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Effect of parity number and days in milk on somatic cell count in dairy cows

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Abstract: *The somatic cell count in milk is an effective indicator for assessing the health of the mammary gland and detecting any issues related to milk production in dairy cows. The aim of this study was to evaluate the effect of parity and days in milk on somatic cell count in the milk of dairy cows during the year. This study included (n = 600) Holstein dairy cows with an average milk production of 10,154 kg for a standardized 305-day lactation. We confirmed the increase of somatic cell count in the milk of dairy cows with increasing days in milk. Higher somatic cell count after parturition reflects on the immunological preparation of the cow for calving and in late lactation on the reduction of milk production. The lowest somatic cell count was observed in cows in their first lactation, as a result of the growth and development of the mammary gland. As the parity number increases, the incidence of mastitis increases, which increases somatic cell count.*

I. INTRODUCTION

The mammary gland of a cow is an organ that is composed of various cells associated with milk production. With bacterial infections or traumatic injuries, some endothelial cells stop synthesizing milk and instead trigger a response to protect the tissue from inflammation [1].

Somatic cell count (SCC) in milk represents cells of the immune system, such as leukocytes and epithelial cells released from mammary gland tissue. Their presence is a natural part of milk, but an increased number of somatic cells often signals health problems, especially processes such as mastitis [2]. The number of somatic cells in milk is a suitable tool for monitoring the health of the mammary gland and the occurrence of milk secretion disorders, or mastitis in dairy cows [3]. Approximately 15-25% of the somatic cells in the milk of healthy dairy cows are formed by mammary epithelial cells as part of the regular turnover and regeneration of the mammary gland epithelium, the number of which increases especially during colostrum production and at the end of lactation, and the remaining 75-85% are blood cells (leukocytes), which contribute to the immune protection of the mammary gland and their number increases in the case of various pathological processes (subclinical, clinical mastitis) [4-5].

Increased SCC leads to the degradation of milk proteins and fats, which can reduce the milk yield, quality and technological value of dairy products such as cheese or butter. Therefore, SCC is an important indicator not only of animal health but also of the economic efficiency of milk production. In the USA, the maximum permissible limits of SCC in dairy cows' milk are set at the level of 750,000/ml [6], while within the countries of the European Union, according to Commission Regulation (EC) No. 853/2004 [7], the limit is at 400,000/ml.

In addition to pathological processes, SCC in milk can be influenced by several factors, including genetic

predispositions of dairy cows, their health, herd management, hygienic conditions, stage of lactation, number of lactations, season, and frequency of milking [8-9]. Regular monitoring of SCC is essential for early detection of health problems and to ensure high milk quality. Appropriate herd management, consistent hygiene, and timely treatment of mastitis are key to minimizing SCC and maintaining healthy and efficient milk production.
The aim of our study was to evaluate the effect of parity number and days in milk on somatic cell count in the milk of dairy cows during the year.

II. Material and Methods

2.1 Sampling

This study included (n = 600) Holstein dairy cows with an average milk production of 10,154 kg for a standardized 305-day lactation. The cows were fed total mix rations (TMR), which were formulated monthly depending on the nutrient needs according to the lactation phase and the dry matter intake (DMI). Dairy rations were formulated from corn and alfalfa silage and supplemented with carbohydrate feed (cereal feed and cereal by-products) and protein supplements (soybean and rapeseed meal) provided ad libitum.

The effect of the parity and days in milk (DIM) on SCC in milk was evaluated in the annual average. The milk samples were divided into the following groups according to:

- Parity number: primiparous cows (number of lactations = 1) and older dairy cows (number of lactations 2, 3, 4+)
- DIM: 0–30, 31–100, 101–200, 201–305

2.2 Laboratory analyses

The samples of the feed rations were taken from the feed manager and were analyzed for dry matter (DM), which consisted of crude protein (CP), fat, acid and neutral detergent fiber (ADF, NDF), and starch analyzed by conventional methods according to Commission Regulation (EC) No. 691/2013 [10]. The DM was determined by weight upon drying the sample at 105 °C under the prescribed conditions. The CP content was determined by the Kjeldahl method using a 2300 Kjeltec analyzer unit (Foss Tecator AB, Sweden). The fat was determined by the device Det-Gras (JP Selecta, Spain).

The ADF and NDF were determined using a Dosi-Fiber analyzer (JP Selecta, Spain), and the starch content was determined polarimetrically. The net energy for lactation (NEL) and non-fiber carbohydrates (NFC) were calculated according to the nutrient requirements of dairy cattle [11]. The cows were milked twice a day at 06:00 a.m. and 04:00 p.m. in a parallel milking parlor (BouMatic, Sweden) and individual milk samples were analyzed once per month.

The samples were cooled to 4 °C and immediately transported to the Central Analytical Laboratory of Milk with accreditation under the registration number 096/5878/2015/2 in collaboration with The Breeding Services of Slovakia, using the breeding information system. Milk samples were analyzed for milk protein, fat, lactose and SCC by MilkoScan FT+ (Foss Electric, Hillerød, Denmark) and Fossomatic FC (Foss Electric, Hillerød, Denmark).

2.3 Statistical analyses

The results were processed using the statistical program SPSS Statistical Software version 24.0 (IBM Corp., Armonk, NY, USA) and expressed as mean (x), standard deviation (SD), minimum (min.) and maximum values (max.). One-way analysis of variance (ANOVA) was used to assess SCC, where parity and days in milk were the main effects at a significance level of $P < 0.5$.

III. Results and Discussion

The average concentration of nutrients in the TMR for the whole farm is shown in Table 1. The average dry matter intake (DMI) for the farm was 21.59 ± 2.0 kg in the range of 18.0 to 26.0 kg/day (d).

The production indicators in the average for the entire breeding are summarized in Table 2. The fluctuation of production parameters points to the different composition and nutrient content of TMR for individual groups of dairy cows due to the different genetic potential of the herd, order and stage of lactation of the dairy cows.

Table 1 Nutritional content of the diet (% in DM)

Items	x	SD	Min.	Max.
CP	15.37	1.1	10.5	17.4
NEL	6.44	0.2	5.7	6.7
NDF	37.31	4.0	28.0	45.0
ADF	22.99	2.8	18.7	34.2
Starch	22.93	5.0	10.3	30.1
NFC	35.80	3.7	20.6	40.9
Fat	4.18	0.5	3.1	6.0

Note: DM – dry matter; CP – crude protein; NDF – neutral detergent fiber; ADF – acid detergent fiber; NFC – non-fiber carbohydrates; NEL – net energy for lactation; x – means; SD – standard deviation; min – minimum; max. – maximum.

Table 2: Milk production and composition (mean ± SD, min and max).

Items		x	SD	Min.	Max.
Milk yield	(kg/d)	34.00	10.0	7.5	52.0
Fat	(%)	3.73	0.79	2.26	6.47
Protein	(%)	3.28	0.40	2.72	4.52
Lactose	(%)	4.84	0.24	4.22	5.19
SCC	(10^3/ml)	132.04	82.53	2.00	352.3

Note: d – day; SCC – somatic cell count; x – means; SD – standard deviation; min – minimum; max. – maximum.

Figure 1 shows the relationship between SCC depending on DIM. We confirmed increasing SCC in the milk with increasing DIM, with higher SCC after parturition. Our results are similar to that reported by Butendieck [12], who observed high SCC at the beginning of the lactation and explained this fact as a biological immunological preparation of the cow for calving. The cow is exposed to a high metabolic load and an increased risk of infection. As a result, there may be an increase in SCC.

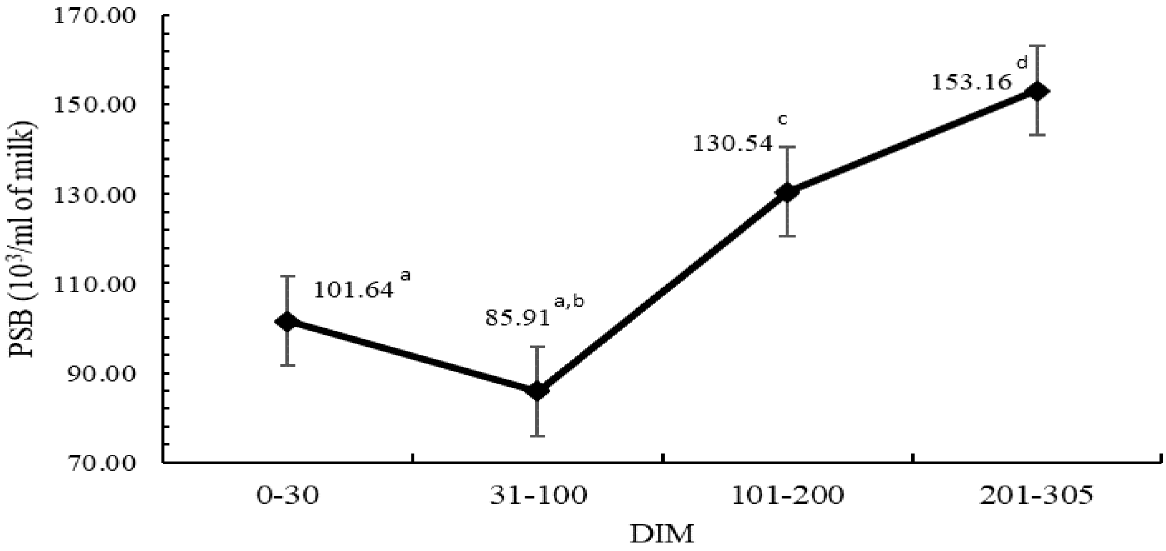

Figure 1: Evaluation of SCC depending on DIM
Note: Means with the same letter are not significantly different ($P > 0.05$)

According to Harmon [13], at the beginning of lactation, a greater number of epithelial cells are released as part of tissue renewal, which contributes to the increase of SCC. The SCC increases in the late lactation due to a decrease in milk production and the concentration of SCC in a smaller volume of milk. According to Ruegg [14], tissue wear and lower immunological defenses may contribute to an increased risk of mastitis. According to Ruegg and Pantoja [15], increasing SCC toward the end of the lactation is associated with greater pathogen exposure due to a more frequent interaction among healthy and diseased cows.

Figure 2 shows the evaluation between SCC and parity. SCC increased ($P < 0.05$) with increasing parity number. Our results are similar to those reported by Tineo and Andía [16], who studied the relationship between mastitis and parity number and found that higher SCC was observed in cows in their third and higher lactations. We found that cows in the first lactation had the least SCC due to continued body frame and mammary gland growth when milk production and SCC decreased. As the lactation of cows increases, the occurrence of mastitis rises with an increase in SCC in the milk and a decrease in milk production [17].

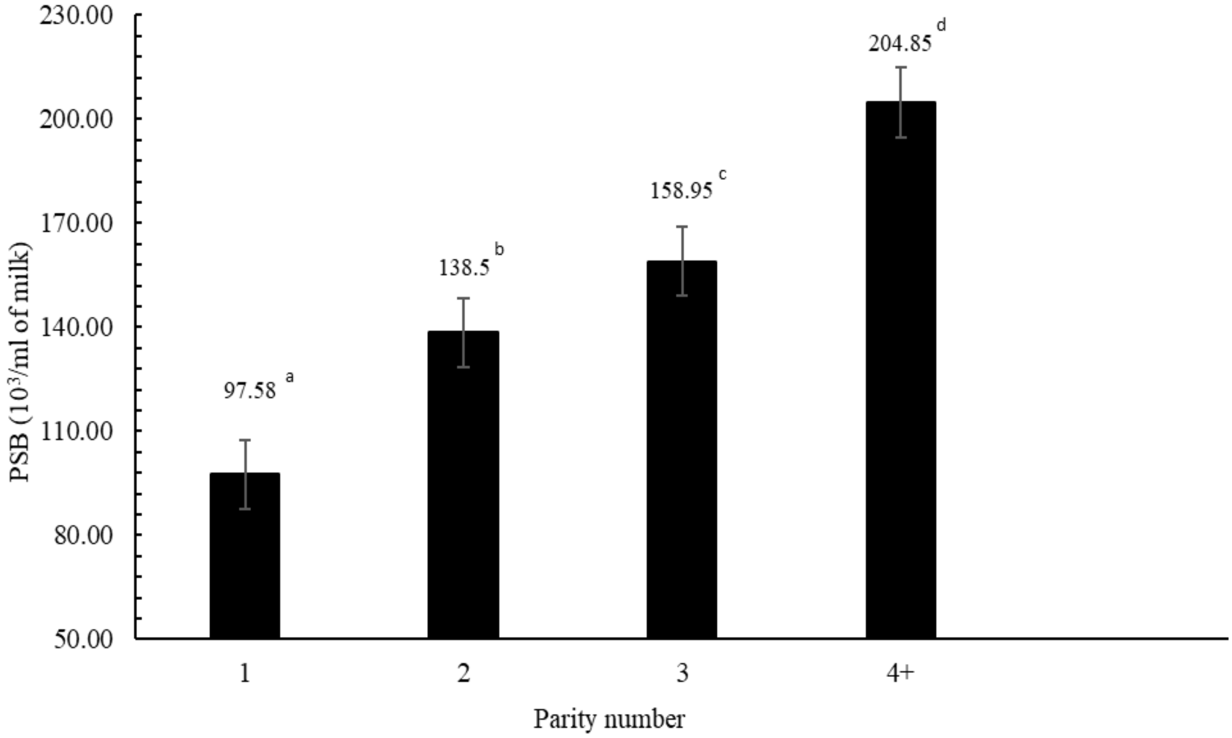

Figure 2: **Evaluation of the SSC depending on the parity number of dairy cows**
Note: Means with the same letter are not significantly different ($P > 0.05$).

IV. Conclusion

To maintain the health of cows and optimize milk quality, it is important to implement measures for the prevention and treatment of mastitis. Monitoring the SCC in milk through regular tests can help identify problems early and take corrective actions. An important part of prevention also includes proper nutrition for the cows, maintaining good hygiene conditions on the farm, and providing adequate veterinary care.

V. Acknowledgement

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