

Evaluation of Milk Components and Somatic Cells Count in breeding herd of the Slovak Spotted Cattle

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Abstract

The aim this work was to evaluate the milk components and somatic cells in selected herd of dairy cows of Slovak Spotted cattle. The traits included the control samples of milk in kilograms, fat, proteins, lactose in percentages and somatic cells count as well as the correlation between given traits. By evaluation of milk yields we have find out that the average of control sample of milk production during the examined period in all the 14,160 control samples in 1,024 dairy cows was 20.69 ± 9.69 kgs of milk with a fat content of 3.94 ± 0.68 %, protein 3.48 ± 0.33 % and lactose 4.87 ± 0.21 % and $338.39 \pm 846.15 \times 10^3$ cells/ml. The correlation between the traits of milk production and the somatic cells count, for example milk in kgs, fat in %, proteins in %, lactose in % and somatic cells count in cells $\times 10^3$ /ml, where these values were $r = -0.03679$, $r = 0.08985$, $r = 0.08830$, $r = -0.30855$. These coefficients were statistically highly significant $p < 0.0001$.

Keywords: coefficients of correlation, dairy cows, effects impact, milk components, Slovak Spotted cattle, somatic cells count.

1. Introduction

Milk somatic cells (SCs) are a mixture of milk-producing cells and immune cells. These cells are secreted in milk during the normal course of milking and are used as an index for estimating mammary health and milk quality of dairy animals worldwide [1, 2].

The heritability for somatic cell counts (SCC), clinical mastitis and milk components is relatively low [4-6].

The European Union requires that milk used for dairy products sold in its territory have SCC levels below 400 000 cells/ml [7].

Many factors such as milk productivity, health of an animal, management, and environment affect the release of SCs in milk as discussed below.

Factors affecting on milk components and somatic cells count shows in publications others authors as Cerón-Muñoz et al. [8], Sahin et al [9], Silva et al. [10], Savić et al. [11], Tančin et al. [12] and affecting others traits Bujko et al. [13, 14], Kasarda et al. [15] and Gábor et al. [16].

The aim this work was to evaluate the milk components and somatic cells count in selected herd of dairy cows of Slovak Spotted cattle.

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2. Materials and methods

The material for evaluation of milk components and somatic cells count in breeding herds of Slovak Spotted cattle was provided from the database of Breeding Services of the Slovak Republic [17].

A total of 1,024 (14,160 control samples) dairy cows between 2014 and 2016 were observed during evaluation: milk in kg (M), fat in % (F), proteins in % (P), lactose in % (P) and somatic cells count in ml⁻¹ (SCC).

We divided dairy cows by order of lactation the "A" - the first, "B"- the second, "C"- the third, "D"- the fourth, "E"- the fifth and higher lactation.

We divided dairy cows only breed-type S₀ - cows with genetic proportion of pure Slovak Spotted blood into 87.5 %, S₁ - cows with genetic proportion of pure Slovak Spotted blood from 75% to 87.4 %, S₂ - cows with genetic proportion of pure Slovak Spotted blood from 50 % to 74.9 % [18].

The basic statistical and variability characteristics (least square means, standard deviations) were evaluated using the Statistical System (SAS) version 9.3 [19].

The mixed procedure was used for the final analysis. The value of statistical significance (P), the value of the F-test and the coefficient of determination (R²) of the above mentioned of milk components and somatic cells were evaluated with its relation to: year and month of controls, order of lactation, breeding type and sire.

For the actual computation a linear model with fixed effects was used:

$$y_{ijklm} = \mu + Y_i + MC_j + P_k + BT_l + S_m + e_{ijkl}$$

where: μ = mean value of dependent variable, Y_i = fixed effect of years (1 - 3), MC_j = fixed effect of months of control (1 - 12), P_k = fixed effect of order of lactation (1 - 5), BT_l = fixed effect of breeding type (1 - 3), S_m = fixed effect of sire (1 - 39), e_{ijkl} = residual error.

Statistical evaluations of the differences between traits were tested at the levels of statistical significance: * P<0.05, **P<0.01, ***P<0.001 or P>0.05.

3. Results and discussion

The basic traits of milk components and somatic cells count in breeding herd Slovak Spotted dairy cows were 20.69 ±9.69 kg milk, 3.94±0.68 % fat, 3.48±0.33 % proteins, 4.87±0.21 % lactose and 338.39±846.15 x 10³ cells x ml⁻¹. In the year evaluation 2014 was analysed 4,537 samples with 12.85±3.63 kg milk, 3.91±0.65 % fat, 3.52±0.33 % proteins, 4.85±0.21 % lactose and 297.74±703.25 x 10³ cells x ml⁻¹ SCC. In the years 2015 and 2016, was found a higher average value of the control milk yield, which is related to breeding program of the breed [18] as shown in Table 1.

Table 1. Statistical characteristic of milk in kg (M), fat in % (F), proteins in % (P), lactose in % (L) and somatic cells count (SCC) in control samples in dairy cows of Slovak Spotted cattle by year's evaluation

Traits	Statistical parameter						
	n ¹	\bar{x} ²	SD ³	CV ⁴	MODE ⁵	MEDIAN ⁶	
2014	Milk in (kg)		12.85	3.63	28.28	11.9	12.7
	Fat in (%)		3.91	0.65	16.55	3.82	3.87
	Proteins in (%)	4 537	3.52	0.33	9.33	3.63	3.52
	Lactose in (%)		4.85	0.21	4.87	4.79	4.87
	SCC in (ml ⁻¹)		297.74	703.25	236.19	38.0	107.0
2015	Milk in (kg)		21.68	9.58	44.19	15.5	20.1
	Fat in (%)		3.97	0.67	16.77	3.89	3.93
	Proteins in (%)	5 093	3.48	0.34	9.61	3.40	3.48
	Lactose in (%)		4.92	0.21	4.33	4.98	4.95
	SCC in (ml ⁻¹)		331.62	830.24	250.36	20.0	121.0
2016	Milk in (kg)		27.43	8.32	30.34	31.9	27.6
	Fat in (%)		3.92	0.72	18.41	4.02	3.91
	Proteins in (%)	4 530	3.44	0.34	9.78	3.46	3.43
	Lactose in (%)		4.82	0.21	4.31	4.89	4.86
	SCC in (ml ⁻¹)		386.74	981.82	253.87	26.0	129.0

¹number of observation, ²average, ³standard deviation, ⁴coefficient of variation, ⁵mode (value that appears most often in a set of data), ⁶median

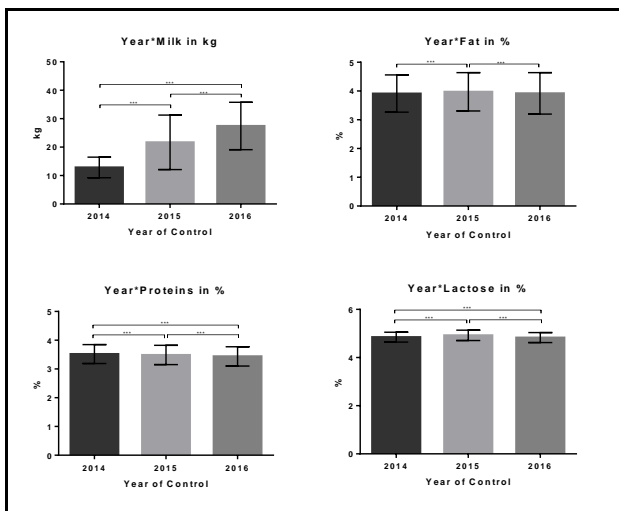


Figure 1 Statistical significance of differences milk components by year's evaluations

Figure 1 shows the differences between milk components by year's evaluation 2014 to 2016. The values of milk in kg between years has rising tendency, which is related to the breeding

goal. These differences were significant ($P < .0001$).

Figure 2 shows the differences for milk components in % and somatic cells count in ml^{-1} between classes of parity in Slovak Spotted dairy cows. The average of milk components were between 3.89 to 4.01% for fat, 3.45 to 3.54 % for proteins, 4.75 to 4.96 for lactose, where was fluctuating tendency. The average of somatic cells count were 244.07 to $647.17 \times 10^3 \text{ ml}^{-1}$, where with higher order of lactation, the number of somatic cells in milk increases. Increasing milk traits with the current increase in SCC (somatic cells count) leads to a negative correlation dependence which is documented by Savić et al. [12], Dadpasand et al. [22] and Haile-Mariam et al. [20]. The negative environmental correlation between SCS and yield traits implies that the environmental factors which increase milk production also are helpful in reducing the SCS with conclusion by Dadpasand et al. [22].

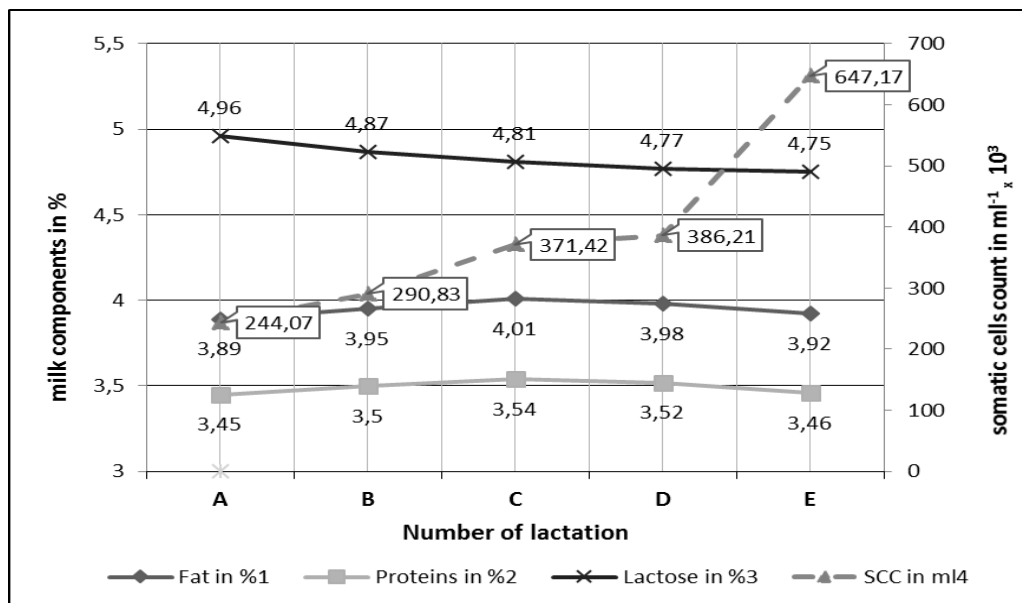


Figure 2. Milk components and somatic cells count by order of lactation in breeding herd Slovak Spotted cattle

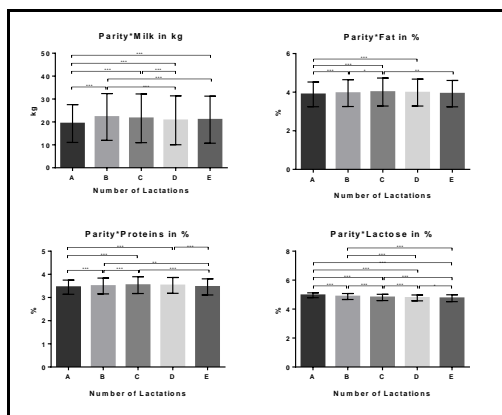


Figure 3. Statistical significant differences of milk components by number of lactation

Figure 3 shows the differences of milk components by number of lactation. The average

of milk in kg has fluctuating tendency. These differences were significant ($P < 0.0001$).

Correlation between evaluated somatic cells count and milk components were lower negative and statistically highly significant, scilicet between somatic cells count (SCC) and kgs of milk, % of fat, % of proteins, % of lactose was $r = -0.03679$, $r = 0.08985$, $r = 0.08830$ and $r = -0.30855$ (Table 2). These results are similar with conclusions Alhussien et al. [1], Haile-Mariam et al. [21] and Dadpasand et al. [22]. By reported Koivula et al. [21] and shows to genetic correlation between somatic cells count (SCC) and traits of milk production positive in the first lactation, but negative or near zero in the second lactation.

Table 2. Relation between somatic cells count and milk components.

Traits	Milk in kg	Fat in %	Proteins in %	Lactose in %
somatic cells count	-0.03679 ⁺⁺⁺	0.08985 ⁺⁺⁺	0.08830 ⁺⁺⁺	-0.30855 ⁺⁺⁺

⁺⁺⁺ $P < 0.001$

Table 3. Factors affecting on the milk components and somatic cells count in Slovak Spotted cattle

Sources of variability	DF ¹	R-Square ²			
		Fat ³	Proteins ⁴	Lactose ⁵	SCC ⁶
Years	2	0.001620 ⁺⁺⁺	0.009652 ⁺⁺⁺	0.037623 ⁺⁺⁺	0.001807 ⁺⁺⁺
Months of control	11	0.086424 ⁺⁺⁺	0.036385 ⁺⁺⁺	0.026196 ⁺⁺⁺	0.001489 ⁺
Order of lactation	4	0.004195 ⁺⁺⁺	0.010645 ⁺⁺⁺	0.133072 ⁺⁺⁺	0.0224863 ⁺⁺⁺
Breeding type	2	0.000457 ⁺	0.000127 ⁻	0.005417 ⁺⁺⁺	0.001489 ⁺⁺⁺
Father	39	0.040529 ⁺⁺⁺	0.076706 ⁺⁺⁺	0.176486 ⁺⁺⁺	0.033207 ⁺⁺⁺
Together all factors	57	0.148660⁺⁺⁺	0.179434⁺⁺⁺	0.285120⁺⁺⁺	0.047472⁺⁺⁺

¹grades of freedom, ²coefficient of determination (R^2), ³fat in % (F), ⁴proteins in % (P), ⁵lactose in % (L), ⁶somatic cells count ml^{-1} (SCC), ⁻ $P > 0.05$, ⁺ $P < 0.05$, ⁺⁺ $P < 0.01$, ⁺⁺⁺ $P < 0.001$

Table 4 showed the linear model to represent coefficients of determination on somatic cells count (SCC) was the highest effect of sire $R^2 = 0.033207$ than effect of order of lactation $R^2 = 0.0224863$. The linear model to represent coefficients of determination on milk components were the highest effect of sire $R^2 = 0.176486$ for lactose in %, $R^2 = 0.076706$ for proteins in %. The highest effect of effect of months of control $R^2 = 0.086424$ for fat in %. These effects were significant ($P < 0.0001$). These results are similar with results Cerón-Muñoz et al. [8], Sahin et al

[9], Silva et al. [10], where years-month control for milk components and father for SCC.

4. Conclusions

The basic traits of milk components and somatic cells count in breeding herd Slovak Spotted dairy cows were 20.69 ± 9.69 kg milk, 3.94 ± 0.68 % fat, 3.48 ± 0.33 % proteins, 4.87 ± 0.21 % lactose and $338.39 \pm 846.15 \times 10^3$ cells in ml^{-1} .

The results confirm that correlation between evaluated somatic cells count (SCC) and milk

components were lower negative and statistically highly significant, scilicet between somatic cells count (SCC) and kgs of milk, % of fat, % of proteins, % of lactose was $r = -0.03679$, $r = 0.08985$, $r = 0.08830$ and $r = -0.30855$. These results were statistically highly significant.

The analyses by the effect on somatic cells count was the highest effect of sire $R^2 = 0.033207$ than effect of order of lactation $R^2 = 0.0224863$ and milk components in % was the highest effect of sire $R^2 = 0.176486$ for lactose in %, $R^2 = 0.076706$ for proteins in %. The highest effect of effect of months of control $R^2 = 0.086424$ for fat in %. These effects were significant ($P < 0.0001$).

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