MILKING TECHNOLOGY INFLUENCE ON DAIRY COW MILK PRODUCTIVITY AND QUALITY

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Abstract. The aim of the research was to evaluate the milk quality in the automatic milking system (milking robot) and milking parlor. The somatic cell count is the indicator of inflammation in the udder. If milk ejection is inhibiting, inflammation develops in the udder. Stress is one of the reasons to inhibit milk ejection. As a result the somatic cell count increases but the milk yield decreases. The stress level is higher for primiparous compared with multiparous. The milk yield was significantly greater in the milking robot milked cow milk (28.5±0.60 kg). The somatic cell count was significantly greater in the parlor milked cow milk in the 1st (319.0±90.69 thousand per ml) and 2nd (119.0±26.46 thousand per ml, $p < 0.05$) recordings. The milk yield was not significantly different in the multiparous group. The milk fat and protein contents were greater in the parlor group. The somatic cell count of the multiparous group was significantly greater in the 3rd recording (146.0±43.92 thousand per ml, $p < 0.05$). Linear type traits of udder were not different - neither primiparous nor multiparous. Milk ejection was not affected by the linear type of the udder. The stress factor which is responsible for elevated somatic cell count could be the environment factor.

Keywords: milking robots , milking parlor, milk yield, somatic cell.

Introduction

Different milking technologies can be used for the milking process – milking parlors, milking jugs and automatic milking systems (milking robots). The aim of dairy business is to produce high qualitative milk. The quality of milk can be affected by genetic (animal breed) and non-genetic factors, for example, feeding, welfare, environment [1-3].

Stress is one of environment factors, which affects the quality of milk. Before milking, less than 20 % of the milk yielded by dairy cows is stored within the cistern, where it is immediately available for removal. Premilking teat stimulation inducts to elevation of oxytocin concentration. Oxytocin is responsible for milk removal. Influence time of oxytocin is 6 to 7 minutes. Any interruption of the milk ejection process can disturb milk removal. The result of periodic interruption of milk ejection is inflammation in the udder. The indicator of inflammation is the somatic cell count [4]. The stress level is the greatest for primiparous, dairy cows are adapted in new environment. Ergonomic milking technology and responsible employees affect the welfare for cows [5]. Each cow goes individually to the milking robot. All cows are moved to the milking parlor at the same time [6]. Cows are loading milking robots during the day. The load of the milking robots decreases during night [7]. For evaluation of cow welfare in different milking technologies, the somatic cell count is a suitable indicator.

The aim of the research was to compare the milk quantity, composition and quality at early lactation in different milking technologies.

Materials and methods

The research place was the LUA Training and Research Farm Vecauce. Data were collected from 40 ($n = 40$) dairy cows, which were milked in voluntary milking systems (VMS) and 71 ($n = 71$) dairy cows were milked in the parallel parlor (*Side by Side*). VMS and parlor were from the company DeLaval. All cows were milked 3 times per day, in every 8 hours. In the parlor milking times were 3:30 a.m., 12:00 p.m., 7:30 p.m. In VMS milking time was individual for each cow. Cows were from different breeds. In VMS group 15 cows were Holstein Black and White and 25 were from Red breed. In the parlor group 18 cows were from Black and White breed and 53 cows were from Red breed. Cows had *ad libitum* access to total mixed ration. Ingredients of total mixed ration for the parlor group were 20.0 kg grass silage, 16.0 kg maize silage, 6.7 kg grain meal, 3.2 kg rapeseed meal, 2.3 kg soybean meal, 0.2 kg Complect Keragen, 0.1 kg chalk, 0.15 kg baking soda, 0.07 kg salt. Ingredients of total mixed ration for the WMS group were 30.0 kg grass silage, 10.0 kg maize silage, 2.5 kg grain meal, 1.9 kg rapeseed meal, 0.15 kg Complect Keragen 0.07 kg salt, concentration feed 0.4 kg per one kg of milk. Cows were kept in the loose housing system.

The data were collected from 2013 January to November. The data were collected from the Agricultural data center database from the heard recording data. Monthly control milk samples were analyzed for fat, protein and the somatic cells count. All of these parameters were analyzed in accredited milk quality laboratory SIA 'Piensaimnieku Laboratorija' with FOSS instrument CombiFoss FC.

The somatic cell count was calculated to the somatic cell score (SCS) by formula [15]:

$$SCS = \log_2 (\text{Somatic cell count} / 100000) + 3. \quad (1)$$

The first recording was done on the 20th day of lactation in both research groups. Each next recording was done after 30 days.

Data analysis was performed using program R and MS Excel packages. For traits characterization mean values and standard errors were used. T-test for independent samples was performed to determine significance. The difference was significant if $p < 0.05$. Significant differences were marked by different letters with superscripts.

Results and discussion

Milk productivity of primiparous is shown in Table 1. The milk yield of primiparous of VMS group was the greatest in the 2nd recording (28.5±0.60 kg). The milk yield was significantly greater compared with the parlor group (26.5±0.73 kg; $p < 0.05$). The milk yield of the parlor group was greater in the 3rd recording. According by researchers of the Netherlands, the milk yield was greater by 2.0 kg per day in milking robots compared with the parlor [6; 7]. The fat content was significantly different in the 1st and 2nd recordings. The fat content was greater by the parlor group. The protein content was significantly different in all recordings. Similar as the fat content, the protein content was greater by the parlor group. The somatic cell count was significantly greater by the parlor group in the 1st and 2nd recordings ($p < 0.05$). The somatic cell count was greatest by the parlor group in the 1st recording (319.0±90.69 thousand per ml). The somatic cell score was significantly greater by the parlor group in the 2nd recording (2.27±0.22). According to the study done by scientists from Italia, the omatic cell score was greater by primiparous in milking robots compared with parlor milking cows [9]. Comfort and welfare for primiparous is the main factor for milk productivity in both, the robots and the parlor [10].

Table 1

Milk productivity of primiparous

Traits	1st recording	2nd recording	3rd recording
	$\bar{x} \pm s_{\bar{x}}$		
	VMS group n=20		
Milk yield, kg	25.0±0.66	28.5±0.60[a]	28.3±0.93
Fat, %	3.89±0.11[a]	3.37±0.14	3.67±0.09[a]
Protein, %	3.13±0.05[a]	3.05±0.06[a]	3.21±0.07[a]
SCS	2.60±0.30	1.32±0.28[a]	1.65±0.29
Somatic cell count, thousand per ml	114.7±25.82[a]	45.0±9.35[a]	57.0±12.15
×	Parlor group n=48		
Milk yield, kg	25.4±0.60	26.5±0.73[b]	28.0±0.66
Fat, %	4.18±0.09[b]	3.96±0.09	4.05±0.08[b]
Protein, %	3.34±0.05[b]	3.14±0.04[b]	3.37±0.04[b]
SCS	3.25±0.26	2.27±0.22[b]	2.29±0.21
Somatic cell count, thousand per ml	319.0±90.69[b]	119.0±26.46[b]	123.0±34.94

[a,b] – traits with different letters in superscript are significantly different between the VMS and parlor group ($p < 0.05$)

The milk yield of multiparous of the VMS group was greater in the 2nd recording (37.40±1.21 kg). The milk yield of the parlor group was greater in the 1st and 2nd recording – 34.2 kg. The milk yield

was not significantly different. Foreign scientists have found that the milk yield of multiparous increases in milking robots [11]. Fat content was greater in the parlor group. Researchers from Poland have found that the fat content was greater in the voluntary milking system [12]. Significant difference was in the 2nd and 3rd recording ($p < 0.05$). Protein content was not significantly different. The somatic cell count of the parlor group was significantly greater in the 3rd recording (146.0±43.92 thousand per ml; $p < 0.05$). The somatic cell score of the parlor group was significantly greater in the 1st and 3rd recording, Table 2.

Table 2

Milk productivity of multiparous

Traits	1st recording	2nd recording	3rd recording
	$\bar{x} \pm s_{\bar{x}}$		
	VMS group n = 20		
Milk yield, kg	32.3±1.49	37.40±1.21	36.2±0.95
Fat, %	3.81±0.14	3.51±0.12[a]	3.54±0.16[a]
Protein, %	3.36±0.08	3.17±0.06	3.25±0.11
SCS	1.47±0.25[a]	1.43±0.41	1.11±0.27[a]
Somatic cell count, thousand per ml	50.0±13.90	89.0±37.53	41.0±10.88[a]
×	Parlor group n = 23		
Milk yield, kg	34.2±1.57	34.2±1.61	34.00±1.10
Fat, %	4.17±0.10	4.09±0.12[b]	4.23±0.12[b]
Protein, %	3.33±0.07	3.33±0.07	3.36±0.06
SCS	2.24±0.28[b]	1.57±0.40	2.33±0.40[b]
Somatic cell count, thousand per ml	106.0±32.66	117.0±48.83	146.0±43.92[b]

[a,b] – traits with different letters in superscript are significantly different between the VMS and parlor group ($p < 0.05$)

The structure of the udder is connected with milk quality. The structure of the udder is evaluated by linear type traits (1.0 to 9.0 point scale). Optimal value is each of the udder traits. Linear type traits are characterized by the structure of the udder. The linear type traits – udder front, rear udder height, rear udder width, force udder attachment – optimal values are 9.0 points. Five points are optimal values for the udder depth, teat length, rear teat placement, front teat placement. Six points are optimal value for udder cleft.

We did not find significant differences between the linear type traits of the udder comparing the VMS group and parlor group. According to the optimal values of the linear type traits, we concluded that rear of the udder was not enough in height and width. Udder front was not enough developed, Figure 1. As focused by other scientists, udder front and rear udder height sameness is an important prerequisite for low somatic cell count in milk. Harmony of the quarter structure provides smooth milk ejection [13]. A study done by some researchers indicated the general trend that in older parities the somatic cell count increased. This trend is connected with changes of the udder structure in older parities [14].

Similar as primiparous, the linear type traits of multiparous were not significantly different. This fact allows concluding that the structure of the udder does not affect the somatic cell count. Several stress factors could affect dairy cows, for example, the milk maker, dominance of older parity cows and other factors, Figure 2.

A prerequisite for decreased somatic cell count in milk is identifying stressor. Deceased influence of stressor is very important for dairy cow welfare and milk quality. The somatic cell count a little increased in each early lactation stage. The increase is not significant [13].

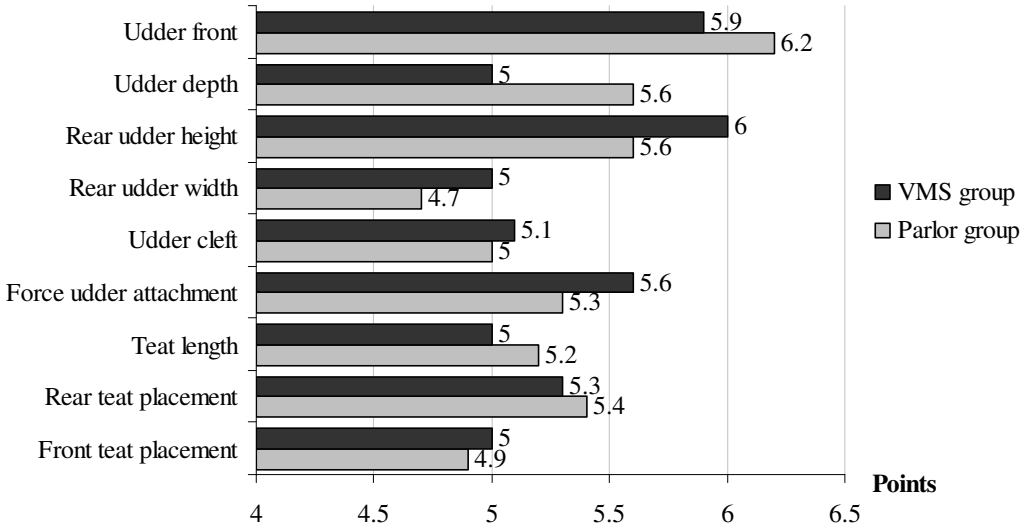

Fig. 1. **Linear traits of udder primiparous**

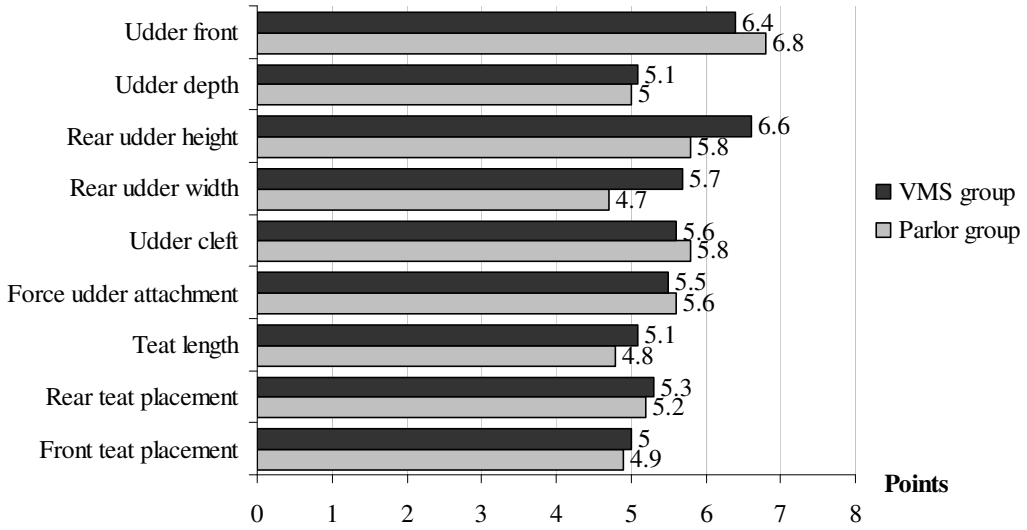

Fig. 2. **Linear traits of udder multiparios**

Conclusions

1. The milk yield of primiparous of the VMS group was significantly greater in the 2nd (28.5±0.6 kg per day; $p < 0.05$)
2. The somatic cell count of primiparous of the parlor group was significantly greater in the 1st recording (319±90.69 thousand per ml; $p < 0.05$). There is a tendency that the somatic cell count decreased in each next recording.
3. The milk yield of multiparous was not significantly different; however, the milk yield was greater in the VMS group.
4. The somatic cell count of multiparous of the parlor group was significantly greater in the 3rd recording (146±43.92 thousand per ml; $p < 0.05$).
5. The linear type of the udder traits was not significantly different; neither primiparous, nor multiparous comparing the VMS group with the parlor group.

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