

ISBN 978-86-82431-69-5

10th International Symposium
MODERN TRENDS
IN LIVESTOCK PRODUCTION

PROCEEDINGS



Belgrade, Serbia, 2 - 4 October, 2013

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INSTITUTE FOR ANIMAL HUSBANDRY
BELGRADE - SERBIA

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ISBN 978-86-82431-69-5
Number of copies / 250 electronic copies



PATRON

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Development of the Republic of Serbia



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VARIABILITY OF MILK TRAITS IN THE POPULATION OF SIMMENTAL CATTLE IN SERBIA

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Original scientific paper

Abstract: The work is the presentation of performance data and phenotypes of milk traits of Simmental cows in Serbia. The analysis of quantitative phenotypic parameters was carried out in four breeding areas and on dozen of large and small farms housing and rearing 1370 cows – first calving heifers. The obtained data were analysed using the method of Least Squares and analysis results were obtained by applying mathematical-statistical data analysis using mixed models. Mathematical - statistical analysis of data was performed using linear methods with fixed effects, using the method of Least Squares (LS method). Based on these results, it was established that the breeding area, statistically analysed, caused highly significant deviations ($P < 0.01$) of production traits from the general population average. Calving season has influenced significantly ($P < 0.05$), and the interaction of area and calving season has produced a highly significant variation in milk yield, milk fat and protein ($P < 0.01$).

Key words: cow, phenotype, milk, milk fat, protein.

Introduction

The most numerous breed of cattle in the Republic of Serbia is Simmental breed. At the beginning of year 2013, preliminary results of the agricultural census in the Republic of Serbia, performed in 2012, were obtained. According to the census results, in Serbia there is a total of 908.990 heads of cattle, of which about 450.000 cows and pregnant heifers. In regard to the breed structure of cattle in Serbia, it is estimated that the Simmental breed makes up about 85%, or around 360.000 cows and heifers (Perišić *et al.*, 2009 and Petrović M.M. *et al.*, 2013). Simmental cattle are increasingly reared in intensive farming systems, and on increasing number of farms in Serbia, with over 50 heads of breeding females (Bogdanović *et al.*, 2012).

In some areas of Serbia is semi-intensive rearing of cattle in herds of several cows is still present. Genetic improvement of the breed is mainly focused on breeding and selection in purebred (*Petrović, M.M. et al., 2009*). Improving the genetic basis of the population of Simmental cattle in our conditions is mainly done through quality bulls (Germany, Austria and others.) And in recent years there is a number of imported heifers of high-quality genetic from the best European populations of this breed.

Improving the phenotypes of milk performance requires continuous work, which includes the systematic improvement of quantitative genetic traits and work on their improved expression/demonstration. High yield of milk, milk fat and protein, in addition to the selection, requires and optimal provision of para-genetic factors (nutrition, housing, rearing, health care, etc.). Studies of quantitative characteristics and performance data of this breed of cattle and the influence factors on para-genetic same properties have been presented by following authors: *Miesenberger and Fuerst (2006)*; *Pantelić, V., (2006; 2010)*., *Petrović, M. M. et al. (2006; 2009)*, *Gerber et al. (2008)*, *Nikšić et al. (2011)*, *Petrović M.D. et al. (2012)*.

Material and Methods

Data included in the analysis were collected in four breeding areas (regions) in Serbia. These areas are distinguished by geographical features (altitude, precipitation, soil quality, duration of growing season, etc.). Also there were differences in the genetic quality of cattle, the method and the quality of food and nutrition management in production, etc. The research included 1370 cows – first calving heifers of Simmental breed that have calved, and concluded lactations in 2011 and 2012. First calving season includes the months of February, March and April, the second, May, June and July, the third, August, September and October, and the fourth, November, December and January.

The bull-sires were of Simmental breed and come from local AI centres and from abroad. Cows – first calving heifers were kept loose or tied, depending on the farm. Animals were fed usual diets depending on the degree of intensity of production and on breeding areas, and there were also differences in the quality and quantity of forage, i.e. amount of concentrated feed and roughage.

Statistical - mathematical analysis was performed using the Least Squares Mixed Model with fixed and random effects (LS - Least Squares and BLUP - Best Linear Unbiased Prediction) program using the Least Squares Program (LSMLMW), Harvey, 1990. When analysing the influence of region, year and season of calving on dairy cows in first lactation, the following model was used:

$$Y_{ijkl} = \mu + OP_l + G_j + S_k + GS_l + b_1(x_1-x_2) + e_{ijklm}$$

Where:

Y_{ijkl} – individual animal (m) reared in area (i), calved in year (j) and season (k),

μ = general population average,

OP_l = fixed effect of breeding area (1-4),

G_j = fixed effect of year of calving (1-2),

S_k = fixed effect of the season (1-4),

OPS_l = fixed effect of the breeding area/calving season interaction,

b_1 = linear regression effect of age at calving,

e_{ijklm} = random error

Results and Discussion

First calving heifers our research produced 4913 kg milk with 193.1 kg of milk fat and 3.93% of milk fat. The total amount of protein in milk produced in the first lactation was 161.1 kg with 3.29% protein (Table 1).

Cows reared in area 2 are produced 508.9 kg more milk compared to the general average and 900 kg more than those reared in the breeding area 4.

Table 1. Effect of systematic factors as LSM deviation (\hat{c}_i) on productive traits

Traits	Milk, kg		Milk fat, kg		Milk fat, %		Milk protein, kg		Milk protein, %	
M	4913		193.1		3.93		161.1		3.29	
S.E.	168.8		6.8		.03		5.9		.03	
Breeding Area	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM
1	69.6	4978	-1.6	193.6	0.1	3.89	-2.7	163.8	0.1	3.29
2	508.9	5422	-8.9	202.8	0.2	3.74	-12.4	173.5	0.1	3.20
3	-188.1	4725	2.7	190.4	-0.1	4.03	2.6	159.2	-0.1	3.37
4	-392.0	4521	8.1	184.0	-0.2	4.07	11.9	149.6	-0.1	3.31
Season of Calving	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM	\hat{c}_i	LSM
I	206.6	5120	-5.1	198.1	0.1	3.87	-13.4	176.1	-0.1	3.44
II	-98.1	4814	10.9	180.1	0.1	3.75	1.4	161.0	-0.1	3.35
III	-207.1	4706	5.70	186.0	-0.1	3.96	12.0	149.1	0.1	3.17
IV	97.3	5010	-11.1	204.1	-0.1	4.08	-0.5	162.1	0.1	3.25

Statistically, breeding area influenced highly significant ($P < 0.01$), the deviations of milk yield, milk fat and milk protein yield (Table 2).

Season of the beginning of lactation in cows - first calving heifers, i.e. calving season showed significant deviations in regard to yields of milk, milk fat and milk protein in relation to the general average ($P < 0.05$). So heifers which had calved in February, March and April produced 206 kg of milk more than the general average, or 413 kg more milk than those whose lactation beginning was in August, September and October (Table 1)

Table 2. Least – Squares analysis of variance (exp. F)

Influences	Milk, kg	Milk fat, kg	Milk fat, %	Milk protein, kg	Milk Protein, %
Breeding Area	11.475**	11.879**	25.248**	10.654**	23.876**
Season of calving	2.801*	3.643*	3.565*	2.987*	2.876*
Breeding area/season of calving	2.818**	2.889**	1.867 ^{NS}	2.111**	1.939 ^{NS}

NS – $P > 0.05$ * – $P < 0.05$ ** – $P < 0.01$

First calving heifers in the present study produced 4913 kg of milk with 193.1 kg of milk fat and 3.93% of milk fat and 161.1 kg and 3.29% of milk protein. The results obtained in our research were significantly higher compared to the results of the milk performance of the same breed animals obtained by *Pantelić (2006; 2010)*, *Petrović, M. M. et al., (2006; 2009)* and *Petrović M.D. et al. (2012)*. The results of the present study are similar to those obtained in Bavaria for the same breed by *Gerber et al. (2008)*. The results obtained in our study were slightly higher compared to those established by *Nikšić et al. (2011)*. *Gerber et al. (2008)* has found differences in the production of milk fat and protein, which ranged from 178.1 to 267.9 kg and 146.1 kg to 227.5 kg, respectively, depending on the housing system (the extensive and intensive). The results obtained in our research showed a positive genetic trend in regard to quantitative traits of milk performance of domestic Simmental cows. Comparing our (last presented) results and the results of the above-mentioned authors it can be concluded that the milk yield of Simmental cows (main/basic herd) annually in Serbia increases by at least 100 kg of milk per cow (depending on genetics, area, feeding technology and housing).

Conclusion

In the breed structure of cattle in Serbia, it is estimated that the Simmental breed makes up about 85%, or around 360.000 cows and heifers. Simmental cattle are increasingly grown in intensive farming systems and on increasing number of farms in Serbia, with over 50 heads of cows.

Genetic improvement of the breed is mainly focused on breeding and selection in pure breed. Improving the genetic basis of the population of Simmental

cattle in our conditions is mainly done through quality bulls (Germany, Austria and others.) and in recent years there is a number of imported cattle of high-quality genetic from the best European populations of this bred.

Improving the phenotypes of milk performance requires continuous work, which includes the systematic improvement of quantitative genetic traits and work on their improved expression/demonstration. High yield of milk, milk fat and protein, in addition to the selection, requires and optimal provision of para-genetic factors (nutrition, housing, rearing, health care, etc.). Being that the fastest improvement through selection and genetic improvement of production traits is through choice of bull sires this should be given the utmost attention. Knowledge of the influence of environment factors on quantitative traits is very important with respect to their importance in achieving breeding goals and good economic results.

Acknowledgement

Research was financed by the Ministry of Education, Science and Technological Development, Republic of Serbia, project TR31053.

Varijabilnost osobina mlečnosti u populaciji simentalških goveda u Srbiji

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Rezime

Najbrojnija rasa goveda u Republici Srbiji je simentalška. Početkom 2013.godine dobijeni su preliminarni rezultati popisa poljoprivrede u Republici Srbiji, obavljenog 2012.godine. Prema rezultatima popisa u Srbiji ima ukupno 908.990 grla goveda od čega je oko 450000 krava i steonih junica. U rasnoj strukturi goveda u Srbiji, procenjuje se da simentalška rasa čini oko 85%, odnosno oko 360000 krava i junica. Simentalška goveda se sve više gaje u intezivnim uslovima držanja, nege i ishrane, odnosno sve je veći broj farmi u Srbiji sa preko 50 grla plotkinja. U nekim područjima Srbije je to još uvek poluintezivno držanje u stadima od nekoliko grla krava. Genetsko unapređenje ove rase se uglavnom sprovodi odgajivanjem i selekcijom u čistoj rasi. Unapređenje genetske osnove populacije simentalških goveda u našim uslovima se uglavnom obavlja preko kvalitetnih bikova (Nemačka, Austrija i dr.) a u poslednjim godinama nije zanemarljiv broj uvezenih genetsko visoko kvalitetnih junica iz najboljih evropskih populacija ove rase. Unapređenje fenotipova mlečnosti zahteva kontinuiran rad koji obuhvata sistematsko poboljšanje kvantitavnih genetskih osobina i permanentni rad

na njihovom poboljšanom ispoljavanju. Visok prinos mleka, mlečne masti i proteina, pored selekcije zahteva i optimalno obezbeđenje paragenetskih faktora (ishrana, držanje, odgoj, nega i dr.).

Podaci obuhvaćeni analizom su prikupljeni u četiri odgajivačka područja (regiona) u Srbiji. Ova područja se razlikuju po geografskim karakteristikama (nadmorska visina, količina padavina, kvalitet zemljišta, trajanje vegetacije i dr.). Takođe razlike su u genetskom kvalitetu grla, načinu i kvalitetu hrane i ishrane, menadžmentu u proizvodnji i dr. Istraživanjem je obuhvaćeno 1370 grla krava-prvotelki simentalске rase koje su se otelile, odnosno zaključile laticiju 2011 i 2012 godine. Prvom sezonom telenja su obuhvaćeni meseci februar, mart i april., drugom, maj, jun i jul., trećom, avgust, septembar i oktobar., četvrtom, novembar, decembar i januar. Bikovi-očevi su simentalске rase i potiču iz domaćih VO centara i iz inostranstva. Prvotelke-krave su držane slobodno ili vezano u zavisnosti od farme. Grla su hranjena uobičajeno u zavisnosti od inezivnosti proizvodnje i područja gajenja a razlike su bile u kvalitetu hraniva odnosno količini kabaste i koncentrovane hrane.

Statističko matematička analiza obavljena je primenom mešovitog modela najmanjih kvadrata sa fiksnim i random uticajima (LS - Least Squares i BLUP - Best linear Unbiased Prediction) primenom programa najmanjih kvadrata (LSMLMW), Harvey,1990.

Prvotelke obuhvaćene našim istraživanjima su proizvele 4913 kg mleka sa 193.1kg mlečne masti i 3.93% mlečne masti. Ukupna količina proteina u mleku, proizvedena u prvoj laktaciji je iznosila 161.1 kg sa 3.29% proteina. Krave gajene u području 2 su proizvele 508.9 kg mleka u odnosu na opšti prosek a 900 kg mleka više od onih koje su gajene u odgajivačkom području 4. Statički analizirano, odgajivačko područje je visoko značajno prouzrokovalo ($P<0.01$) odstupanje prinosa mleka, mlečne masti i proteina. Godišnje doba početka laktacije krava – prvotelki odnosno sezona telenja pokazuje značajna odstupanja prinosa mleka, mlečne masti i proteina u odnosu na opšti prosek ($P<0.05$). Tako su junice oteljene u februaru, martu i aprilu proizvele 206 kg mleka više u odnosu na opšti prosek, odnosno 413 kg mleka više u odnosu na one čiji je početak laktacije bio u avgustu, septembru i oktobru.

Poredeći naše (poslednje iznete) rezultate i rezultate napred navedenih autora može se zaključiti da se prinos mleka simentalških krava (matični zapat) u Srbiji godišnje uvećava za najmanje 100 kg mleka po kravi (zavisno od genetike, područja, odnosno tehnologija ishrane i držanja).

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