THE DIFFERENCES IN SUBCLINICAL MASTITIS PREVALENCE AND EFFECT ON MILK PRODUCTION DUE TO COWS' BREED AND BREEDING REGION

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Vesna Gantner[1], Vera Popović[2], Zvonimir Steiner[3], Ranko Gantner[4], Klemen Potočnik[5]

Abstract

The purpose of this study was to look into how the breed (Holstein or Simmental) and breeding region (Central, Eastern, and Mediterranean) influence the occurrence of subclinical mastitis and its impact on milk production. In order to do this, the study examined 3,953,637 test-day records of Holstein cows and 4,922,751 test-day records of Simmental cows. The daily lactose content was utilized to diagnose subclinical mastitis. The study's findings showed that subclinical mastitis rates varied significantly depending on the breed and breeding location. The Eastern region's Holstein cows were the least common. On the test-day, when subclinical mastitis was found in all regions and breeds, the lowest daily milk output was also noted. Subsequent milk records, however, revealed an increase in milk output that differed according to breed and breeding location. The Holstein cows from the Eastern region showed the largest overall increase in milk production. According to these results, healing potential differs greatly depending on the breed and breeding area. Eastern region farms raised Holstein cows, who had the lowest rate of mastitis-related problems and the best likelihood of recuperating and reaching their genetic output potential. As a result, this study implies that dairy cows that are reared at the large, specialized dairy farms that are common in the Eastern region recover more quickly.

Key words: *milking cows, subclinical mastitis, occurence, milk production.*

1 Vesna Gantner, Ph.D., Full professor, J.J. Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia, E-mail: vgantner@fazos.hr

2 Vera Popović, Ph.D., Principal research fellow, Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad, Serbia, E-mail: vera.popovic@ifvcns.ns.ac.rs

3 Zvonimir Steiner, Ph.D., Full professor, J.J. Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia, E-mail: zsteiner@fazos.hr

4 Ranko Gantner, Ph.D., Full professor, J.J. Strossmayer University of Osijek, Faculty of Agrobiotechnical Sciences Osijek, Vladimira Preloga 1, Osijek, Croatia, E-mail: rgantner@fazos.hr

5 Klemen Potočnik, Ph.D., University of Ljubljana, Biotechnical faculty, Department of Animal Science, Groblje 3, Domžale, Slovenia, E-mail: klemen.potocnik@bf.uni-lj.si

Introduction

Undoubtedly one of the most common and expensive diseases affecting dairy cows, mastitis is characterized by inflammation of the udder. The condition causes a range of symptoms in the udder, including swelling, increased warmth, redness, pain, and in severe cases, necrosis. These symptoms lead to a reduction in milk production and overall weakening of the animals. Mastitis can be induced by a variety of factors, including bacterial infections (such as *Escherichia coli, Staphylococcus aureus,* and *Streptococcus species*), non-infectious factors (such as mechanical injury, irritation, or hormonal imbalances), and environmental factors (such as inadequate hygiene, dirty or wet bedding, and inadequate milking).

Mastitis can occur in clinical or subclinical states, and both states cause substantial losses in revenue for dairy farmers as a result of a decline in milk quality and reduced milk yield. Furthermore, the incidence of mastitis may have detrimental effects on the environment; however, by identifying, treating, and preventing subclinical mastitis early on, a dairy farm can lower its greenhouse gas emissions per kilogram of milk produced. Ebrahimi et al. (2019) have reported that increased use of antibiotics in response to mastitis can lead to possible resistance of the causative agent. Therefore, it is essential to develop efficient ways of monitoring dairy herds and preventing mastitis prevalence to enable economically and environmentally efficient dairy farming. Pyorala (2003) states that daily lactose content is a good measure of the prevalence of mastitis. According to Silanikove et al. (2014), inflammation in the mammary gland results in cell damage and reduced lactose production, which lowers the amount of lactose in milk. According to Babnik et al. (2004), milk with a daily lactose concentration of less than 4.5% implies a substantial risk of mastitis prevalence.

Given that mastitis is one of the most common issues on dairy cattle farms, this study attempted to assess the effect of cow breed (Holstein or Simmental) and breeding area (Central, Eastern, and Mediterranean) on subclinical mastitis occurrence and its impact on the production of milk. This study will provide a more comprehensive understanding of the factors that contribute to mastitis prevalence, which will help in the development of effective strategies to prevent and control the condition, leading to more efficient and sustainable dairy farming practices.

Material and Methods

The research used test-day records of dairy cattle (Simmental and Holstein breed) collected during regular milk recording in Republic of Croatia between 01 / 2005 and 12 / 2022. Milk recording was conducted every four weeks using the alternative milk recording method (AT4/BT4). Milk samples were tested at the Croatian Agency for Agriculture and Food's Central Laboratory for Milk Quality Control using the Milcoscan FT6000, which uses an infrared spectrophotometry method to determine milk components. The dataset underwent logical control in accordance with ICAR guidelines and nonlogical variable values were rectified (ICAR, 2017). 3,953,637 test-day records for the Holstein breed and 4,922,751 test-day records for the Simmental breed made up the corrected dataset.

To determine the *subclinical mastitis prevalence*, the daily lactose content (DLC) was used as an indicator. A DLC of 4.5% or higher meant the animals were healthy, while a DLC lower than 4.5% indicated a subclinical mastitis prevalence. The subclinical mastitis prevalence was expressed as a percentage of cows at subclinical mastitis from the total dairy cattle population and was analysed separately for each breed and breeding region.

The study also looked at the *effect of subclinical mastitis* on daily milk production at successive milk recordings. The analysis included only cows with a determined subclinical mastitis (DLC < 4.5%), and the daily milk yield on the day when subclinical mastitis was determined was used as the reference value. The mastitis index was created based on the number of days after subclinical mastitis was confirmed. The index includes five categories: D-0 (which is the day when subclinical mastitis was detected), A-1 (within 35 days), A-2 (from 36 to 70 days), A-3 (from 71 to 105 days), and A-4 (more than 105 days). To evaluate the effect of subclinical mastitis on daily milk production, a statistical model was used. This model considered various factors, including lactation stage, age at first calving, milk recording season, herd size, and mastitis index. The statistical analysis was done separately for each breed (Holstein and Simmental) and breeding region (Central, Eastern, and Mediterranean). To test the significance of differences between the estimated LSmeans, the MIXED procedure of SAS (SAS Institute Inc., 2019) was used, along with Scheffe's method of multiple comparisons.

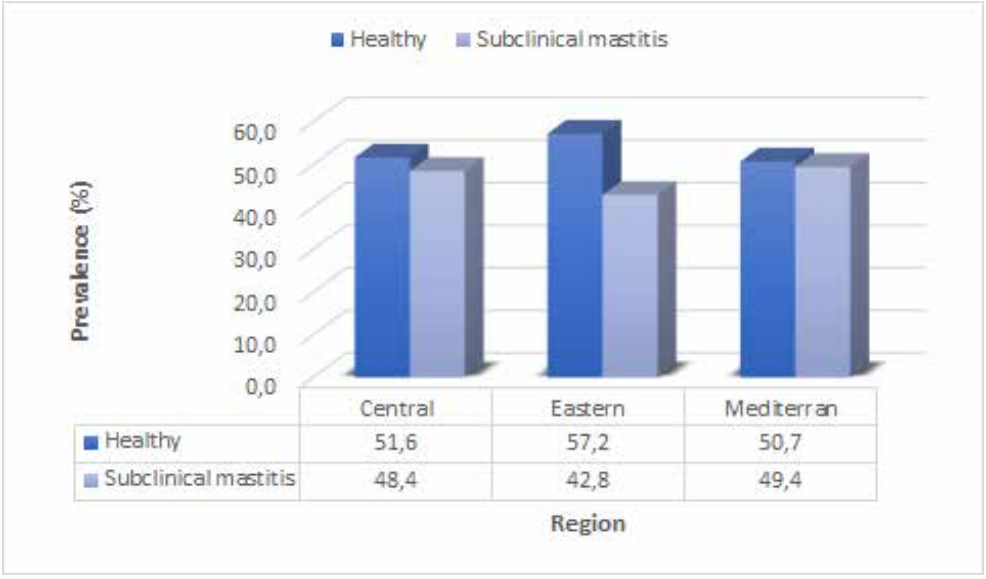
The *estimated differences in daily milk production* between the analysed milk recordings (D-0, A-1, A-2, A-3, A-4) were presented separately by breed and

breeding region. Based on the estimated daily differences and intervals between successive recordings, the *total difference in milk production* over four successive milk recordings (from D-0 to A-4) after subclinical mastitis was calculated. Finally, the total difference in milk production in kg of milk in the analysed period was presented separately by breed and breeding region.

Results and discussion

The present study aimed to investigate the prevalence of subclinical mastitis in dairy cows and to identify potential factors that contribute to its occurrence. Results showed that there were significant differences in the health status of dairy cows based on their breeding region (figures 1 and 2). Holstein cows exhibited a prevalence rate ranging from 42.8% to 49.4%, with the Mediterranean region having the highest prevalence rate, and the Eastern region having the lowest. Similar trends were observed in Simmental cows, with a slightly higher prevalence rate ranging from 45.7% in the Eastern region to 52.5% in the Mediterranean region.

Figure 1. The occurrence of subclinical mastitis in Holstein cows in three breeding regions (Central, Eastern, and Mediterranean)

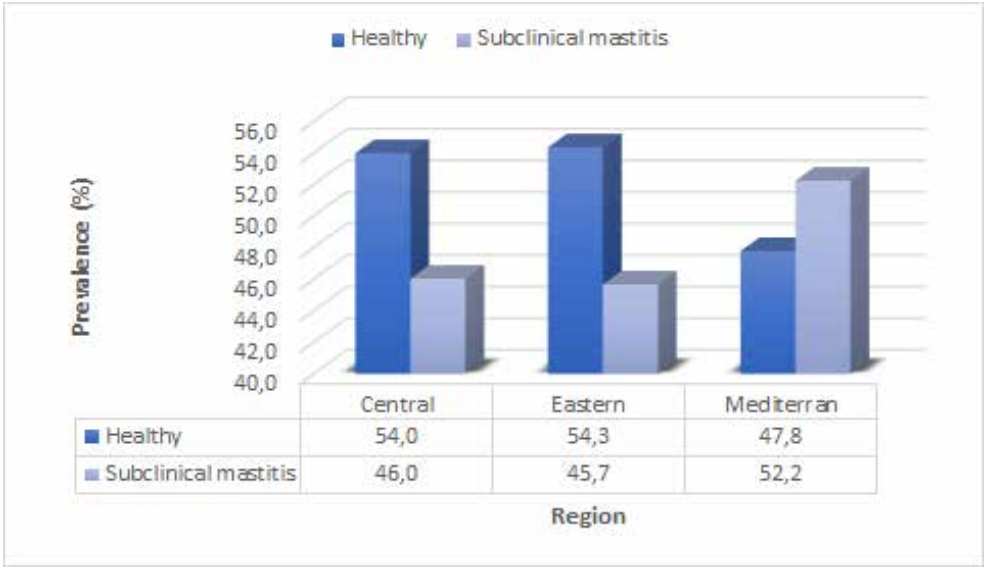


According to Tomazi et al. (2018), a variety of parameters, including season, herd size, level of production, and production system, can influence the oc-

currence of mastitis-causing bacteria and the incidence rate of mastitis cases in dairy herds. Furthermore, high temperatures and humidity promote heat stress in dairy cows, increasing the likelihood of intramammary infections caused by environmental pathogens. According to Antanaitis et al. (2021), the causal agent of subclinical mastitis in milk appears more frequently during the summer. However, the occurrence of mastitis can be linked to seasonal fluctuations in management systems, diet, and housing. Gantner et al. (2011) and Weber et al. (2020) have also noted that season, herd size, husbandry system, and average production may all be connected with the occurrence of mastitis in dairy cattle.

The observed differences in subclinical mastitis occurrence regarding breed and breeding region could be explained by the differences in animals' genetics (Holstein and Simmental breed), as well as by the difference in management practices, average herd size, and environmental conditions in different breeding regions (with the highest frequency of heat stress days in the Mediterranean region). Overall, these data indicate that focused treatments aimed at minimizing the impact of environmental factors and enhancing herd management methods could help lower the occurrence of subclinical mastitis in dairy cows.

Figure 2. The occurrence of subclinical mastitis in Simmental cows in three breeding regions (Central, Eastern, and Mediterranean)



Statistical analysis showed that daily milk production, in both breeds (Holstein and Simmental) and all regions (Central, Eastern, and Mediterranean), was significantly (< 0.0001) affected by mastitis index (D-0, A-1, A-2, A-3, A-4). LsMeans of daily milk yield in Holstein cows varied from 23.71 kg/day at D-0 to 24.19 kg/day at A-3 in the Central region; from 23.32 kg/day at D-0 to 24.48 kg/day at A-4 in Eastern; and from 23.07 kg/day at D-0 to 23.59 kg/day at A-2 and A-4 (Table 1). The highest daily milk production was observed in Holsteins bred in the Central region. In the Simmental breed, significantly lower daily milk yield in comparison to Holstein was determined with the highest production observed in the Eastern region.

In all breeds and regions, the lowest daily milk production was determined at D-0 (the test-day record when subclinical mastitis was determined), followed by an increase at subsequent milk recordings that varied depending on the breed and region of breeding.

Table 1. LsMeans of daily milk yield at evaluated milk recordings (D-0, A-1, A-2, A-3, A-4) concerning the breeding region and breed.

Milk recording	Parameter	Holstein			Simmental		
		CE	ES	ME	CE	ES	ME
D-0	Estimate	23.71	23.32	23.07	17.26	17.73	17.55
D-0	StdErr	0.05	0.03	0.09	0.06	0.03	0.09
A-1	Estimate	24.19	24.12	23.50	17.47	18.03	17.94
A-1	StdErr	0.05	0.03	0.09	0.06	0.03	0.09
A-2	Estimate	24.15	24.23	23.59	17.37	17.98	18.05
A-2	StdErr	0.05	0.03	0.09	0.06	0.03	0.09
A-3	Estimate	24.08	24.25	23.48	17.28	17.91	18.15
A-3	StdErr	0.05	0.03	0.09	0.06	0.03	0.09
A-4	Estimate	24.09	24.48	23.59	17.16	17.87	18.26
A-4	StdErr	0.05	0.03	0.08	0.06	0.02	0.07

* CE – Central, ES – Eastern, ME – Mediterranean

Table 2 presents the total difference in milk production (kg) in the analysed period from D-0 to A-4 milk recordings, considering the breeding region and breed. Among all breeds and regions, Holsteins in the Eastern region showed the highest increase in daily milk yield (24.03 kg) at first successive milk recordings after detecting subclinical mastitis (A-1), with a total increase in

milk production of 35.05 kg. In contrast, Simmental cows bred in the Central region showed the lowest increase in milk production (6.12 kg), with a decrease of 3.07 kg at the end of the analysed period.

The highest total increase in milk production was observed in Holstein cows in the Eastern and Simmental cows in the Mediterranean region. The amount of increase in milk production following the prevalence of subclinical mastitis represents the animal's recovery potential. The findings of this study show that this potential varies greatly depending on the breed and breeding region. Holstein cows situated in farms in the Eastern region showed the highest possibility of recovery aa well as restoration of production following their genetic potential.

Table 2. Total difference in milk yield in the analysed period of four successive milk recordings (from D-0 to A-4) regarding the breeding region and breed

Holstein					
Region	A-1	A-2	A-3	A-4	Total difference
CE	14.28	-1.26	-2.12	0.29	11.19
ES	24.03	3.28	0.63	7.10	35.05
ME	12.80	2.67	-3.34	3.51	15.63
Simmental					
Region	A-1	A-2	A-3	A-4	Total difference
CE	6.12	-3.03	-2.47	-3.69	-3.07
ES	9.01	-1.50	-2.25	-1.15	4.11
ME	11.47	3.36	3.16	3.26	21.25

* CE – Central, ES – Eastern, ME – Mediterranean

The differences in milk production increase after detecting subclinical mastitis depended on the breed and the breeding region. These differences can be explained by varying feeding management and microclimatic conditions in different regions, as well as the genetic potential of different breeds. Holsteins bred in the Eastern region showed the greatest rise in daily milk yield, showing that they recuperate more efficiently when bred on big, specialized dairy farms common in that region. Chen et al. (2023) also observed differences in mastitis occurrence across regions, which they attributed to diverse climate conditions. According to Antanaitis et al. (2021), variances in systems for management, feeding approaches, and animal care contribute to discrepancies in milk yield.

Conclusion

The purpose of this study was to evaluate at the impact of breed (Holstein or Simmental) and breeding region (Central, Eastern, and Mediterranean) on the occurrence of subclinical mastitis and its effect on milk production. The findings revealed considerable disparities in subclinical mastitis frequency among breeding regions and breeds, with Holstein cows from the Eastern region having the lowest incidence. Furthermore, the lowest daily milk yield was recorded on the test day, when subclinical mastitis occurred in all breeds and all regions, followed by an increase in subsequent milk recordings that fluctuated depending on the breed and region of origin. Holstein cows from the Eastern region experienced the greatest overall increase in milk production.

These findings show that recovery potential varies greatly depending on the breed and breeding region. Holstein cows from farms in the Eastern region had the lowest prevalence of mastitis-related disorders and the best chance of recovering and restoring output due to their genetic potential. Therefore, these data show that dairy cows recuperate more quickly when they are reared on big, highly specialized dairy farms, which are widespread in the Eastern region.

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