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SOMATIC CELL COUNT AND QUARTER MILK FLOW PARAMETERS FROM UDDER OF DAIRY COWS

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ABSTRACT

The quarter milk flows were recorded from 62 Holstein cows during two consecutive months using special quarter milk flow recorder developed at our institute. Using the four-chamber claw all quarters were milked separately. The recorder consists of four milk receiver jars, the advancing weight (tensometers) of which was recorded each third second. The quarter milk weight registrations during milking were converted to a milk flow rate profile. Before milking, the samples of milk from each quarter were taken for somatic cell count measurement (SCC). The quarters with high SCC had lower milk yield, duration of milk flow and plateau, but higher duration of overmilking than quarter with low SCC. The highest SCC was found in the quarters with long duration of decline phase. There was a tendency of higher SCC in the quarters with longer overmilking only. The shorter milk flow, higher milk yields on one side and longer decline and overmilking phases for the quarters with high peak flow rate on the other were recorded. For good udder health we have to reduce overmilking, however, the reduction of decline phase could be important too.

Key words: Dairy cow, milking, quarter of udder, somatic cells, milkability.

INTRODUCTION

The technical possibilities of industry allow development of new milking machines with partial or full automation of the milking process and flow-controlled systems that are able to change functional parameters according to the current milk flow. Milk production and milk flow characteristics are very important economic factors in dairy practice. They are used for animal selection (Miller et al., 1976, Bruckmaier et al., 1995), animal breeding, or monitoring of udder health (Duda, 1995, Naumann et al., 1998). In addition to economical aspects of milk production and monitoring of milking efficiencies for farmers, recording of milk flow is used for evaluation and development of milking machines and in setting parameters for their use (Thomas et al. 1991, Rasmussen, 1993). Measures of milk flow are also important in studying physiological responses of dairy animals to milking (Marnet and McKusick, 2001) or indicating the efficiency of milk ejection (Tančin and Bruckmaier, 2001).

Recently we have reported that quarter milk flow parameters could be useful information for improving the udder health (Tančin et al, 2002, 2003). More efficient control systems require single quarter based milk flow data due to considerable differences in milk yield and milk flow among quarters (Rothschild et al., 1980; Mihina et al., 1991; Tančin et al., 2006; Karas and Gálik, 2005).

The objectives of our study were to describe the effect of somatic cell count and other selected milk flow parameters on milk yield and milk removal process.

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MATERIAL AND METHODS

A total of 62 Holstein cows, in their first to third lactation, different stages of lactation and free of clinical symptoms of mastitis, were investigated. The cows were milked twice a day at 5:30 a.m. and 4:30 p.m. in the 2 x 5 herringbone-milking parlour.

The special quarter milk flow recorder was developed in our institute. The equipment was placed in parlour to the first milking stall. Using the four-chamber claw all quarters were milked separately. The recorder consists of four milk receiver jars, the advancing weight (tensometers), which was recorded at each third second. The quarter milk weight registrations during milking were converted to a milk flow rate profile. Before milking the samples of milk from each quarter were taken for somatic cell count measurement (SCC).

Premilking udder preparation consisted of forestripping, cleaning and drying with a dry paper towel for a period of about 40 s per udder and milk sampling. Milking and pulsation vacuum was set at 42 kPa. Pulsation ratio was 60:40 at a rate of 52 c.min^{-1}. When milk flow ceased, the gentle stripping (pushing cluster by hand down) started until milk flow ceased again. Quarter milk flows were recorded during two consecutive months at evening milking. A total of 493 quarter milk flow profiles were available for evaluation.

Total milk yield (g) is given per one quarter. Peak flow rate (g.min^{-1}) represents the maximum milk flow rate at any time interval of 15 s. The increase phase (s) represents the time from attachment until the plateau (stabile milk flow pattern) is reached. Decline phase (s) represents reducing of milk flow and lasts from the end of plateau until the flow is lower than 0.1 kg.min^{-1} per quarter. Overmilking phase (s) lasts from the end of decline phase until the milk flow from last milked quarter did not decline under 0.1 kg.min^{-1}. The milk flow (s) represents the sum of the duration of first three phases.

A general linear model with fixed effects was used to identify the main sources of variation for studied traits in preliminary statistical analyses (SAS, 2001). Three levels for milkability were defined in the model, two levels of somatic cell count (less and over 5.10^5 cells. ml^{-1}), three levels of the duration of decline (over 60 s, between 20-60 s, less than 20 s) and overmilking phases (over 75 s, between 4 and 75 s, less than 4 s), three levels of peak flow rate of quarter milk flow (over 1.1 kg.min^{-1}, between 0.8 and 1.1 kg.min^{-1}, less than 0.8 kg.min^{-1}) and quarter position. Statistical significance of the effects included in the model was tested using Fisher's F-test. Differences between the levels of the effects were tested by Scheffe's multiple range test for studied traits. Data are presented as ls means ± standard error.

Table 1: Least square means and standard error for quarter milk flow and yield parameters according to the factors

	Categories of estimated factors							
	SCC		duration of overmilking, s			duration of decrease, s		
	< 5.10^5	>5.10^5	>75	4-74	<4	>60	20-60	<20
Number of quarters	457	36	132	203	158	176	167	150
Milk flow, s	250a	225b	187a	242b	284c	243	234	237
Milk yield, kg	2.74a	2.49b	2.2a	2.67b	2.98c	2.48a	2.59a	2.77b
Time to peak flow, s	109	103	85a	105b	127c	82a	110b	125c
Peak flow, kg.min^{-1}	1.02	1.01	1.09a	1.04a	0.89b	1.11a	1.01b	0.92c
SCC, log x	-	-	4.62	4.53	4.52	4.71a	4.57a	4.41b
Duration of phases, s								
increase	31	32	31	32	31	32	31	32
plateau	170a	141b	109a	161b	196c	118a	164b	184c
decline	44	54	39a	48b	62c	-	-	-
overmilking	60a	83b	-	-	-	55a	71b	87c

[9]SCC – somatic cell count
a,b,c, - within one factor, values without a common superscript were significantly different at P<0.05

Table 2: Least square means and standard error for quarter milk flow and yield parameters according to the factors

	Categories of estimated factors						
	peak flow rate, kg/min			quarter position			
	>1.1	0.8-1.1	<0.8	[17]LF	RF	LR	RR
Number of quarters	188	145	160	123	126	123	121
Milk flow, s	217a	241b	255c	226a	221a	253b	250b
Milk yield, kg	2.88a	2.67b	2.29c	2.33a	2.31a	2.88b	2.96b
Time to peak flow, s	91a	108b	118b	103ac	95a	123b	102c
Peak flow, $kg.min^{-1}$	-	-	-	0.96a	0.92a	1.08b	1.09b
SCC, log x	4.53	4.52	4.56	4.48ac	4.62b	4.61ab	4.44c
Duration of phases, s							
increase	29a	32b	33b	36a	28bc	32b	31c
plateau	133a	157b	176c	139a	141a	173b	169b
decline	59a	52b	37c	46a	50ab	46a	55b
overmilking	88a	75a	51b	94a	103a	43b	45b

LF - left front, RF - right front, LR - left rear, RR - right rear,
a,b,c, - within one factor, values without a common superscript were significantly different at $P<0.05$

RESULTS AND DISCUSSION

The quarters with high SCC (over 5.10^5 $cells.ml^{-1}$) had lower milk yield, milk flow and plateau, but higher duration of overmilking than quarter with low SCC. Our previous reports confirmed these results (Tančin et al., 2003). In this study we have found tendency of higher duration of decline phase in quarters with high SCC though in another study conducted by Tančin et al. (2003), the effect was significant. SCC (Table 1) did not influence other parameters such as peak flow rate.

The quarters with different duration of overmilking showed no significant effect on SCC. Though there was a tendency of higher SCC in the quarters with longer overmilking. Quarters with long overmilking showed to have the lower milk yield by 0.78 kg and shorter time of milk flow by 100s as compared to quarters with short overmilking. The clearest effect of studied factors on SCC was seen by duration of decline phase. The highest SCC was found in the quarters with long duration of decline phase (Table 1) though these quarters had shorter phase of overmilking as compared to quarters with short decline phase that had longer overmilking. Milk yield was also reduced when decline phase was longer though this effect wasn't reported in our earlier study (Tančin et al, 2002).

Peak flow rate plays an important role in relation to the sensitivity of the udder to mastitis (Grindal & Hillerton, 1991). We found no direct relationship between peak flow rate and SCC (Table 1, 2). Though when analyzed the effect of decline and overmilking duration, there were always observed situations that the highest peak flow rate was in combination with the highest SCC. From the most important differences in milkability (Table 2), we can mention that shorter the duration of milk flow, higher is the milk yield on one side and longer the duration of decline, higher is the peak flow rate in the overmilking phases for the quarters.

In conclusion, evaluated factors influenced the parameters of quarter milk flow and milk yield. Therefore for good quarter health we have to reduce its overmilking, however, the reduction of decline phase could be important too. More research is needed to clearly demonstrate the relationship between SCC and milk flow pattern at quarter levels.

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