Factors Affecting on Somatic Cells Count in Slovak Simmental Dairy Cows

Jozef Bujko[1], Juraj Candrák[1], Július Žitný[1], Cyril Hrnčár[2]

[1] *Department of Genetic and Breeding Biology, Faculty of Agrobiology and Food Resources, Slovak Agricultural University in Nitra, A. Hlinku 2, 949 76 Nitra, Slovak Republic,*
[2] *Department of Poultry Science and Small Animal Husbandry, Faculty of Agrobiology and Food Resources Slovak Agricultural University in Nitra, A. Hlinku 2, 949 76 Nitra, Slovak Republic,*

Abstract
The aim this work was to analyse factors affecting on the somatic cells count in Slovak Simmental dairy cows. Data were analysed using the SAS version 9.1.3. and linear model with fixed effects of herd, years and months controls, sire and breeding types. The analyses by the effect on somatic cells count was the highest effect of herd-years-months of control R^2 = 0.151316 and effect of sire R^2 = 0.054182. These effects were high statistical significant P<0.01. Correlation coefficients between milk in kg, fat, protein, lactose in % with somatic cells count were r= -0.25096, r= 0.02593, r= 0.22321and r=-0.39567.

Key words: coefficients of determination, correlations, dairy cows, milk production, Slovak Simmental cattle, somatic cells count,

1. Introduction

Slovak Simmental breed is a dual-purpose breed with a good milk and meat production [1, 2], which belongs to the Simmental type of cattle.
The somatic cells count (SCC) of milk is widely used to monitor udder health and the milk quality [3, 4].
The SCC is important to dairy producers both because counts that are too high can lead to poor quality or even unsalable milk and SCC can be used to monitor mastitis incidence in the herd [5, 6]. In addition, SCC is frequently used to determine quality payments to dairy producers [7].
The European Union requires that milk used for dairy products sold in its territory have SCC levels below 400,000 cells/ml [8].
Milk composition can be affected by a wide array of factors: breed, age, stage of lactation, and diet of the animal. In addition, infectious mastitis (hereafter referred to as mastitis), an inflammatory reaction of the mammary gland to an infection, is also known to have a multitude of effects on the quantity, quality and processing properties of the produced milk [9]. Factors affecting on somatic cells count shows in publications others authors as Cerón-Muñoz et al. [10], Souza et al. [11], Rhone et al. [12] and affecting on others traits [13, 14].
Understanding the relationship between the production of high quality milk and SCC due to mastitis in dairy herds is fundamental for the profitability of the dairy business [15].
The aim this work was to analyse factors affecting on the somatic cells count in selected herds of dairy cows Slovak Simmental cattle.

2. Materials and methods

The material for evaluation traits in breeding herds of Slovak Simmental breed between 2004 and

* Corresponding author: Ing. Jozef Bujko, PhD., +421 37 641 4294, Jozef.Bujko@uniag.sk

2013 were received from of Breeding Service of Slovak republic for period [16].

We observed subsequent for 1 143 (16 602 control samples) dairy cows Slovak Simmental: somatic cells count (SCC) and milk in kg (M), fat in % (F), and proteins in %(P) and lactose in % (L).

We divided cows by breed-type to subsequent groups: 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 %.

The research material was divided into 4 groups according to the SCC values: I – up to 100 000 SCC cm^{-3}; II – 101–400 000 SCC cm^{-3}; III – 401–500 000 SCC cm^{-3}; IV > 500 000 ≤ 1 million SCC cm^{-3}.

The basic statistic analysis of traits of milk production and somatic cells count (SCC) were analysed using the Statistical Analysis System (SAS) version 9.1 Enterprise Guide 3.0 [17]. For the actual computation a linear model with fixed effects was used:

$$y_{ijklm} = \mu + HYS_i + b_j + c_k + d_l + d_m + e_{ijklmn}$$

, where: μ = mean value, HYS_i = effect of herd, years and season of control, b_j = father, c_k = breeding type, d_l = ..., d_m = cod of effect of M in kg, e_{ijklmn} = residual error

3. Results and discussion

The basic traits of milk production and somatic cells count (SCC) in evaluated breeding herds of dairy cows Slovak Simmental breed are presented in Table 1. In the breeding type S_0 was analyses 11 749 samples with 21.20 kg of milk, 4.21±0.98 % of fat, 3.47±0.51 % of proteins, 4.81±0.40 % of lactose. Similar tendency was in others breeding type.

Table 1. Statistical characteristic of milk in kg (M), fat in % (F), and proteins in % (P) and lactose in % (L) in control samples in dairy cows of Slovak Simmental by breeding type

Traits		Statistical parameter				
		n[1]	$\bar{x}$ [2]	SD[3]	CV[4]	MODE[5]
S_0	Milk in (kg)	11 749	21.20	7.97	37.58	19
	Fat in (%)		4.21	0.98	23.24	4
	Proteins in (%)		3.47	0.51	14.82	3
	Lactose in (%)		4.81	0.40	8.31	5
S_1	Milk in (kg)	2 724	21.93	7.74	35.30	21
	Fat in (%)		4.16	0.93	22.32	4
	Proteins in (%)		3.55	0.51	14.47	4
	Lactose in (%)		4.84	0.37	7.63	5
S_2	Milk in (kg)	2 129	20.72	7.87	37.99	20
	Fat in (%)		4.08	0.92	22.48	4
	Proteins in (%)		3.52	0.51	14.61	4
	Lactose in (%)		4.80	0.42	8.74	5

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

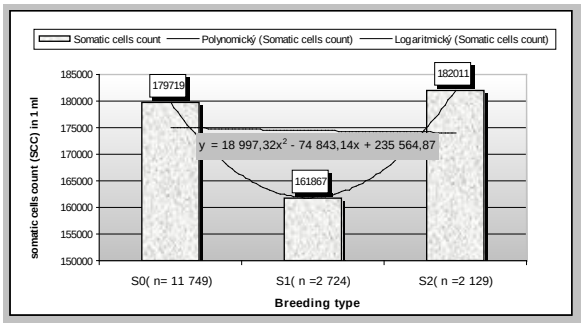

Figure 1. Somatic cells count by breeding type

In Figure 1 shows the differences for somatic cells count in ml^{-1} between breeding type dairy cows in population of Slovak Simmental cattle.

The average of somatic cells count (SCC) was 117.084 ± 200.340 in ml^{-1} in selected herds of dairy cows of Slovak Simmental cattle.

The results of milk traits in control samples by code SCC divided into 4 groups are presented in Table 2. These results are similar with conclusions Król *et al.* [3], where values perceptual of milk traits has fluctuating tendency.

Table 2. Statistical characteristic of milk in kg (M), fat in % (F), and proteins in % (P) and lactose in % (L) in control samples in dairy cows of Slovak Simmental by code of SCC

Traits		Statistical parameter				
		n[1]	$\bar{x}$ [2]	SD[3]	CV[4]	MODE[5]
I.	Milk in (kg)	8 470	23.34	7.12	30.49	19
	Fat in (%)		4.16	0.97	23.37	4
	Proteins in (%)		3.37	0.49	14.50	3
	Lactose in (%)		4.94	0.24	4.80	5
II.	Milk in (kg)	6 012	19.73	7.87	39.88	19
	Fat in (%)		4.25	0.96	22.60	4
	Proteins in (%)		3.58	0.52	14.44	4
	Lactose in (%)		4.75	0.44	9.35	5
III.	Milk in (kg)	648	17.94	8.61	48.01	16
	Fat in (%)		4.13	0.93	22.38	4
	Proteins in (%)		3.61	0.54	15.05	4
	Lactose in (%)		4.57	0.52	11.40	5
IV.	Milk in (kg)	1 472	17.98	8.76	48.74	15
	Fat in (%)		4.11	0.96	23.43	4
	Proteins in (%)		3.61	0.50	13.95	4
	Lactose in (%)		4.55	0.53	11.62	5

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

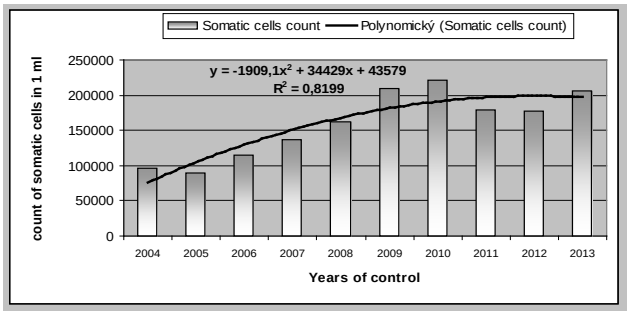

Figure 2. Somatic cells count by years of control

As the graph 5 shows SCC (somatic cells count) during the years of control samples analyzed had a rising trend with R^2 = 0.8199 in years 2004 to 2013. Increasing milk traits with the current increase in SCC (somatic cells count) leads to a negative correlation dependence which is documented by the results Haile-Mariam et al. [5] and Koivula et al. [18].

Table 3. Relation between somatic cells count and traits of milk production.

Traits	Milk in kg	Fat in %	Proteins in %	Lactose in %
somatic cells count	-0.25096 <.0001	0.02593 0.0291	0.22321 <.0001	-0.39567 <.0001

Correlation between evaluated somatic cells count and traits of milk production were lower negative and statistically high significant, scilicet between somatic cells count (SCC) and kgs of milk, % of fat, % of proteins, % of lactose was r= -0.25096, r= 0.02593, r= 0.22321 and r= -0.39567 (Table 3). These results are similar with conclusions Król *et al.* [3] and Němcová et al. [4]. By reported Koivula et al. [18] 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. The negative phenotypic correlation between milk traits and SCC and the increase in negative association with parity is also in agreement with conclusion by Haile-Mariam et al. [5].

Table 4. Factors affecting on somatic cells count in Slovak Simmental dairy cows

Sources of variability	DF[1]	Mean Square	F Value	Pr > F	R-Square [2]
					somatic cells count (SCC)
Herd-years-season	1773	56864.6	1.49	<.0001	0.151316
Sire	122	295911.75	7.74	<.0001	0.054182
Breeding type	2	381979.04	9.53	<.0001	0.001147

[1]grades of freedom, [2] coefficient of determination (R^2)

In Table 4 showed the linear model to represent coefficients of determination on somatic cells count with all fixed effects R^2 = 0.207105 % (P<.0001). By analyses by the effect on somatic cells count was the highest effect of herd-years-season R^2 = 0.151316 than effect of sire R^2 = 0.054182. These effects were significant (P<.0001). These results are similar with results Cerón- Muñoz et al [10] and Souza et al. [11], where authors shows the highest effect of HYS (herds-years-season of control).

4. Conclusions

The results confirm that correlation between evaluated somatic cells count (SCC) and traits of milk production (milk in kg, fat, proteins, lactose in %) were lower and negative r= -0.25096, r= 0.02593, r= 0.22321and r=-0.39567. These results were statistical high significant. The analyses by the effect on somatic cells count was the highest effect of herd-years-months controls R^2 = 0.162796, others effects of sire R^2= 0.052569 and breeding type R^2= 0.001527.

Acknowledgements

This work was supported by projects of Ministry of Education Slovak Republic of the KEGA No. 027SPU-4/2012 and APPV No. 0636-11. The authors thank the Breeding Services of the Slovak Republic for providing the database of this breed for the study.

5. References

1. Strapák, P., Chovateľsko - plemenárska charakteristika slovenského strakatého plemena na Slovensku: Habilitation, Nitra: SPU, 2000, 234 p.
2. Bujko, J., Optimalization Genetic Improvement Milk Production in Population Slovak Spotted Breed. Monograph. Nitra: SPU, 2011, 78 p. (in Slovak)
3. Król, J. et al., Effect of somatic cell counts in milk on its quality depending on cow breed and season. Annales UMCS 28, 2010, (3), p. 9-17.
4. Němcová. E. et al., The relationship between somatic cell count, milk production and six linearly scored type traits in Holstein cows. Czech Journal of Animal Science, 2007, vol. 52 (12). p. 437-446.
5. Haile-Mariam. M., Bowman, P. J. and Goddard, M. E., Genetic and environmental correlations between test-day somatic cell count and milk yield traits. Livest. Prod. Sci., 2001, vol. 73, p. 1–13.
6. Mostert, B.E. et al., Breeding value estimation for somatic cell score in South African dairy cattle. S. Afr. J. Anim. Sci. 34, 2004, p.32-34
7. Wattiaux et al., Statistical evaluation of factors and interactions affecting dairy herd improvement milk urea nitrogen in commercial Midwest dairy herds. Journal of Dairy Science, 2005, vol. 88, p.3020-3035
8. European Commission, Regulation (EC) No. 853/2004 of the European parliament and of the council of 29 April 2004 laying down specific hygiene rules for food of animal origin. OJ EU L 47. 206.
9. Le Maréchal. C. et al., Mastitis impact on technological properties of milk and quality of milk products—a review. In Dairy Science & Technology, 2011, vol. 91(3), p.247-282.
10. Cerón-Muñoz, M. et al., Factors affecting somatic cell counts and their relations with milk and milk constituent yield in buffaloes. Journal of dairy science, 2002, vol.85 (11), p. 2885-2889
11. Souza. G. N. et al., Factors affecting somatic cell counts (SCC) in Brazilian dairy cows. In: Animals and environment. Vol.1: Proceedings of the XIIth ISAH Congress on Animal Hygiene. Warsaw. Poland. 4-8 September 2005,BEL Studio sp. zoo. 2005. p. 237-240.
12. Rhone, J. A. et al. Factors affecting milk yield, milk fat, bacterial score, and bulk tank somatic cell count of dairy farms in the central region of Thailand. In Tropical animal health and production, 2008, vol. 40, no. 2, p. 147-153
13. Bujko, J. et al., Factors Effecting of Milk Productions in Select Herds of Slovak Spotted Breed.

Scientific Papers Faculty of Animal Sciences and Biotechnologies, Timisoara, 44 (1), 2011, p. 176- 179
14. Oudah, E. Z. M., Non-genetic factors affecting somatic cell count, milk urea content, test-day milk yield and milk protein percent in dairy cattle of the Czech Republic using individual test-day records. *Livestock Research for Rural Development*, 2009, *Vol.21*. http://www.lrrd.org/lrrd21/5/ouda21071.htm
15. Sharif, A., Muhammad, G., Somatic cell count as an indicator of udder health status under Modern dairy production: a review. In: Pakistan Vet. J., 2008, 28(4): 194-200.
16. The Breeding Service of the Slovak Republic. S.E. Results of dairy herd milk recording in Slovak Republic at control years 2004 to 2013.
17. SAS User's Guide 2002-2003. Version 9.1 (TS1M3). SAS Institute. Inc., Carry. NC. USA.
18. Koivula, M. et al., Genetic and phenotypic relationship among milk yield and somatic cell count before and after clinical mastitis J. Dairy Sci., 88 (2005). p. 827–833.