SOURCES OF VARIATION FOR MILK TRAITS IN REGIONS OF VOJVODINA

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Abstract

The study aimed to investigate different sources of variation for milk traits in dairy cows, in first lactation from three breeding regions of Vojvodina (Srem, Banat and Backa). For research purposes a total of 2767 complete and 305 days records of milk yield (MY), fat yield (FY) and milk fat content (MFC) of Holstein-Friesian (HF, black and red) dairy cows was used. All cows were involved in the official milk recording program in 2013 in Vojvodina. Milk traits were analyzed using the mixed linear model in order to explain total variation with bull-sire as a random effect, region, year of birth and calving season as fixed effects and length of lactation as covariates. The average values of MY, MF and MFC in the first lactation of 305 days were 6053.4 kg of milk, 225.24 kg of milk fat and 3.74% milk fat content. The effects of the bull-sire, calving season, year of birth and breeding region on all investigated milk traits were highly significant ($p > 0.01$) during 305 days, but year of birth for complete records had no significant effect on these parameters ($P > 0.05$).

Key words: *dairy cows, milk traits, regions*

Introduction

It is important to evaluate various sources of variation in regard to phenotypic and genetic variability of milk in order to ascertain which effects are major for a dairy production and future decision for selection and breeding program. Production traits were greatly affected by para-genetic factors such as season of calving, parity, age of cow, age at first insemination, etc. (Petrović et al., 2006), as well as significant influence of genetic components, Pantelić et al. (2011), Trivunović (2006).

In the last years, according to the official statistics, the total number of dairy animals in Serbia (including the province of Vojvodina) was reduced but it was not significantly reflected in total milk production at the country level. Indeed, in the last 10 years, milk production was stable and amounted to about 1.5 to 1.6 million tons of raw milk per year. Significant increase of yield per cow was realized in herds involved in the official milk recording program (Kučević et al., 2011). Increase in row milk production was achieved due to genetic improvement and selection program by the Center for the breeding of domestic animals in Vojvodina. In relation to the other cattle population, HF breed is the most present in Vojvodina and makes around 78%. This breed is specialized for milk production and breeding goals are adjusted to achieve sufficient quantities of milk according to the quality standards requested by the European Union (Bogdanović et al., 2007). According to the Center's Annual Report in 2013, the average milk yield of

recorded and controlled dairy cows of the total population of HF breed in Vojvodina was around 6307 kg with 237 kg of milk fat and average milk fat content of 3.76%.

Objective of this study was to analyse different sources of variation for milk traits in HF dairy cows in first lactation from three regions of Vojvodina (Srem, Banat and Bačka).

Materials and methods

This research included 2767 HF first calvers involved in the official milk recording program in Vojvodina. We examined the variability of complete and 305 days records of MY, FY and MFC. Data were collected from three breeding regions in Vojvodina: Srem (1), Banat (2) and Bačka (3). In order to explain different sources of variation for milk traits a mixed model with a sire as a random effect, the region, year of birth and season as fixed effects and length of lactation (in days) as covariates were used. The effects of the various factors influencing milk traits were evaluated by fitting a mixed model of least squares with fixed and random effects (LS-Least Squares), procedure of *STATISTICA* ver.10 (StatSoft Company, 2013). Factors included in the model were based on their significance and impact on the studied traits, which represent systematic fixed part of the model. Systemic effects were combined in various ways. Determination of model for investigated traits ranged from 19% to 33%, which is in line with their biological characteristics. The following model was used for complete records:

$$Y_{ijklm} = \mu + R_i + Y_j + S_k + B_1 + b_1 (x_1 - x_1) + e_{ijklm}$$

where:

Y_{ijklm} - phenotypic value of observed traits

μ – general mean

R_i – fixed effect of breeding region (1-3)

Y_j – fixed effect of year of birth (1-5)

S_k – fixed effect of season of calving (1-3)

B_1 – random bull-sire effect (1-72)

$b_1(X_1-X_1)$ – linear regression effect of length of lactation

e_{ijklm} – random error

For the records of 305 day the same model but without length of lactation was used.

Results and discussion

In the Table 1 results of the descriptive statistical analysis of the studied traits are presented.

Table 1. *The average values and variability of investigated traits*

Traits	$\bar{x}$	$S\bar{x}$	SD	min	max	CV %
MY, kg	7131	38.27	2013.4	3121	13491	28.2
MF, kg	276.72	1.53	80.85	115	682	29.2
MFC, %	3.88	0.006	0.34	2.10	7.67	8.9
MY 305, kg	6053.4	26.94	1417.6	2048	12557	23.4
MF 305, kg	225.24	0.99	52.43	69.00	709.0	23.2
MFC 305, %	3.74	0.008	0.43	2.06	7.74	11.5

Milk yield =MY; Milk fat =MF; Milk fat content =MFC; MY for 305 days =MY 305; MF for 305 days =MF 305; MFC for 305 days =MFC 305

Based on studied sample, average values of investigated parameters for complete lactation (on average 359 days) amounted to 7131 kg of MY, 276.72 of MF and 3.88 of MFC whereas during standard lactation of 305 days it was produced 6053.4 of MY, 225.24 of MF and 3.74 of MFC.

The lowest recorded milk yield during 305 days included in the study was 2048 kg and the highest was 12557 kg, resulting in high value of the variation width of even 10509 kg of milk. Values of the variation coefficient (CV) and standard deviation (SD) for milk yield were also very high and amounted to CV=23.4% and SD=1417.6. Contrary to the established values of CV and SD for MY, the value obtained for MFC was significantly lower CV=11.5% and SD=0.4. These lower values indicate that the variability of this trait is more under the influence of biological and breed characteristics of dairy cows than on rearing conditions present on the farm. Similar data on variation of milk traits were obtained by Kučević et al. (2011) and Radinović et al. (2011).

Using the mathematical-statistical model we identified genetic and environmental factors which influenced expressions of investigated traits. The obtained factors in the study are shown in tables 2 and 3.

Table 2. *The effect of genetic and environment factors on investigated milk traits*

Factors	DF	MY	MF	MFC
		F-value	F-value	F-value
Region	2	27.36**	14.97**	5.98**
Year of calving	4	1.35 ns	1.83 ns	0.90 ns
Season	2	8.04**	3.10*	3.73*
Sire	71	11.56**	9.42**	4.37**

DF-degree of freedom; F-values; **-P<0.01-statistically highly significant effect; ns-P>0.05-no significant effect

Table 3. *The effect of genetic and environment factors on investigated milk traits in 305 days*

Factors	DF	MY 305	MF 305	MFC 305
		F-value	F-value	F-value
Region	2	27.15**	14.04**	4.65**
Year of calving	4	2.13**	4.80**	3.76**
Season	2	8.01**	3.62*	6.54**
Sire	71	14.12**	7.45**	6.69**

DF-degree of freedom; F-values; **-P<0.01-statistically highly significant effect; ns-P>0.05-no significant effect

Data presented in tables 2 and 3 show highly significant effect (p>0.01) of the sire, calving season and breeding region on all investigated milk traits. Only age for complete records had no significant effect on these parameters (p>0.05). The research is in accordance with the results obtained by Perišić (1998), Petrović et al. (2006) and Sekerden (1997), which stated that calving season highly significantly affected milk yield, milk fat, and protein in standard lactation. Petrović et al. (2009) confirmed that quantitative milk traits of first calving cows under the influence of region had highly significant deviation from general average. If we observe production of milk in the region of Vojvodina it may be pointed out that dairy production is organized in very different rearing and farm management conditions, therefore statistically highly significant sources of variation in regard to breeding region was expected. Considering that the heritability values for milk

performance traits range from very low to medium, applied technology and management, which includes nutrition, housing, care, milking, etc., express strong effect on phenotypic variability of traits.

Conclusion

In the studied population of Holstein-Friesian dairy cows, involved in the official milk recording program in the three regions of Vojvodina, the variability of complete and 305 days records of milk traits as well as different sources of genetic and para-genetic variation was examined. The average values of MY, MF and MFC in the first lactation of 305 days were 6053.4 kg of milk, 225.24 kg of milk fat and average milk fat content amounted to 3.74%. Based on obtained results it was established that effects of the bull-sire, calving season, year of birth and breeding region were highly significant ($p > 0.01$) on all investigated milk traits. Year of birth had no significant effect for complete records on these parameters ($p > 0.05$). It can be concluded that investigated factors significantly affect milk traits therefore it is necessary to work on further optimization of the environmental factors, as well as on genetic improvement, primarily of bull-sires in the population of HF dairy cows.

Acknowledgment

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