

## SOME GENETIC VARIATION OF BLOOD PROTEINS IN TSIGAI SHEEP IN YUGOSLAVIA

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*The Tsigai sheep is an autochthonous breed traditionally reared in Vojvodina. With the aim to describe some electrophoretic variants of genetic markers in the blood of Tsigai sheep the biochemical variations of eight protein systems: hemoglobin (Hb), X- protein (X), purine nucleoside phosphorylase (NP), carbonic anhydrase (CA), NADH-diaphorase (Dia), transferrin (Tf), arylesterase, (EsA) and albumin (Alb) were evaluated.*

*The characteristic gene frequencies of the tested systems were established as follows: Hb<sup>A</sup> and Hb<sup>B</sup> (0.08 and 0.92); X<sup>+</sup> and X<sup>-</sup> (0.98 and 0.02); NP<sup>H</sup> and NP<sup>L</sup> (0.51 and 0.49); CA<sup>S</sup> and CA<sup>F</sup> (0.98 and 0.02), Dia<sup>F</sup> and Dia<sup>S</sup> (0.66 and 0.34); Tf<sup>A</sup>, Tf<sup>B</sup>, Tf<sup>C</sup>, Tf<sup>D</sup> and Tf<sup>E</sup> (0.19, 0.14, 0.20, 0.40 and 0.07); EsA and EsA<sup>-</sup> (0.38 and 0.62), respectively. Only one type of albumin was revealed in the tested population of Tsigai.*

*Key words : Tsigai sheep, biochemical polymorphism. hemoglobin, X- protein, nucleoside phosphorylase, carbonic anhydrase, NADH-diaphorase, transferrin, arylesterase, albumin*

### INTRODUCTION

The Tsigai breed descended from Asiatic Urial (*Ovis vignei*). The natural habitat of Tsigai ancestors was Asia Minor, from where it migrated to the Pannonian Plain passing through the Balkan Peninsula. Nowadays, the Tsigai sheep is widespread throughout Central Europe.

The Tsigai is a triple-purpose breed reared for wool, milk and meat, all equally important. There are several purebred Tsigai varieties distinguished by morphological (color of face, legs and wool) and production characteristics.

Tsigai wool is medium-coarse. The mature animals are covered with a semi-opened, white fleece with black over-hairs that give a grayish shade to the body. Lambs are usually black. The head and legs are bare and black. The head is medium large with a convex profile. The ears are long and limp. Almost all rams are horned with open, spirally wound horns, while ewes are mostly hornless. The heritage of direct descendant from Urial is present in the long tail containing 16 vertebrae (40 - 42 cm).

The natural habitat of the Tsigai in Yugoslavia is Voivodina where it is traditionally reared on pasture. The estimated size of the Tsigai population is around 250,000 animals, but the number is decreasing constantly. The most important domestic type of Tsigai is the dairy type producing of 150 l of milk containing 6-7% of fat during 6 months.

The biochemical polymorphism of some blood protein systems in Tsigai sheep has been evaluated in order to characterize the breed, since 1970. Meanwhile allelic distribution within hemoglobin (Hb), X-protein (X), purine nucleoside phosphorylase (NP), carbonhydrase (CA), transferrin (Tf), arylesterase (EsA) and albumin loci were evaluated.

#### MATERIAL AND METHODS

Samples of blood, collected in heparinized tubes were obtained from 150 Tsigai sheep. After separation of plasma red cells were washed three times in saline solution and lysed with distilled water. The separation of blood proteins was carried out by horizontal electrophoresis following previously published procedures: hemoglobin according to Tucker et al., (1983), arylesterase, carbonic anhydrase, and X- protein according to the method described by Tucker et al., (1967); NADH-diaphorase (Tucker and Crowely, 1978), nucleoside phosphorylase (Tucker and Young, 1976), transferrin following the method of Rasmussen (1973) and albumin according to Tucker (1975). From the results obtained by electrophoresis gene frequencies and allelic distribution in the population were analyzed.

#### RESULTS AND DISCUSSION

Allelic gene distribution determined in Tsigai sheep in Yugoslavia are presented in Table 1.

*Carbonic anhydrase:* Three phenotypes (Ca F, CA FS, CA S), genetically determined by two autosomal co-dominant alleles were established within the CA system of Tsigai sheep. The predominant frequency of the CA<sup>S</sup> allele (0.98) found in Yugoslav Tsigai sheep is similar to the CA gene frequencies reported in other breeds (Tucker 1967).

*Nucleoside phosphorylase:* Respecting the importance of the role of red blood cell phosphorylase in energy metabolism, NP polymorphism in Tsigai sheep has been analyzed. Two NP types: NP H (high activity) and NP L (low activity) were established in the tested population. The characteristic frequencies of NP<sup>H</sup> and NP<sup>L</sup> genes in Tsigai sheep were 0.51 and 0.49, respectively. A study of genetic polymorphism of red cell NP in different sheep breeds suggests that the NP H phenotype predominates in breeds selected in Western Europe (Tucker 1976), while NP L seems to dominate in Eastern European breeds (Makaveev 1986).

A comparison of the NP allelic distribution found in Tsigai and those established in other sheep breeds revealed a characteristic approximately equal

distribution of the two genes. Similar equal distribution of  $NP^H$  and  $NP^L$  genes was established only in some types of Pramenka: 0.51 and 0.49 (Savic, 1989) and the Veuwee breed: 0.55 and 0.45 (Tucker, 1976).

*X-protein:* Two different phenotypes of X protein have been described in sheep, so far. The evaluations of protein X polymorphism in Tsigai sheep revealed two phenotypes ( $X^+$  and  $X^-$ ). The established frequencies of  $X^-$  (0.02) and  $X^+$  (0.98) genes are highly comparable to the distribution of the protein X genes reported in other sheep breeds (Tucker 1975).

*NADH-diaphorase:* From the results obtained by starch gel electrophoresis, three common NADH-diaphorase phenotypes (Dia F, Dia FS and Dia S), controlled by two codominant alleles  $Dia^F$  and  $Dia^S$  were revealed in the Yugoslav Tsigai population. The  $Dia^F$  and  $Dia^S$  gene frequencies established in the Tsigai population were 0.66 and 0.34, respectively. The Dia genes frequencies in the tested population did not differ from those found in other sheep breeds (Tucker and Crowely 1978).

*Aryl esterase:* The evaluation of arylesterase polymorphism in Tsigai sheep revealed that two phenotypes of the enzyme:  $EsA^+$  (positive) and  $EsA^-$  (negative) were distributed in the tested population. The characteristic frequencies of  $EsA^+$  and  $EsA^-$  genes were 0.38 and 0.62, respectively. Other data in the literature show that a very low frequency of  $EsA^+$  alleles (under 0.100) is a character of nearly all tested breeds. Thus, the frequency of the  $EsA^+$  gene in the population of Tsigai is relatively high compared to the distribution of the gene reported in the other breeds. The most similar breed to Tsigai is Rambouillet (0.36) (Tucker 1967). Only Friesian sheep (0.49) (Buis, 1983) have a higher  $EsA^+$  gene frequency than Tsigai.

From the relatively high frequency of the  $EsA^+$  gene established in Tsigai sheep, it can be expected that these animals can metabolize organophosphoric compounds better than sheep of other breeds. This feature enables better detoxification following administration of organophosphoric drugs.

*Albumin:* No albumin polymorphism in Tsigai sheep has been observed, so far. All samples tested were identified as AlbS phenotype, which commonly occurs in other sheep breeds (Tucker 1975). The  $Alb^F$  allelic gene was not detected and so far it is most often found only in native Norwegian sheep.

*Hemoglobin:* Two allelic genes  $Hb^A$  and  $Hb^B$  were revealed within the Hb locus in sheep. The populations of sheep have a specific, altitude dependent distribution of Hb alleles, due to the different capacity for oxygen binding which is type specific.

In Yugoslav Tsigai the  $Hb^B$  gene predominates at 0.92 while  $Hb^A$  gene frequency is only 0.08. This distribution was first established by Jovanović et al (1982) leading to the conclusion that the Tsigai in Yugoslavia is well adapted to the natural lowland habitat.

*Transferrin:* Five allelic genes: A, B, C, D, and E, with characteristic gene frequencies: 0.19, 0.14, 0.20, 0.40, 0.07, respectively have been established in Yugoslav Tsigai, so far. The distribution of Tf genes revealed in Yugoslav Tsigai

type seems to be population specific when compared to the Tf locus in Hungarian Tsigai (Fesus, 1992).

Table 1: Gene frequencies of eight protein systems in a Yugoslav population of Tsigai sheep

Allelic gene	Frequency	Allelic gene	Frequency
Hb <sup>A</sup>	0.08	Tf <sup>A</sup>	0.19
Hb <sup>B</sup>	0.92	Tf <sup>B</sup>	0.14
		Tf <sup>C</sup>	0.20
X <sup>+</sup>	0.98	Tf <sup>D</sup>	0.40
X <sup>-</sup>	0.02	Tf <sup>E</sup>	0.07
NP <sup>H</sup>	0.51	EsA <sup>+</sup>	0.38
NO <sup>L</sup>	0.49	EsA <sup>-</sup>	0.62
CA <sup>S</sup>	0.98	Alb <sup>S</sup>	0.00
CA <sup>F</sup>	0.02	Alb <sup>F</sup>	1.00
Dia <sup>F</sup>	0.66		
Dia <sup>S</sup>	0.34		

From the results obtained by electrophoretic typing of eight blood protein systems in Yugoslav Tsigai it can be concluded that the domestic population of this breed does not differ from other tested populations in neighboring countries. All evaluated populations of Tsigai showed different distributions of transferrin types (Fesus 1992).

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#### GENETSKA VARIJABILNOST PROTEINA KRV I KOD CIGAJE U JUGOSLAVIJI

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#### SADRŽAJ

Cigaja je domaća rasa ovaca koja se tradicionalno uzgaja u Vojvodini. U ovom radu je opisana genetska varijabilnost osam polimorfnih markera u krvi: hemoglobina (Hb), X proteina (X), purin nukleozid fosforilaze (NP), karboanhidraze (CA), NADH-diaforaze (Dia), transferina (Tf), arilesteraze (EsA) i albumina.

Karakteristična frekvencija gena hemoglobina je iznosila  $Hb^A$ : 0.08 i  $Hb^B$ : 0.92, a X proteina  $X^+$ : 0.98,  $X^-$ : 0.02. U okviru NP sistema, utvrđena su dva gena:  $NP^H$  i  $NP^L$  sa frekvencom 0.51 i 0.49, po redosledu; a dva gena  $CA^S$  i  $CA^F$ , frekvence 0.98 i 0.02. Kod cigaje je NADH diaforaza pod kontrolom dva alelna gena:  $Dia^F$ : 0.66 i  $Dia^S$ : 0.34, a u okviru transferinskog sistema se distribuira pet gena  $Tf^A$ ,  $Tf^B$ ,  $Tf^C$ ,  $Tf^D$  i  $Tf^E$ , sa frekvencom 0.19, 0.14, 0.20, 0.40 i 0.07, po redosledu. U sistemu esteraze su utvrđena dva alela  $EsA^+$  (0.38) i  $EsA^-$  (0.62). Kod ispitane populacije ustanovljen je samo jedan tip albumina.

Genetska karakterizacija cigaje u Jugoslaviji pokazuje veliku sličnost sa populacijama u susednim zemljama.

