

The Effect of Pinzgauer Introgression on the Red Pied Sided Coat Colour of Cika Cattle

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Summary

The aim of this study was to evaluate the effect of the proportion of Pinzgauer cattle in the pedigree of the Cika cattle on the coat colour pattern. Both breeds share similar pied sided coat colour pattern. A total of 66 male and 237 female animals, aged from 4 days to 13.1 years were included in the study. The width of the white stripes on the back, on the rump, on the front and on the rear legs were measured with the tape. The red basic coat colour intensity was performed by Minolta CR-300 Chroma meter using CIE (L^*a^*b) colour system at three parts of the body (shoulder, rare ribs, round). All animals were measured in the spring after housing period. The GLM procedure (SAS/STAT) considered fixed effect of sex and the proportion of Pinzgauer cattle in the pedigree of each Cika animal as linear regression. The effect of sex significantly affected the width of white stripes on the back, rump and rear legs as well as the red colour intensity (a^*). Females had significantly wider white stripes and more intensively red coat colour than males. The effect of the Pinzgauer proportion in the pedigree of Cika was found significantly related to white stripes on the back and rump as well as in all three coat colour parameters (L^*a^*b). White stripes on the back and rump significantly increased, while values of L^* (lightness), a^* (redness) and b^* (yellowness) significantly decreased with increased Pinzgauer proportion in the pedigree. Introgressed Cika animals with Pinzgauer had wider white stripes on the back and rump as well as darker coat colour with less intensively red and yellow shades. The results comply with an eye evidence of differences in the coat colour pattern according to sex and pedigree data. However, genetic characterisation found introgression of other breeds besides Pinzgauer in some Cika animals, which could influence the coat colour as well.

Key words

Cika, Pinzgauer, coat colour pattern, red pied sided, white stripe

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Introduction

Colour sidedness is a dominantly inherited phenotype of cattle characterized by the polarization of pigmented sectors on the flanks, snout and ear tips. Typically, colour sided breeds display a white band along their spine. Colour sidedness is documented at least since the Middle Ages and is presently segregating in several cattle breeds around the globe (Olson, 1999, Porter & Mason, 2002). It is determined by a first allele on the chromosome 29, which results from the translocation of a 492-kilobase chromosome 6 segment encompassing KIT to chromosome 29, and a second allele on chromosome 6, derived from the first by repatriation of fused 575-kilobase chromosome 6 and 29 sequences to the KIT locus (Durkin et al., 2012).

One of the pied sided coat colour breeds is the autochthonous Slovenian Cika cattle, widespread especially in the Alpine areas. The typical white stripe takes place along the back, the tail, the udder, the abdomen and the chest. Likewise, white stripes are in the upper arms and the upper part of the hind legs. The border between red and white coat colour is typically ragged. The basic coat colour is yellow-red to dark red-brown, mostly chestnut brown. The short head is red coloured with rose-coloured muzzle, large eyes, well-expressed arcades, thin horns with dark points, a thin skin pleated in the neck and dark hooves (Žan Lotrič et al., 2010). Cika cows were on average 126.5 cm high at the withers and have 420 kg of body weight at the age of 33.9 months, which clearly shows that it belongs to small or medium body sized cattle (Simčič et al., 2016).

The Pinzgauer cattle is an autochthonous breed from the Pinzgau region of the federal state of Salzburg in Austria and have pied sided coat colour as well. The Pinzgauer cattle have a chestnut brown basic colour with a characteristic broad white stripe over the withers, back, thigh, belly and lower breast. The tail is also white. The upper arms and the upper part of the hind legs are usually white. Animals are auburn in the basic coat colour. A luscious chestnut-colour is the breeding goal. The muzzle are rose-coloured, while claws are dark. Horns are bright with black tips. Claws are dark (Samraus, 1999). The Pinzgauer cow stands 130-138 cm at the withers, weighting 650 kg on average, while for bulls the figures are 140 – 147 cm and 900 – 1100 kg (Felius, 1995).

Based on the above description, Cika and Pinzgauer cattle share similar pied sided coat colour pattern. Investigations on the historical development of the breed showed that Cika cattle originate from the local single-coloured cattle improved with the more productive Mölltaler sires during the second half of the 19th century (Žan Lotrič, 2012, Simčič et al., 2013). At that time, Cika cattle adopted the red-pied Mölltaler coat colour pattern, but the body frame retained features of the primitive local cattle (Ferčej, 1947). The Mölltaler cattle was assimilated in the Pinzgauer herd-book in 1925 (Samraus, 1999) due to the similar pied sided coat colour pattern. Thereafter, Pinzgauer sires were widely used for the continuous upgrading of the Cika breed in lowlands farms. Not all breeders accepted upgrading with another breed and in the mountains, breeders rejected Pinzgauer sires due to the calving difficulties and large feed consumption

of the offspring. Consequently, two different types of Cika were developed, the large ‘lowland’ and the light ‘mountain or Bohinj’ type, respectively (Ferčej, 1947).

After 1976, Cika sires were not licensed anymore, and the law prohibited natural services. Breeders were forced to choose between the semen of a few imported Pinzgauer sires and the semen of crossed Cika sires with only 25–50% of Cika genes (Jeretina, 2004). Only later, it became known that breeders in the mountains had defied the ban on natural service of unlicensed Cika sires. In 1992, only 60 Cika cows introgressed with Pinzgauer and registered in the herd book with known pedigree existed. In addition, on mountain farms, breeders who preferred natural service were managed to conserve 300 potentially pure Cika cattle (Simčič et al., 2015). All the collected information and previous researches showed that only a part of the Cika cattle population was introgressed with Pinzgauer cattle in the past.

The aim of this study was to evaluate the effect of the proportion of Pinzgauer cattle in the pedigree of Cika cattle on the coat colour pattern of Cika cattle.

Material and methods

Sampling

Among the 303 Cika cattle included in the study, 66 were males and 237 female animals, aged from 4 days to 13.1 years. The measurements of animals were performed in the springtime of the 2013, after the housing period. All the present animals in the stables of 34 farms all over the country were measured.

The width of the white stripes on the back, on the rump, on the front and on the rear legs were taken with the tape. In the same time, the wither height of animals were taken with the Lydtin stick. All four parameters of the width of white stripes were computed as the proportions of the wither height. The red basic coat colour intensity was performed by Minolta CR-300 Chroma meter using CIE (L*a*b) colour system at three parts of the body (shoulder, rare ribs, round) as was recommended by Tóth et al. (2014).

The average wither height of 303 Cika animals was 115.89 ± 15.89 cm (Table 1). All categories of the cattle were measured, from the youngest and the lowest calves (minimum = 68 cm) to the tallest sires (maximum = 145 cm). Consequently, the width of the white stripes were considered as the proportion to the wither height. In average, the white stripe on the back was 8.53 ± 9.51 cm width; on the rump 28.32 ± 15.10 cm; on the front legs 2.23 ± 4.84 cm and on the rear legs 8.66 ± 9.65 cm. The red basic coat colour intensity was expressed like the average values of three parameters, L* (40.31 ± 3.23), a* (5.78 ± 0.73) and b* (7.63 ± 2.44).

Statistical analysis

The GLM procedure (SAS/STAT) (SAS Inst. Inc., 2014) considered fixed effect of sex (S_i) and the proportion of Pinzgauer cattle in the pedigree of each Cika cattle animal as linear regression (b_i) in the Model 1 which was used for all included traits.

$$y_{ij} = \mu + S_i + b_i(x_{ij} - \bar{x}) + e_{ij} \quad \text{Model 1}$$

Table 1. Descriptive statistics of the coat colour traits

Trait	N	Mean ± SD	SD error	Minimum	Maximum
Wither height (cm)	303	115.89 ± 15.89	0.91	68.00	145.00
White stripe:					
– on the back (cm)	302	8.53 ± 9.51	0.55	0	45.00
– on the back (%)	303	7.27 ± 7.90	0.45	0	34.09
– on the rump (cm)	302	28.32 ± 15.10	0.87	0	72.00
– on the rump (%)	303	24.19 ± 12.32	0.71	0	58.16
– on the front legs (cm)	302	2.23 ± 4.84	0.28	0	51.00
– on the front legs (%)	303	1.88 ± 3.85	0.22	0	36.43
– on the rear legs (cm)	240	8.66 ± 9.65	0.62	0	40.00
– on the rear legs (%)	254	7.03 ± 8.18	0.51	0	34.19
Basic coat colour intensity					
L* (lightness)	303	40.31 ± 3.23	0.19	32.66	52.52
a* (redness)	303	5.78 ± 0.73	0.04	3.56	7.84
b* (yellowness)	303	7.63 ± 2.44	0.14	2.56	14.92
Age at measuring (days)	303	1594.73 ± 1482.84	85.19	4.00	7585.00

N - number of animals, SD – standard deviation

Results and discussion

We used the standard instrumental method as an objective method exists, which makes the description of the colours easier and more precise. The method is able to specify the colour quantitative in the L*a*b colour system. The instrumental method was used by various researches to measure the coat colour parameters of horses (Curik et al., 2013; Tóth et al., 2014) and cattle (Radácsi et al., 2009; Mészáros et al., 2015; Kasarda et al., 2016).

In this study, it was found that the effect of sex significantly affected the width of white stripes on the back, rump and rear legs as well as the red colour intensity (a*) in the Cika cattle animals. Females had significantly wider white stripes on the back (7.92 ± 0.50% of wither height), rump (25.66 ± 0.77% of wither height) and rear legs (7.95 ± 0.59% of wither height) than males (4.99 ± 0.95%, 19.10 ± 1.46%, 4.78 ± 1.00% of wither height), respectively. Likewise, females had significantly more intensively red coat colour (a* = 5.85 ± 0.05) than males (a* = 5.36 ± 0.09) (Table 2).

The effect of Pinzgauer admixture was found significantly related to white stripes on the back and rump as well as in all three coat colour parameters (L*a*b) (Table 2).

White stripes on the back and rump significantly increased (Figure 1), while values of L* (lightness) (Figure 2), a* (redness) and b* (yellowness) (Figure 3) significantly decreased with increased proportion of Pinzgauer in the Cika pedigree. According to the pedigree data, introgressed Cika animals with a higher proportion of Pinzgauer in the pedigree had wider white stripes on the back and rump. They had darker coat colour with less intensively red and yellow shades, compared to the purebred Cika animals according to the pedigree or animals with lower proportion of the Pinzgauer in the pedigree.

Furthermore, Kasarda et al. (2016) recorded the intensity of the chestnut brown coat colour of the Slovakian Pinzgauer cattle, measured on 304 cows from four farms. The Slovakian Pinzgauer cattle is very similar to Pinzgauer cattle from Austria. In the year 1870, the Pinzgauer breeding area in Slovakia was established; when Pinzgauer breed absorbed the old land cattle population of Carpathians to form the Slovakian Pinzgauer (Feliuss, 1995).

Slovakian Pinzgauer cows (Kasarda et al., 2016) had darker (L* = 22.60 ± 4.62) coat colour compared to Cika cows (L* = 40.17 ± 0.20) which is in agreement with the results of this study where introgressed Cika animals had darker coat colour.

Table 2. LSM means and standard errors as well as p-values for the coat colour traits

Trait	LSM ± SE		p-values	
	Males	Females	Sex	Proportion of Pinzgauer in the pedigree (%)
White stripe (% of wither height)				
– on the back	4.99 ± 0.95	7.92 ± 0.50	0.007	0.001
– on the rump	19.10 ± 1.46	25.66 ± 0.77	<0.001	0.001
– on the front legs	2.13 ± 0.48	1.82 ± 0.25	n.s.	n.s.
– on the rear legs	4.78 ± 1.00	7.95 ± 0.59	0.003	n.s.
Basic coat colour intensity				
L* (lightness)	40.72 ± 0.39	40.17 ± 0.20	n.s.	<0.001
a* (redness)	5.36 ± 0.09	5.85 ± 0.05	0.002	0.001
b* (yellowness)	7.92 ± 0.29	7.54 ± 0.15	n.s.	<0.001

LSM – least square means, SE – standard error

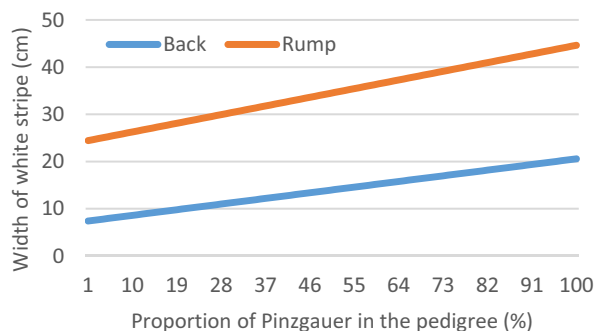


Figure 1. The effect of the proportion of Pinzgauer in the pedigree on the width of white stripes of Cika cattle

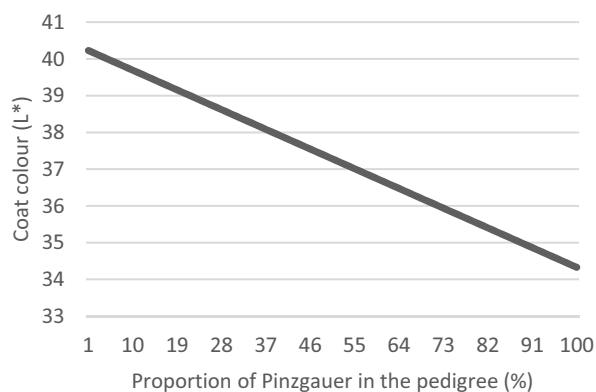


Figure 2. The effect of the proportion of Pinzgauer in the pedigree on the L* parameter of the coat colour of Cika cattle

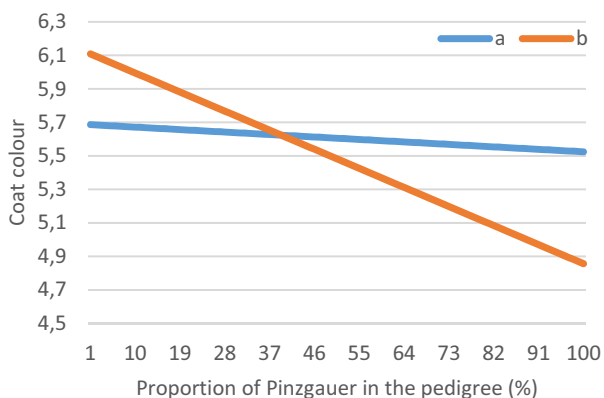


Figure 3. The effect of the proportion of Pinzgauer in the pedigree on the a* and b* parameters of the coat colour of Cika cattle

Slovakian Pinzgauer cows had significantly more expressed redness ($a^* = 8.84 \pm 2.42$) of the coat colour compared to Cika cows ($a^* = 5.85 \pm 0.05$), which is not in agreement with this study where redness significantly decreased with the increased proportion of Pinzgauer in the pedigree. Likewise, Slovakian

Pinzgauer cows had significantly more expressed yellowness ($b^* = 13.32 \pm 3.75$) of the coat colour compared to Cika cows ($b^* = 7.54 \pm 0.15$), which is not corresponding with this study where yellowness significantly decreased with the increased proportion of Pinzgauer in the pedigree.

Conclusion

According to the results of the study, significant differences in the width of the white stripes as well as red basic coat colour among Cika animals comply with an eye evidence of differences according to sex and pedigree data. Females had significantly wider white stripes on the back, rump and rear legs than males. Likewise, females had significantly more intensively red coat colour than males. The effect of the proportion of Pinzgauer in the pedigree was found significantly related to white stripes on the back and rump as well as in all three coat colour parameters. Cika cattle animals introgressed with Pinzgauer had wider white stripes on the back and on the rump as well as darker coat colour with less intensively red and yellow shades. However, genetic characterisation found introgression of other breeds besides Pinzgauer in some Cika animals, which could influence the coat colour as well.

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