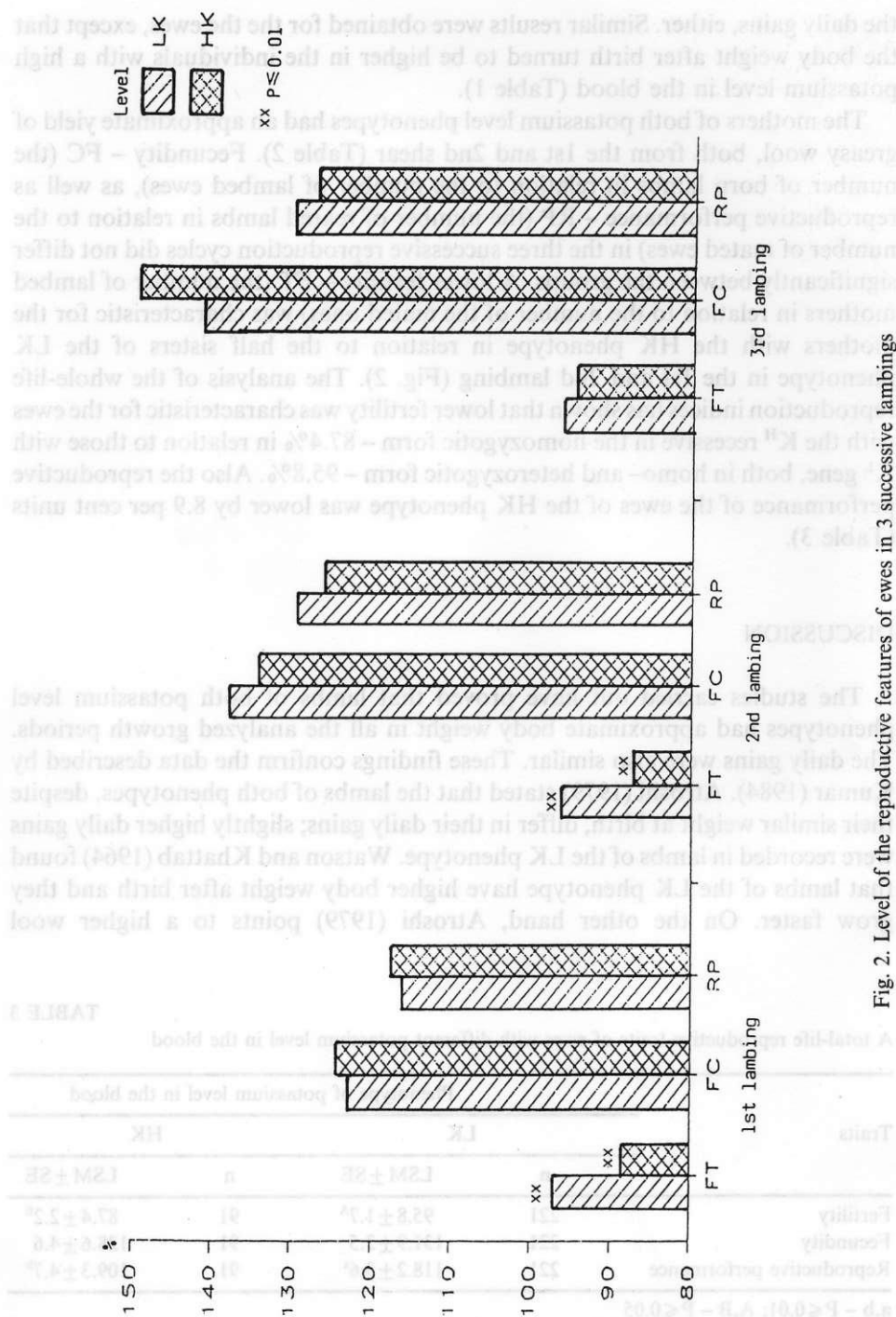


Fig. 2. Level of the reproductive features of ewes in 3 successive lambings

productivity in ewes of the LK phenotype. This, however, had not been confirmed in the present research.

The ewes of the Polish Lowland sheep of the HK phenotype were characterized by lower values of the reproduction features, i.e. fertility (FT) and reproduction performance (RP). Similar results were obtained by Atroshi (1979) and Dragnev and Tsvetanov (1963). The ewes of the HK phenotype better reared the lambs which has also been proved by Atroshi (1979) and Khattab et al. (1963). Lower reproduction performance (RP) of the ewes found in the present study was mainly caused by lower fertility and slightly lower fecundity. Reverse results were presented by Meyer et al. (1967), who pointed out the favourable effect of the HK phenotype on the reproduction performance.

CONCLUSIONS

The results obtained allow us to conclude that a high potassium level in the blood unfavourably affects the reproduction performance. However, the use of this trait as a genetic marker of the productivity needs to be supported by further similar research.

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STRESZCZENIE

Poziom potasu we krwi owiec a ich produktywność

Badania przeprowadzono na owcach o wysokim i niskim poziomie potasu we krwi. Poziom potasu we krwi u pięciomiesięcznych jagniąt oznaczono i zwierzęta podzielono wg fenotypów: LH i HK. Badaniami objęto 871 jagniąt i 312 maciorek.

W testowanej populacji, częstotliwości występowania genu K^{II} u jagniąt i maciorek wynosiła odp. 0,427 i 0,540. Średni poziom potasu we krwi u 5-cio miesięcznych jagniąt dla fenotypów: HK = 30,5mmol/l; LK = 9,3 mmol/l.

Wyniki wskazują również, że zwierzęta fenotypowo różne mają zbliżoną masę ciała: po urodzeniu (5,1), w wieku 28 (13,3g), 100 dni (30,0g) oraz 12 miesięcy (72,3 g). Maciorki miały podobne wydajności wełny zarówno przy pierwszej (ok. 4,5 kg) jak i drugiej (6,7 kg) strzyży, przeprowadzonych w wieku 10 i 22 miesięcy. Istotnie mniejszą płodność i użytkowość rozplodową miały maciorki o fenotypie HK.