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ERRORS IN IDENTIFYING COAT COLOURS IN HORSES: THE SCALE OF THE PROBLEM

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Key words: coat colour, horses, identification, colour inheritance pattern.

Abstract

The identification system of horses used in Poland is based on the old classification of coat colours which does not include all colours based on colour inheritance patterns. As a result, some colours are incorrectly described. In order to evaluate the scale of the problem, the accuracy of colour identification was assessed by verifying 5779 pedigrees of horses of three different breeds. The verification was performed based on the colour inheritance patterns using a classification of discrepancies. Such discrepancies were detected in 26 cases and related mainly to diluted colours and black. The problem, however, should not be neglected. The number of incorrectly described horses is probably higher, since not all discrepancies can be detected based only on breeding records. The study demonstrated that some errors could be avoided by updating the classification of coat colours. However, a complete elimination of errors is impossible without genetic testing.

BŁĘDY W IDENTYFIKACJI UMASZCZENIA U KONI – SKALA PROBLEMU

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Słowa kluczowe: umaszczenie, konie, identyfikacja, dziedziczenie umaszczenia.

Abstrakt

Opis identyfikacyjny koni stosowany w Polsce oparty jest na przestarzałej klasyfikacji maści. Nie uwzględniane są wszystkie maści, których istnienie potwierdzono dzięki pogłębieniu wiedzy na temat zasad dziedziczenia umaszczenia koni. W efekcie część maści jest nieprawidłowo opisywana. W związku z tym, aby ocenić skalę problemu, przeprowadzono analizę poprawności identyfikacji

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maści, weryfikując 5779 rodowodów koni trzech różnych ras. Weryfikację prowadzono w oparciu o reguły dziedziczenia umaszczenia, wykorzystując opracowaną do tego celu klasyfikację nieprawidłowości. Takie nieprawidłowości stwierdzono w 26 przypadkach. Dotyczyły przede wszystkim maści rozjaśnionych oraz maści karej. Nie należy jednak lekceważyć problemu. Liczba błędnie opisanych koni jest najprawdopodobniej większa, ponieważ nie wszystkie nieprawidłowości są możliwe do wykrycia w oparciu wyłącznie o dokumentację hodowlaną. W badaniach wykazano, że można uniknąć części błędów poprzez uaktualnienie klasyfikacji maści. Jednakże całkowite wyeliminowanie błędów nie jest możliwe bez zastosowania testów genetycznych.

Introduction

Before humans started to interfere in the selection of horses for breeding, primitive horses had a relatively limited variety of colours. The majority of them were blue dun, black, dun, bay or brown, which had been a specific camouflage for this species in its natural environment (CZAPSKI 1874, STACHURSKA et al. 2001). Differently-coloured specimens were usually been eliminated by means of natural selection (CHACHUŁA et al. 1991, GRANDIN and DEESING 1998). When the horse was domesticated, humans started to implement a selection process which included varied traits such as coat colours. Horses with rare colours, which initially would have had fat chance for survival, such as skewbald, grey or palomino, were favoured by humans. The selection of these horses for breeding provoked an elevated frequency of initially rare alleles, which resulted in a higher variety of colours in this species (CHACHUŁA et al. 1991). Today, there are over 30 known colours (STACHURSKA 2002). Coat colours in horses as a typical trait are used to identify these animals and, therefore, accurate description of the colours is very important. Moreover, some breeders wish to have a specific colour of offspring, which is only possible with a precise and accurate description of parental colours. Knowing the colour of parents and offspring, it is possible to eliminate or question the origin of a horse by using the colour inheritance pattern (MIKULSKA 1999).

In Poland, the identification of horse colours is based on the phenotype, usually without taking in consideration the patterns of its inheritance. In addition, an identifying description uses the traditional classification of colour, which does not include such colours as buckskin or red-dun (STACHURSKA 2002). This situation facilitates errors in determining the colours of horses. Therefore, in order to determine a scale of the problem and types of errors, it was attempted to verify the accuracy of colour identification in the selected horse breeds by using the inheritance patterns.

Material and Methods

To analyse the accuracy of colour identification, 5770 horse pedigrees were verified. The data originated from the following stud books:

– the 1st and 2nd volume of The Stud Book of Polish Halfbred Horses (Ksp) – 2160 horses,

– the 1st and 2nd part of volume 4 of The Stud Book of Wielkopolska Horses (Kwlkp) – 2382 horses,

– the 4th volume of The Stud Book of Malopolska Horses (Km) – 1237 horses.

The errors in colour descriptions were identified based on the assumed inheritance patterns and according to up-to-date genetic knowledge by comparing the colour of offspring with the colours of the parents. The verification procedures included three generations of horses. The discrepancies were classified and presented in tables. A personal classification was formulated to systematize the data:

1) Discrepancies based on the properties of alleles located on the locus A (Agouti): the offspring of bay or brown (A_E_) cannot originate from mating black coloured horses (aaE_) and blue dun individuals (aaE_D_) (the lack of allele A in the genotype);

2) Discrepancies in diluted colours determined by the genes located on the locus C (cream colours) and on the locus D (dun colours):

– the offspring of palomino horses (_ _eeCC^{cr}dd) cannot originate from the mating of horses in which none of individuals is cream diluted (the lack of allele C^{cr} in the genotype),

– the offspring of dun horses (A_E_D_) cannot originate from the mating of horses in which none of the individuals is dun diluted (the lack of allele D in the genotype).

3) Discrepancies based on the dominant nature of allele G which determines grey colour: the offspring grey in colour (_ _G_) cannot originate from the mating of horses in which none of the individuals was grey (the lack of allele G in the genotype).

Results and Discussion

The analyses of the accuracy of horse colours based on the patterns of inheritance revealed discrepancies in 26 cases, which constituted 0.45% of all pedigrees included in the study (Table 1). The majority were discrepancies of type 2, i.e. related to the identification of diluted colours (13 cases) and of type 1, i.e. related to the crossbreeding of black horses (10 cases). The most mistakes

were detected in the descriptions of Wielkopolska horses (14 discrepancies) and only in this breed were type 3 discrepancies (related to the identification of grey colour) found (3 cases).

Table 1

Discrepancies detected in pedigrees of horses of selected breeds with regard to the coat colour

Breed	*n*	Discrepancies						Total	
		1		2		3			
		n	[%]	*n*	[%]	*n*	[%]	*n*	[%]
Sp*	2160	5	0.23	2	0.09	0	0.00	7	0.32
Wlkp**	2382	3	0.13	8	0.34	3	0.13	14	0.59
Młp***	1237	2	0.16	3	0.24	0	0.00	5	0.40
Total	5779	10	0.17	13	0.22	3	0.05	26	0.45

* Polish Halfbred Horse
** Wielkopolska Horse
*** Malopolska Horse

The discrepancies of type 2 were detected based on the dominant nature of alleles C^{Cr}, and alleles D which determine the occurrence of diluted cream and dun colours by the specific dilution of basic colours. The presence of allele C^{cr} in the genotype of at least one parent is a prerequisite for obtaining an offspring with cream dilution. Similarly, the presence of allele D is a prerequisite for obtaining an offspring with dun dilution. In other words, due to the dominant nature of these alleles, at least one of the parents must be diluted in colour (STACHURSKA 2002). However, it was found in the verified pedigrees that the parents without these alleles in the genotype produced diluted offspring (palomino or dun). In this group, the most common discrepancies were associated with a situation in which the mating of a dun or golden bay with a chestnut or bay horse produced palomino offspring or vice versa: dun offspring were produced by mating a palomino horse with a bay individual. Since the palomino and dun colours are determined by separate genes, a dun sire (A_E_ CCD_) cannot pass the allele C^{cr} which determines palomino colour to its offspring, and a palomino parent (_ _eeddCCCr) cannot pass the allele D which determines dun colour. Similarly, these alleles cannot be transferred by a parent of basic colours (STACHURSKA and ZASADNY 1999). These discrepancies can have different causes. It seems most probable that the horses identified as dun were actually of buckskin colour (A_E_CC^{Cr}dd), which would explain the presence of C^{cr} allele in the offspring. Since the buckskin colour is not featured in the colour classification used in the identification of the analysed horse breeds, the horses of this colour are mistakenly described as dun, golden bay or light bay. These colours are phenotypically very similar to buckskin colour,

which is characterized by a yellowish-brown coat colour, black mane and tail as well as black markings on the legs (STACHURSKA 2002).

The abnormalities of type 2 could have also resulted from an erroneous identification of a "chestnut" parent which was actually palomino (_ _eeCC^{Cr}dd) or vice-versa, an palomino' offspring was light chestnut (sorrel) (_ _eeCCdd). It cannot be excluded that a dun parent was genotypically buckskin-dun (A_E_CC^{Cr}D_), although this case seems less likely as the frequency of these colours is very low in the populations of the analysed breeds.

Two palomino offspring were detected as having originated from two chestnut parents. Since chestnut horses (_ _eeCCdd) cannot pass the C^{cr} allele to their offspring, they cannot produce palomino offspring. Moreover, horses of this colour crossed with each other can only produce chestnut offspring, which results from the epistatic nature of the recessive ee alleles. The reason for this abnormity was most probably the mistaken description of a palomino horse as light-chestnut. These colours are very similar. In both colours, horse hair is very fair, almost white. The coat of a palomino horse may range from fair-cream to deep golden, whereas light chestnut horses have fair yellow-red coat (CASTLE and SINGLETON 1961, STACHURSKA 2002).

Type 1 discrepancies were relatively common and related to the mating of two black horses (aaE_) and two blue dun horses (aaE_D_). Such mating cannot produce any bay foal (A_E_) as parents cannot transfer the allele A. The most probable explanation of this abnormity seems to be an erroneous description of one of the parents or the offspring itself. Black, dark-bay and sometimes brown colours are often very similar, which hinders a correct colour identification (STACHURSKA et al. 2004). Therefore, one of black parents could have been genotypically bay or brown, or dark-bay offspring could have been actually black. The occurrence of bay individuals can be also explained by the hypothesis that a dominant black colour (E^{D}) may exist in which the presence of allele A would be unnoticeable (DREUX 1966, SPONENBERG and WEISE 1997). The majority of studies carried out to date have rejected the existence of such an allele and colour (MIKULSKA 1999, RIEDER et al. 2001, STACHURSKA 2002).

Although the background of the aforementioned discrepancies may be explained relatively easily, it does not apply to type 3 mating, in which none of the parents of a grey individual was grey in colour. This situation was detected three times while analysing the pedigrees of the Wielkopolska horse breed. The presence of allele G causes greying in the horse, regardless of the initial colour (except for white dominant colour). If an individual has this allele, it is thus visible in the phenotype. Such an error could be relatively easily explained if made in a description of foals or younger horses (as the symptoms of greying may not be visible), but it is much more difficult to be justified in horses registered in stud books. Horses are entered in a stud book at the age of app.

three years when the signs of greying are clearly visible. Therefore, any discrepancies in the description are probably caused by human error (e.g. while copying information into a stud book). As the inheritance pattern of grey colour has been known for long (ZWOLIŃSKI 1977), it seems even more surprising that a person who recorded the data did not question the origin of such horse or the accuracy of its parents' description. It indicates that persons authorized to record the description of horses have limited knowledge on the genetic background of colour inheritance pattern.

Even though the above-mentioned errors may seem trivial, for a person who understands the colour inheritance patterns, a discrepancy in a description may constitute a basis for questioning the origin of such horses. Despite the percentage of discrepancies in the description being relatively low (0.45%), they should not be neglected. The number of erroneously described horses is presumably much higher, taking into consideration the fact that not all discrepancies can be detected based only on breeding records. For instance, the frequency of buckskin horses may be much higher, because these horses were often described as bay, and a colour of bay horse with a bay parent cannot be questioned.

Conclusions

Some of the detected discrepancies could be caused by mistaken parentage, but the genetic control of parentage which is now commonly conducted, will reduce the number of such mistakes. Most of the discrepancies indicate the errors in describing the coat colours in horses. The substantial majority of them resulted from a lack of possibility to correctly identify the colour as the identifying description is based on traditional classification of coat colours. Most errors would be avoided if the classification of colours used in the identification records was updated according to the current state of knowledge on the patterns of colour inheritance. The buckskin, reddun and other colours should be included in the classification. Persons responsible for identification records should know the patterns of colour inheritance, which would also limit the errors. However, a complete elimination of errors is impossible without genetic tests which verify the colours of horses. For instance, identifying black and dark-bay or buckskin colours is sometimes difficult. Unfortunately, the wide-scale implementation of such tests seems unreal, at least for financial reasons.

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