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Original Paper

The impact of genetic and non-genetic factors on somatic cell count as a monitor of udder health in Slovak Simmental dairy cows

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The aim of study was to evaluate the impact of genetic and non-genetic factors on somatic cells count in Slovak Simmental dairy cows in period 2009 to 2013. We observed subsequent results in dairy cows of 55,822 Slovak Simmental cattle. Data were analysed using the SAS and linear model with fixed effects of herd, years and months controls, sire, breeding type. The results of somatic cells count during the years 2009 and 2013 were as follows: the highest number of samples was analysed during 2010 (n = 288,215), where the average count was 560.48 × 10^3·ml^{-1}. The lowest average value of somatic cells count was of amount of 535.93 × 10^3 ·ml^{-1} (n = 280,732) in 2009.The linear model represents coefficient determination R^2 = 0.038296% (P <0.001) for SCC with all fixed effects. According to the analyses by the effects on SCC the highest effect was the effect of herd R^2 = 0.021625, then effect of sire R^2 = 0.015075. These effects were highly statistically significant (P <0.001). Correlation coefficients among milk in kg, fat, protein in % with somatic cells count were r = -0.12918, r = 0.04166 and r = 0.11423. These coefficients were highly statistically significant (P <0.001).

Keywords: dairy cows, milk production, Slovak Simmental cattle, somatic cells count and coefficient of determination

1 Introduction

The somatic cells count (SCC) of milk is widely used to monitor udder health and the milk quality (Sharif, Muhammad, 2008; Jadhav et al., 2016).The composition of milk from dairy cows is of major interest to milk producers, processors and consumers because of its health related issues and also market demand. It directly affects the economy of milk production as well as economic condition of these dairy farmers (Boro et al., 2016). Milk composition can be affected by a wide array of factors: breed, season, age, stage of lactation and diet of the animal (Savić et al., 2017; Tančin et al., 2018).Factors affecting on somatic cells count shows in publications others authors as Cerón-Muñoz et al., 2002; Souza et al., 2005; Rhone et al., 2008; Oudah, 2009; Saravanan et al., 2015 and Alhussien, Dang, 2018. The aim of study was to evaluate the impact of genetics and non-genetics factors on somatic cells count in Slovak Simmental dairy cows.

2 Materials and methods

The material for evaluation traits in population of dairy cows Slovak Simmental cattle between 2009 and 2013 years were received from of Breeding Service of Slovak republic (B.S. SR, S.E., 2014). We observed subsequent results of 55,822 in dairy cows (1,131,509 control samples) Slovak Simmental cattle: milk in kg (DMY), fat in % (DFC), protein in % (DPC) and somatic cells count (SCC). We according to divided dairy cows a breed-type S_0 – cows with genetic proportion of pure Slovak Simmental blood (into 87.5%), S_1 – cows with genetic proportion of pure Slovak Simmental blood (from 75% to 87.4%), S_2 – cows with genetic proportion of pure Slovak Simmental blood (from 50% to 74.9%). To determine the effect of SCC, it was divided into 4 groups according to the SCC values: I. – up to 100,000 SCC cm^{-3}; II. – 101–400 SCC cm^{-3}; III. – 401–500 SCC cm^{-3}; IV. – 501–1 million SCC cm^{-3} and V. >1 million SCC cm^{-3}. The basic statistical analysis of milk production traits and SCC were performed using the Statistical Analysis System (SAS) version 9.3 (TS1M2) Enterprise Guide 5.1. (SAS, 2011). For the actual computation a linear model with fixed effects was used:

$$y_{ijklm} = \mu + H_i + YS_j + b_k + c_l + e_{ijklm}$$

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where:
μ – mean value
H_i – effect of herd
YS_j – effect of years and month of controls
b_k – sire
c_l – breeding type
e_{ijklm} – residual error

3 Results and discussion

The basic traits of milk production and somatic cells count (SCC) in evaluated population of dairy cows Slovak Simmental cattle are presented in Table 1.

Figure 1 shows results of SCC by year's evaluation and trends of rising SCC which related with negative correlation among traits of milk production (DMY, DFC and DPC) and SCC. The correlation coefficients among DMY, DFC and DPC with SCC were r = -0.12918, r = 0.04166 and r = 0.11423. These coefficients were highly statistically significant P <0.001 (Table 2). These results are correspondence with Japertienė et al., 2016. De Freitas et al., 2017 shows correlation coefficients among DMY, DFC and DPC with SCC (r = -0.18116, r = 0.09046 and r = 0.08100).

The results of milk traits in control samples by code of SCC were divided into 5 groups and are presented in Figure

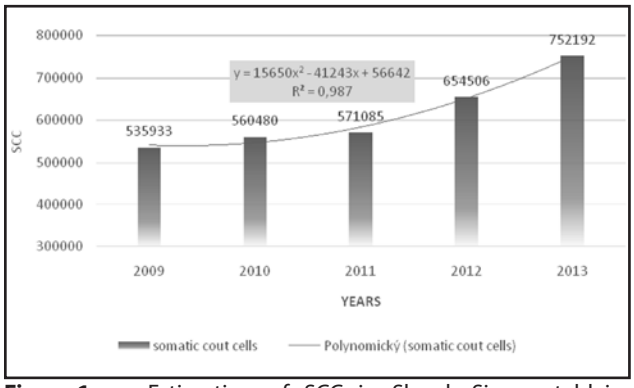

Figure 1 Estimation of SCC in Slovak Simmentaldairy cows by years of control samples

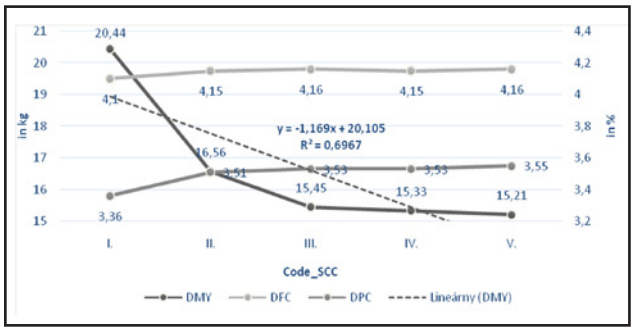

Figure 2 Statistical characteristics of DMY, DFC and DPC in dairy cows of Slovak Simmental by code of SCC

Table 1 Statistical characteristic of DMY, DFC, DPC and SCC in dairy cows of Slovak Simmental

Traits	*n*	$\bar{x}$ ±*SD*	*CV*	Mode	Median
DMY (kg)	55 822	17.68 ±8.08	44.91	16.60	17.0
DFC (%)		4.10 ±0.86	20.98	3.87	4.04
DPC (%)		3.46 ±0.38	10.85	3.40	3.47
SCC (× 10^3·ml^{-1})		594.75 ±1620.55	272.48	31.0	156.0

n – number of observation, $\bar{x}$ – average, *SD* – standard deviation, *CV* – coefficient of variation, Mode – value that appears most often in a set of data, Median – value separating the higher half of a data

Table 2 Relation between SCC and traits of milk production (DMY, DFC and DPC)

Traits	DMY	DFC	DPC
SCC	-0.12918^{+++}	0.04166^{+++}	0.11423^{+++}

$^{+++}$ P <0.001

Table 3 Factors affecting SCC in Slovak Simmental dairy cows

Sources of variability	*DF*	Mean Square	*F*-Value	*R*-Square somatic cells count (SCC)
Herd	489	131,407,525.5	51.12^{+++}	0.021625
Years-month	59	152,738,015	58.33^{+++}	0.003033
Sire	907	49,390,629.528	19.08^{+++}	0.015075
Breeding_type	2	765,211,084.45	291.53^{+++}	0.000515

DF – grades of freedom, *R*-Square – coefficient of determination (R^2), $^{+++}$ P <0.001

2.The average of DMY, DFC and DPC are 15.21 to 20.44, 4.10 to 4.16 and 3.36 to 3.55 by code of SCC.These results are similar with conclusions of Jattawa et al., 2012 and de Freitas et al., 2017, where values perceptual of milk traits by codes of SCC have rising tendency.

Using the linear model we have found out the coefficient determination R^2 = 0.038296% (P <0.001) for SCC with all fixed effects. The analyses by the effect on SCC showed the highest effect of the effect of herd R^2 = 0.021625, followed by the effect of sire R^2 = 0.015075. These effects were highly statistically significant P <0.001 (Table 3). These results are similar with results of Cerón-Muñoz et al., 2002; Souza et al., 2005; Rhone et al., 2008; Saravanan et al., 2015; Boro et al., 2016 and Savić et al., 2017.

4 Conclusions

The results confirm that the effect of herd on somatic cells count was higher R^2 = 0.021625%, than the effect of sire R^2 = 0.015075%. These effects were significant (P <.0001). For comparison, the correlation among evaluated somatic cells count (SCC) and traits of milk production (milk in kg, fat and proteins in %) were lower and negative r = -0.12918, r = 0.04166 and r = 0.11423. These results were statistical high significant (P <.0001).

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