

PRODUCTION TRAITS OF SIMMENTAL BULL DAMS IN FIRST LACTATION ACROSS DIFFERENT DISTRICTS OF SERBIA

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Abstract: Milk yield and composition are among the most important traits in cattle production. The aim of this study was to analyse the production traits of Simmental bull dams in their first lactation in Serbia and to evaluate the influence of the district (breeding region) on the variability of these traits. The study included 408 Simmental cows selected as bull dams from eight districts: Kolubara, Podunavlje, Braničevo, Šumadija, Zaječar, Rasina, Nišava and Belgrade. Milk production traits in the first lactation were standardised to 305 days and included milk yield (kg), milk fat content (%), milk fat yield (kg), protein content (%) and protein yield (kg). The data were analysed using one-way analysis of variance (ANOVA) with the district as a fixed factor. The average milk yield in the first lactation was 6093 kg, with an average milk fat content of 4.00% and protein content of 3.25%, confirming that these cows represent a highly productive segment of the Simmental population in Serbia. Highly statistically significant differences ($p < 0.001$) were found between the districts for all analysed traits. The highest average milk yield was recorded in the Nišava district (6792 kg), the lowest in the Podunavlje district (5735 kg). The highest milk fat content (4.30%) and the highest milk fat yield (288.89 kg) were recorded in the Zaječar district, while the highest protein content (3.35%) was recorded in the Šumadija district. The results presented indicate the need to optimise selection criteria and improve rearing conditions in districts with lower production levels in order to support the sustainable development of milk production in Serbia.

Key words: Simmental cattle, bull dams, milk yield, milk composition, first lactation, breeding regions.

Introduction

Milk and dairy products are an important source of nutrients for the human diet, mainly due to their content of proteins, vitamins, minerals and energy (Siddiqui et al., 2024). The increasing demand for milk and dairy products continues to dictate the main goal of dairy cattle breeding, which is to increase the average milk yield. Milk production depends on various factors such as genetics (breed), the physiological condition of the animal and environmental conditions (feeding, care and housing of the animals) (Bednarski and Kupczynski, 2024). Therefore, improvements in milk production in cows can be achieved by selecting the best animals and through advances in feeding and farm management.

Serbia is one of the European countries where the Simmental cattle breed is well adapted and has been the predominant breed for at least half a century. As a result, the autochthonous cattle populations have been largely replaced by the Simmental breed. The breed spread mainly through the import of heifers, breeding bulls and bull semen from Austria and Germany. Today, the Simmental is the most widespread cattle breed in Serbia and accounts for 75% of the total cattle population (Institute for Animal Husbandry, 2024). Nikšić et al. (2011) reported that the average milk yield of first-calving Simmental cows was 4348 kg, with a milk fat content of 3.93% and a corresponding milk fat yield of 171.1 kg. According to the results of Karamfilov and Nikolov (2019), the average milk yield of primiparous Simmental cows was 5,016 kg with a milk fat content of 4.22 % and a protein content of 3.40 %. The authors also reported that the farm and year of calving had a highly significant influence on all analysed milk production indices ($P < 0.001$). Perišić et al. (2009) stated that according to the research results of domestic and foreign authors obtained in the study of the productive traits of the Simmental breed in various rearing systems, the milk production of the Simmental breed in Serbia is remarkably low compared to the average production of the Simmental breed in most European countries. Buonaiuto et al. (2024) reported that the average milk yield of primiparous Simmental cows was 6,908 kg, with an average fat content of 3.84% and an average protein content of 3.53%.

Bull dams are high-performance cows that are selected for their milk yield, conformation and genetic potential to pass on desirable traits to their offspring. They should generally represent the top 1% of the best, i.e. elite cows, and mating with elite sires should produce the next generation of bulls. Lazarević et al. (2018) analysed the phenotypic expression and variability of milk traits in Holstein-Friesian bull dams and their offspring and came to the conclusion that different housing conditions, nutrition and care contributed to the differences in the expression of milk traits. According to the results of Pantelić et al. (2010), the

regions had a statistically highly significant influence ($P < 0.01$) on all analysed milk traits in Simmental bull dams.

The main objective of this study is to analyse the milk traits of Simmental bull dams in the first lactation and to determine the possible influence of different regions on the variability of these traits.

Materials and Methods

This study included 408 Simmental cows selected as bull dams in Serbia in 2024. The initial selection of cows as bull dams was based on the completion of the first lactation, but also on subsequent lactations. The influence of breeding regions on milk traits in the cows' first lactation was analysed. The milk recording was carried out in accordance with the rules prescribed by the International Committee for Animal Recording (ICAR). The milk traits refer to the first lactation standardized to 305 days and include

- 1) milk yield (kg),
- 2) fat content (%),
- 3) fat yield (kg)
- 4) protein content (%)
- 5) protein yield (kg).

A one-way analysis of variance (ANOVA) was performed to determine whether district had a significant effect on milk production and milk composition traits of Simmental bull dams in first lactation. District was included as a fixed factor and milk yield, milk fat content, milk fat yield, milk protein content and milk protein yield were used as dependent variables. ANOVA results are presented as least squares means $\pm$ standard errors, together with F-values and significance levels. Statistical analyses were performed using STATISTICA (data analysis software), version 7 (StatSoft, Inc., 2004).

The bull dams included in this study come from eight different districts (breeding regions) in Serbia.

The breeding regions and the number of selected bull dams per region are as follows:

- 1) Kolubara – 45,
- 2) Podunavlje – 46,
- 3) Braničevo – 10,
- 4) Šumadija – 19,
- 5) Zaječar – 6,
- 6) Rasina – 188,
- 7) Nišava – 20,
- 8) Belgrade – 74.

Results and Discussion

The descriptive statistics for milk traits of Simmental bull dams in their first lactation are shown in Table 1. The average milk yield was 6093 kg, ranging from 4552 to 9112 kg, with a coefficient of variation (CV) of 10.63%, indicating moderate variability between animals. The mean fat content was 4.00%, with a low CV (2.60%), indicating a relatively uniform fat percentage among cows. The average fat yield was 243.56 kg (CV = 11.01%). Protein content showed slightly higher variability than fat content (mean = 3.25%, CV = 4.59%), while protein yield showed the highest variability among the traits (mean = 197.95 kg, CV = 11.46%).

Table 1. Milk traits of Simmental bull dams in Serbia (1st lactation)

Milk traits	N	Mean	Minimum	Maximum	Std.Dev.	Std.error	CV (%)
Milk yield (kg)	408	6093	4552	9112	647.97	32.08	10.63
Fat content (%)	408	4.00	3.38	4.58	0.10	0.01	2.60
Fat yield (kg)	408	243.56	182.72	361.34	26.82	1.33	11.01
Protein content (%)	408	3.25	2.39	4.11	0.15	0.01	4.59
Protein yield (kg)	408	197.95	145.56	293.00	22.69	1.12	11.46

CV – coefficient of variation

In order to place the results of this study in a broader context and to understand them better, it is necessary to compare them with the results of other authors to gain an insight into how the milk production of Simmental bull dams differs from that reported in other studies.

This study included bull dams, i.e. elite animals in the population, so their production was expectedly higher compared to the results reported by other authors. Similarly, Karamfilov and Nikolov (2019) and Nikšić et al. (2011) reported lower average values for Simmental cows in the first lactation compared to the results presented in this study.

Stanojević et al. (2022) reported an average milk yield of 5,520 kg, a milk fat content of 3.94% and a milk fat yield of 218 kg, which are also lower than the results presented in this study. Pantelić et al. (2005) investigated the phenotypic variability of milk production traits in Simmental bull dams and reported average results of 4,768 kg milk, 3.77% milk fat and 179 kg milk fat per cow in the first lactation. The lower values compared to the results of the present study confirm that the production traits of Simmental bull dams have improved since 2005.

Biçoku et al (2010) found that inadequate feeding throughout lactation affects milk production. In their study, the milk production of Simmental cows in Albania was 3,735 kg in the first lactation, while their dams in Austria produced 5,499 kg in the first lactation.

Compared to the results presented in this study, lower values were also reported by Shevhuzhev et al. (2017) for the Simmental breed in the North Caucasus region of the Russian Federation. The authors reported that the average production of Simmental cows in the first lactation was 5,040 kg, with 4.11% milk fat and 3.29% milk protein.

Janžeković et al. (2004), Čačić et al. (2022) and Bolacali and Ozturk (2018) also reported lower values for the first lactation in the Simmental breed compared to the results presented in this study.

On the other hand, there are studies that report a higher average milk production of the Simmental breed in the first lactation. Küçük Baykan and Özcan (2017) found an average milk yield of 7,693 l for Simmental cows in the first lactation, while Kara (2022) reported values of 6,928 kg for the same trait. Koç and Öner (2023) reported an average milk yield of 8,720 kg for Simmental cows in the first lactation, which is the largest deviation from the results presented in this study.

Table 2 shows the average values of milk traits of Simmental bull dams in the first lactation by districts in Serbia. Significant variability between districts was observed for all analysed traits ($p < 0.001$). The small sample size in the Zaječar region may affect the reliability of the ANOVA results. The highest average milk yield was recorded in Nišava (6792 kg) and Zaječar (6764 kg) districts, while the lowest yield was recorded in Podunavlje district (5735 kg). The highest fat content was recorded in Zaječar (4.30%), while the lowest was in Rasina district (3.97%). Consequently, the fat yield followed a similar pattern, with the highest value in Zaječar (288.89 kg) and the lowest in Podunavlje (228.50 kg). The protein content was less variable and ranged from 2.92% in Nišava to 3.35% in Šumadija. Despite the lower protein content, Nišava achieved a relatively high protein yield (198.44 kg) due to the higher milk yield.

Table 2. Milk traits of Simmental bull dams in the first lactation by districts of Serbia

District	N	Milk yield (kg)	Fat content (%)	Fat yield (kg)	Protein content (%)	Protein yield (kg)
Mean ± Std. error						
Kolubara	45	6152±90.65	4.03±0.01	247.81±3.64	3.30±0.02	203.20±3.25
Podunavlje	46	5735±89.66	3.98±0.01	228.50±3.60	3.21±0.02	184.13±3.22
Braničevo	10	6228±192.31	4.05±0.03	252.20±7.72	3.32±0.04	206.70±6.90
Šumadija	19	6193±139.51	4.01±0.02	248.18±5.60	3.35±0.03	209.35±5.01
Zaječar	6	6764±248.27	4.30±0.04	288.89±9.96	3.26±0.05	220.73±8.91
Rasina	188	6141±44.35	3.97±0.01	243.95±1.78	3.26±0.01	199.72±1.59
Nišava	20	6792±135.98	4.08±0.02	277.61±5.46	2.92±0.03	198.44±4.88
Belgrade	74	5872±70.69	3.99±0.01	234.11±2.84	3.28±0.01	192.80±2.54
F exp.		8.87***	14.6***	13.09***	23.23***	5.68***

*** – statistically highly significant ($p < 0.001$)

Overall, the results indicate that district has a significant influence on milk yield characteristics, with some regions showing clear advantages in production potential, which is consistent with the results reported by other authors (Stanojević et al., 2022; Petrović et al., 2009; Pantelić et al., 2021).

Regional differences in the milk performance of Simmental cows are due to variations in feeding systems, selection intensity, and management practices. In Serbia, as in many other countries with diverse production environments, feeding conditions vary among regions. Areas with more developed dairy production and better access to high-quality forage and concentrates generally achieve higher milk yields and component contents. Differences in selection programmes and breeding goals also contribute to regional variation. In regions where breeding organisations implement more systematic selection of bull dams based on milk performance records, genetic progress tends to be faster. Overall, the observed regional variability highlights the importance of standardising management and selection practices while considering local, environmental and economic conditions. Adapting breeding and feeding strategies to regional resources can improve both the efficiency and sustainability of Simmental bull dam production.

Conclusion

The results of this study provide an overview of the characteristics of milk production in the first lactation of Simmental bull dams in Serbia. The average milk yield of 6093 kg together with the corresponding fat and protein contents show that the selected bull dams represent a high-performing segment of the population in Serbia. Compared to previous studies, especially on Simmental populations in other countries, it can be concluded that there is a significant potential for improving the production traits of this breed in Serbia.

The analysis revealed statistically highly significant differences between the districts ($p < 0.001$) for all analysed traits, which underlines the importance of regional factors such as feeding systems, housing conditions and herd management for production performance. The highest average milk yield and fat yield were recorded in Nišava and Zaječar districts, while the highest protein yield was observed in Zaječar and Šumadija districts, respectively. These results highlight the potential for further genetic and management improvements by selecting better cows and improving production conditions in lower yielding districts.

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Conflict of interest

The authors declare that they have no conflict of interest regarding the publication of this study.

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