

## THE GENETIC STRUCTURE OF THE MAŁOPOSKI HORSES WITH SPECIAL REGARD TO THE PRZEDŚWIT STRAIN

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### Abstract

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The present study covers immunogenetic characteristics of the Małopolski horses, involving 5 blood protein systems, with special regard to horses of the Przedświt strain. Basing on the obtained results it was found that high frequency of allele Es<sup>F</sup> is a characteristic feature of the examined Przedświt strain horses.

Małopolski horse, Przedświt strain, blood protein polymorphism, genetic structure

Intensive development of the horseback riding of recreation and sport horses has brought about a necessity to change the breeding direction focused on general purpose horses towards horses with distinct riding predispositions (PIKUŁA, 1997).

In Poland, the general purpose horse has been represented by the Wielkopolski and the Małopolski horses. The Małopolski breed includes primarily horses of all oriental and Anglo-Arabian types. Also Austrian-Hungarian lineages of English Half-blood character formed by the Furioso and Przedświt strains are very valuable. These horses are represented by a noble horse type, enduring and of balanced temper. As PRAWOCHENSKI (1951) and PRUSKI (1960) state, horses in the Podkarpacie region (Subcarpathia) accumulated the genes of Przedświt and Furioso strains the most and these two strains were found to be the best for improving local horses.

Both Furioso and Przedświt horses are characterised by a fine [pleasing] appearance and aesthetic appeal [beauty], have a broad and deep chest, well-developed croup and slanted scapula, massive underside and excellent motion [move, stride] (BUDZYŃSKI et al., 1989). As KOVALCIK et al. (2000) report, the

average height at the withers for mares, measured with the measuring stick, amounts to 164.5 cm, chest circumference 210 cm and cannon circumference 21.4 cm and they state that the recorded values are typical for Furioso-Przedświt strains.

Unification of breeding objectives has brought about the standardisation of exterior features and utility value.

Therefore, it is purposeful to carry out broader immunogenetic characteristics, including 5 blood protein systems, of half-blood horses with special regard to horses of the Przedświt strain.

### MATERIAL AND METHODS

Polymorphism of the following blood proteins: albumin (Al), transferrin (Tf), esterase pH 8.5 (Es pH 8.5), vitamin D-binding protein (Gc) and protein X<sub>K</sub> (X<sub>K</sub>), was determined in the blood of 125 Małopolski stallions and of 22 Przedświt strain ones, which completed the performance test at the Biały Bór Training Center (Poland).

The results were used for immunogenetic characteristics of the examined horse population. The pheno-

typic and allelic frequencies of proteins, the observed and expected distribution of phenotypes, the frequencies of homozygotes and heterozygotes and the observed and expected distribution of homozygotes and heterozygotes were calculated according to the Hardy-Weinberg equilibrium principle.

For assessing the conformity between the observed and expected distributions and the significance of differences in the frequency of respective phenotypes and alleles the chi-square test was used.

## RESULTS AND DISCUSSION

Yet a pioneering study on blood protein polymorphism in half-blood horses, mentioning the Przedświt and Furioso strains, has been presented by TO-

MASZEWSKA-GUSZKIEWICZ et al. (1974). She compared the Wielkopolski horses, Anglo-Arabs, Furioso-Przedświt horses, Gidran horses, Polish koniks and cold-blooded horses within the transferrin system and found, among others, no homozygotic phenotypes O and R nor heterozygotic phenotypes HO, HR and OR in the horses of Furioso-Przedświt strains. She proved at the same time that phenotypes DF and F were of the highest frequency. Her study included the transferrin system only and did not take into account yet the distribution of allele  $Tf^f$  (due to different migration rate of this sub-fraction) into two types determined by alleles  $Tf^{f1}$  and  $Tf^{f2}$ .

Phenotypic and allelic frequencies of polymorphic blood proteins in the analysed 147 stallions are presented in Table I.

I: Phenotypic and allelic frequencies of polymorphic blood proteins in the Małopolski and Przedświt stallions

Proteins	Phenotypes	Małopolski horses				Przedświt			
		N	%	allele		N	%	allele	
				N	q			N	q
Albumin (Al)	F	13	10.4	78	0.3120	4	18.2	16	0.3636
	FS	52	41.6			8	36.4		
	S	60	48.0	172	0.6880	10	45.5	28	0.6364
Transferrin (Tf)	D	15	12.0	68	0.2720	3	13.6	15	0.3409
	DF <sub>1</sub>	12	9.6			5	22.7		
	DF <sub>2</sub>	16	12.8			4	18.2		
	DH	3	2.4			-	-		
	DO	7	5.6			-	-		
	DR	-	-			-	-		
	F <sub>1</sub>	9	7.2	58	0.2320	-	-	12	0.2727
	F <sub>1</sub> F <sub>2</sub>	19	15.2			7	31.8		
	F <sub>1</sub> H	3	2.4			-	-		
	F <sub>1</sub> O	4	3.2			-	-		
	F <sub>1</sub> R	2	1.6			-	-		
	F <sub>2</sub>	24	19.2	92	0.3680	2	9.1	16	0.3636
	F <sub>2</sub> H	2	1.6			1	4.5		
	F <sub>2</sub> O	3	2.4			-	-		
	F <sub>2</sub> R	4	3.2			-	-		
	H	1	0.8	11	0.0440	-	-	1	0.0227
	HO	1	0.8			-	-		
	HR	-	-			-	-		
	O	-	-	15	0.0600	-	-		-
	OR	-	-			-	-		
	R	-	-	6	0.0240	-	-		-
Esterase pH 8,5 (EspH 8,5)	F	2	1.6	14	0.0560 <sup>A</sup>	2	9.1	9	0.2045 <sup>A</sup>
	FI	10	8.0			5	22.7		
	FS	-	-			-	-		
	I	104	83.2	227	0.9080 <sup>a</sup>	15	68.2	35	0.7955 <sup>a</sup>
	IS	9	7.2			-	-		
	S	-	-	9	0.0360	-	-	-	-

Vitamin D binding protein (Gc)	F	125	100.0	250	1.0000	21	95.5	43	0.9773
	FS	-	-	-	-	1	4.5	-	-
	S	-	-	-	-	-	-	1	0.0227
Protein X <sub>k</sub> (X <sub>k</sub> )	F	-	-	2	0.0080	-	-	-	-
	FK	2	1.6	-	-	-	-	-	-
	K	116	92.8	241	0.9640	22	100.0	4	1.0000
	KS	7	5.6	-	-	-	-	-	-
	S	-	-	7	0.0280	-	-	-	-

It was found that in the population of Małopolski horses 15 alleles determined the occurrence of 27 phenotypes, whereas in the group of Przedświt horses 11 alleles were showed to determine the occurrence of 15 phenotypes.

In the albumin system the highest frequency was found for the occurrence of allele Al<sup>S</sup> in both populations.

When examining the transferrin system it was found that in the Małopolski horses phenotypes F<sub>2</sub>F<sub>2</sub> (19.2%) and F<sub>1</sub>F<sub>2</sub> (15.2%) and allele Tf<sup>F2</sup> (q = 0.3680) occurred most frequently, whereas in the Przedświt population these were phenotypes F<sub>1</sub>F<sub>2</sub> (31.8%) and DF<sub>1</sub> (22.7%), and alleles Tf<sup>F2</sup> (q = 0.3636) and Tf<sup>D</sup> (q = 0.3409).

When analysing alkaline esterase, high frequency of Es<sup>I</sup> (q = 0.9080) was observed in the group of Małopolski horses, which differed (at P ≤ 0.05) from that of this allele in the population of Przedświt horses (q = 0.7955). Statistically significant difference (at P ≤ 0.01) was also observed with regard to the frequency of allele Es<sup>F</sup> between the examined horse popu-

lations (Małopolskie horses: q = 0.0560; Przedświt horses: q = 0.2045).

In the protein Gc system, allele Gc<sup>F</sup> was a predominant allele in both populations. Similarly, the predominance of one allele was found in the protein X<sub>k</sub> systems, namely of allele X<sub>k</sub><sup>K</sup>.

In Table II are presented the frequencies of homozygotes and heterozygotes in both examined horse populations. High degree of homozygosity was proved for majority of analysed protein systems, except transferrin.

It was found that the observed distribution in the transferrin system diverged in a statistically significant way (at P ≤ 0.01) from the expected one.

The obtained results are convergent with the results of studies carried out by TOMASZEWSKA-GUSZKIEWICZ (1974) and PIKUŁA et al. (1997).

As NOGAJ et al. (2000) state, the occurrence of low frequency of alleles Al<sup>F</sup> and Gc<sup>S</sup> and high of alleles Tf<sup>D</sup> Tf<sup>F1</sup> and Tf<sup>F2</sup> is a characteristic feature for the Małopolski breed.

## II: Frequencies of homozygotes and heterozygotes in the analysed stallion blood protein systems

System		Małopolski horses		Przedświt	
		N	%	N	%
Albumin (Al)	homozygotes	73	58.4	14	63.6
	heterozygotes	52	41.6	8	36.4
Transferrin (Tf)	homozygotes	49	39.2	5	22.7
	heterozygotes	76	60.8	17	77.3
Esterase pH 8.5 (EspH8.5)	homozygotes	106	84.8	17	77.3
	heterozygotes	19	15.2	5	22.7
Vit.D binding protein (Gc)	homozygotes	125	100.0	21	95.5
	heterozygotes	-	-	1	4.5
Protein X <sub>k</sub> (X <sub>k</sub> )	homozygotes	116	92.8	22	100.0
	heterozygotes	9	7.2	-	-

## CONCLUSIONS

1. The examined horse populations are in the state of genetic balance [equilibrium].
2. Large diversity was found in both examined horse populations with regard to the genetic markers discussed.
3. High frequency of allele Es<sup>F</sup> is a characteristic feature of the horse population of the Przedświt strain.

## SOUHRN

## Porovnání genetické struktury malopolského koně s kmenem Przedświt

Cílem předložené studie je imunogenetická charakteristika Malopolského koně na základě pěti genetických polymorfních systémů bílkovin krevního séra a jeho srovnání s kmenem Przedświt. Na základě zjištěných výsledků je možno konstatovat, že kmen Przedświt je charakteristický vysokou frekvencí alely Es<sup>F</sup>.

Malopolský kůň, kmen Przedświt, polymorfismus krevních bílkovin, genetická struktura

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