# GENETIC POLYMORPHISM OF BLOOD POTASSIUM IN GOAT BELONGING TO THE DIFFERENT BREEDS AND SUBBREED IN MONGOLIA

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## ABSTRACT

*In the goats belonging to the different breeds and sub breed the genetic polymorphism at the determinant locus of blood potassium was revealed by flame spectrophotometer method. The kalemic systems, in those breeds were characterized by a polymorphism of middle level due to the existence of the two phenotypes and of three genotypes. The polymorphic character of this system is given by the distributional discontinuity of potassium ions in whole blood, the discontinuous space ranging were 10-34 m eq/L in the Mongolian native breed, 0.38-20.3 m eq/L in the Govigurbansaihan breed, 10.27- 15.8 m eq/ L in the AltainUlaan sub breed. The remarkable differences in the whole blood of potassium concentrations were recognized between Mongol and Govi-Gurban Saikhan breeds td=6.46 or (p<0.001), Govi-Gurban Saikhan and Altai ulaan (td=5.7) or (p<0.001). As this trait, the slight difference was revealed between Mongol and Altai ulaan breeds (td=1.87) or (p>0.05). The correlation of the trait was also high r=0.57 between these breeds.*

*The animals with potassium ion concentration below the discontinuity space are of LK type and those with ionic concentration above the discontinuity space are of HK type. The blood potassium level is determined by two alleles; $K^L$ and $K^h$, being in incomplete dominance relationship; the allele $K^L$, responsible for low potassium, is dominant compared to its recessive $K^h$ allele which causes high levels of blood potassium. These two alleles at the Ks locus, located on an autosomal chromosome, determine three genotypes; $K^LK^L$ (dominant homozygote), $K^LK^h$ (heterozygote), and $K^hK^h$ (recessive homozygote). In the Mongolian native breed the allele $K^h$ was less frequent (20%) than its dominant $K^L$ (80%), in the Govi Gurban Saihan breed, the frequency of the alleles were also 5 %, 95% respectively. The phenotype LK (80%-100%) achieved a much higher frequency than the phenotype HK (5%-20%) in those breeds. Consequently, the recessive homozygosis and heterozygosis recorded in an equally frequency (50%, 50%) in the Mongolian native breed, instead, the frequency of recessive homozygosis were slightly higher than heterozygosis (66%>34%) in the Govi Gurban Saihan.*

**KEY WORDS**: blood potassium, genetic polymorphism, goat.

## INTRODUCTION

The variability of potassium concentration in erythrocytes and whole blood, depending on species, breed, individual, age, sex, physiological status, etc., was frequently reported in domestic animals by clinicians and physiologists, without specifying the limits of normal and pathological. Many studies have noted distributional discontinuity of potassium in the blood of

animals, which has suggested that this chemical element presents polymorphism having genetic determinism [2,3, 5,7,810, 11,13, 17,21, 22].
The polymorphism of erythrocyte potassium was for first time detected in sheep by Evans and King [4]. The existences of polymorphism for potassium in red blood cells or whole blood were confirmed in goat [5,12,14,15,16, 23,24] . Furthermore, several studies have reported, as well as in sheep, some associations between the biochemical polymorphism of potassium, other blood electrolytes and various production traits [10,12,18,20].
The present paper has proposed to reveal the genetic structure at the determination locus of blood potassium in the Mongolian different breeds and sub breed goats.

## MATERIAL AND METHODS

The existence of polymorphous character of blood potassium in goats was investigated on a random population of the different breeds and sub breed from the distinctive regions in Mongolia. The blood samples were taken from animals by jugular venipuncture directly in tubes with heparin as an anticoagulant.
The determination of genetic variants of blood potassium was made using the flame spectrophotometer of atomic absorption system (Shimadzu). For K determination whole blood were diluted by distilled water in a ratio 1:500
Analysis variance and correlations of blood potassium polymorphism between breeds were calculated by Data analysis in Excel program.
*The detection of potassium phenotypes*. The identification of the blood potassium types was made depending on the cationic concentrations of potassium in whole blood of goats. The polymorphic character of blood potassium in goats is given by the discontinuous variability of its concentration distribution. The animals with ionic concentration of potassium below the discontinuity space are of LK type (with low potassium) and those with ionic concentration above the discontinuity space are of HK type (with high potassium).
*The allelic phenotypic and genotypic frequencies (f)* of potassium system were calculated according to incomplete dominance phenomenon by which the kalemic system is inherited.

## RESULTS

Each group was consisted of 20 goats from Mongolian native, Govi Gurban Saihan breeds and Altainulaan sub breed. The whole blood potassium concentrations ranged per group from 10-34 m eq/L, 0.38-20.3 m eq/L and 0.38-20.3 m eq/L, 10.27-15.8 m eq/L respectively. The concentration distributions of blood potassium in goat populations are presented as a curvein figure 1.

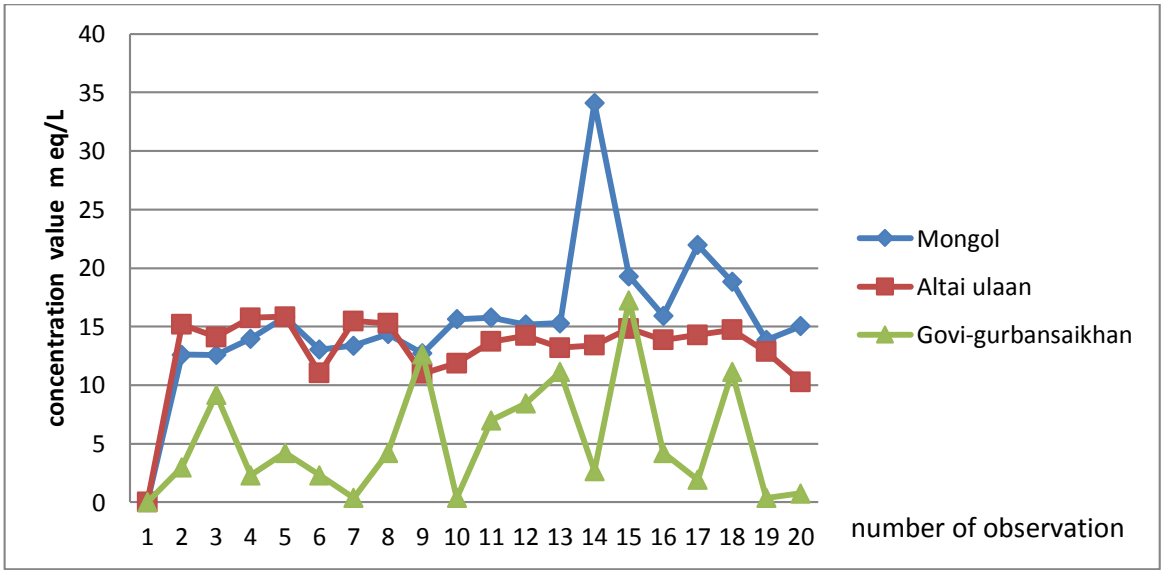


Figure 1. Concentration distributions of blood potassium in goats

According the curve the goats could be divided into two subpopulations via LK having 0.38-18 m eq/L of $K^+$ and HK having 18.83 -34.09 eq/L of $K^+$ with mean of 6.193±1.2 m eq/L of $K^+$in the Govi-gurbansaikhan breed, 15.97±1.12m eq/L of $K^+$in the Mongolian native breed and 13.56±0.4 12m eq/L of $K^+$in the Altai ulaan sub breed goats (Fig.1).

The remarkable differences in the whole blood of potassium concentrations were recognized between Mongol and Govigurbansaikhan breeds td=6.46 or ($p<0.001$), and between Govi-Gurban Saikhan and Altai ulaan (td=5.7) or ($p<0.001$). Instead, as this trait, the slight difference was revealed between Mongol and Altai ulaan breeds (td=1.87) or ($p>0.05$). Also, the correlation of the trait was high (r=0.57) between these breeds (Fig 2).

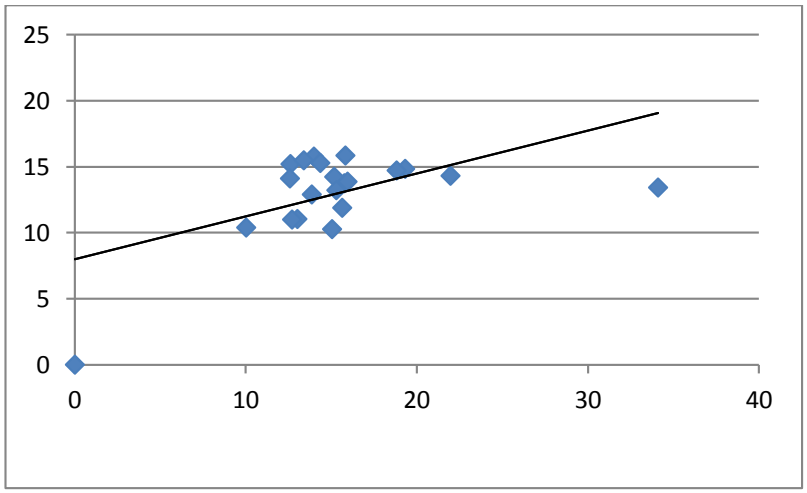


Figure 2. The trait correlation between Mongol breed and Altainulaan sub breed goats

The goat breeds are characterized by the predominance of group with phenotype LK (80-100%), the group with phenotype HK, have a moderate representation (5-20%) (Fig .2).

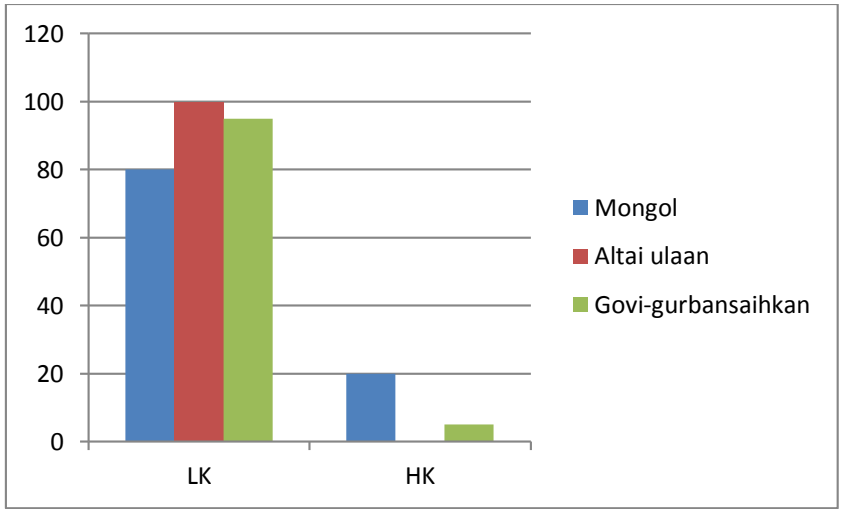


Figure 3. Phenotypic structure at the locus K in the different breeds and sub breed

Their gene frequency, obtained in the populations is given in the table 1.In those breeds, the two potassium alleles have a very unbalanced distribution.The recessive allele $K^h$ having a very little spreading (5-20%) in comparison with its dominant $K^L$ which has a high frequency (30-100%).

Table 1

Determination gene and genotypes of blood potassium polymorphism

| Breeds of goat | Number of observation | Gene frequency (%) | | |
|---|---|---|---|---|
| | | $K^LK^L$ | $K^LK^h$ | $K^h K^h$ |
| Mongol | 20 | 30 | 50 | 20 |
| Govi-gurbansaikhan | 20 | 61 | 34 | 5 |
| Altaiulaan | 20 | 100 | - | - |

As a result of this fact, the distributions of potassium genotypes are not also very uniform. Therefore, on the total populations too, the homozygosis and heterozygosis for both types are 50% and 50% in the Mongolian native breed, the homozygote (66%) is much higher compared to the heterozygote (34%)in the Govi Gurban Saikhan breed.

## DISSCUSSION

The existence of two distinct levels of blood potassium ion concentrations is due to some biophysical and biochemical features of the Na/K-ATP aseactivity in the membranes of the two types of red cells, enzyme that uses energy derived from ATP hydrolysis to maintain intracellular potassium ions and expel sodium ions. This phenomenon is possible because the ATPase enzyme intimately involved in sodium-potassium pump mechanism from the level of cell membrane [22]. The goats represent the second species after sheep, on the extent of potassium polymorphism investigation. In comparison with other species in which, in most breeds, the phenotype LK is predominant [4, 5, 7, 8, 20], in the Mongolian native, GoviGurban Saihan breeds and Altai ulaan sub breed goats, the phenotype LK is widespread, so the results are not similar to the some other studies in goat breeds [17, 18]. But, this characteristic is also common on the phylogenetic scale of species. In the other species of domestic animals, this research field is almost nonexistent, only a few summary reports being recorded, such as cow [2, 19,15], buffalo [21], yak [19,13] and zebu [6] among mammals and in birds within the palmiped family. This is because in these animals the kalemic polymorphism is very less obvious.Potassium polymorphism in goats can be used as a selection tool for the genetic improvement of this species if the studies concerning the association correlation of genetic structure of blood potassium with the production and reproductive traits, with the health status of individuals or with the resistance of animal to environmental and technological factors require such approaches.

## CONCLUSIONS

1. The kalemic system in the Mongolian native and Govigurbansaihan breeds was characterized by middle polymorphism due to the existence of two phenotypes (LK and HK) and of three genotypes ($K^LK^L$ $K^LK^h$ and $K^hK^h$).
2. In the Altai ulaan sub breed goats, even 100% LK predominant phenotype has been revealed by the concentration of potassium in the blood samples, the distribution of the concentration level was too close to the result of Mongolian native breed and the correlation of this trait was higher(r=0.57) than othersbetween these breeds.
3. In the Mongolian and Govi Gurban Saikhan breeds the allele $K^L$ is more common; phenotype HK recorded a less frequency than LK phenotype; genotypecally, it comes out a less frequency of recessive homozygosis ($K^hK^h$), a middle incidence of heterozygosis ($K^LK^h$) and high presence of dominant homozygosis ($K^LK^L$).
4. The summed homozygosis of both types (dominant +recessive) were in an equally with the heterozygosis in the Mongol native breed.

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