Comparison of teat tissue changes after milking with conventional or automated milking units

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Summary

For this trial, 32 German Holstein Frisian cows were milked conventionally (CON, 2 x 4 tandem parlour with low pipe lines; DeLaval; vacuum: 43 kPa) and 33 cows robotically (VMS, voluntary milking system; DeLaval; vacuum: 43 kPa; mean milking frequency (MF): 2.7 per day). With 21-day intervals, the CON group was sampled 5 times (twice a day) and the VMS group 13 times (during 24 hours at every milking). Parameters included the cytobacteriological status of quarter foremilk (QFM), the changes in thickness (cutimeter technique) prior to and after milking in teat end and teat barrel, and the corresponding changes in teat length. The overall cell count (SCC) mean in QFM in both groups was < 4.5 lg cells/ml (< 32.000 cells/ml), but differed significantly ($p < 0.0001$). The mean teat end thickness before milking was 11.2 mm, the mean teat length 5.1 cm, displaying the physiological level of teat dimensions. All thickness changes were significantly ($p < 0.05$) lower in the VMS group than in CON. While for VMS, the most significant factor influencing the changes in teat was the variation in milking intervals, in the CON group the quarter position represented the only significant influence on machine-induced teat tissue changes.

Key words: *Milking systems, VMS, CON, teat tissue changes*

Introduction

As the majority of pathogens gain access to the gland via the teat canal and local defence may be impaired due to technopathies, the interaction between machine milking and teat tissue is one of the key factors to identify machine-induced influences on the new infection risk of the bovine udder. This study was performed with the main goal of comparing the influences of the two different milking procedures – conventional (CON) and automatic (VMS) - on machine-induced changes in teat characteristics such as teat end thickness, teat barrel thickness and teat length.

Material and methods

The trial cows (German Holstein Frisian) at different lactation stages and numbers were randomly distributed to the milking systems CON (32 cows) and VMS (33 cows). The milking systems were operating with 43 kPa vacuum, 60 cycles/min and a pulsation ratio of 65 %. Sampling pattern included 5 (sampling twice a day) and 13 (sampling every milking during 24 h) sessions in CON and VMS, resp., observing 21-day intervals in both groups. In every session, quarter foremilk (QFM) samples were taken for posterior cytobacteriological analysis (incl. somatic cell count, SCC) and determination of NAGase (NAG) activity. The machine-induced thickness changes at teat end (TEC) and teat barrel (TBC) were determined by applying a cutimeter just before and immediately after milking (Hamann, 1985). Changes in teat length (TLC) were assessed by using a rigid, open-ended transparent tube (internal Ø = 30 mm) marked with a graduated scale from the upper end (Hamann et al., 1993).

Results

Teat conformation

Table 1 compares the teat conformation before milking for the CON and the VMS group. It should be stressed that the identical cows could not be included in all sampling days.

Table 1. Level of absolute values for teat characteristics before milking in both cow groups (CON, VMS).

Parameter	CON	VMS	Significance
Measurements (n =)	1270	4520	(T-test)
Teat end thickness [mm]	11.15 ± 1.31	11.18 ± 1.30	$p < 0.3889$
Teat barrel thickness [mm]	12.64 ± 1.67	12.14 ± 1.95	$p < 0.0001$
Teat length [cm]	4.98 ± 0.75	5.24 ± 0.82	$p < 0.0001$

Significant ($p < 0.05$) differences between CON and VMS groups regarding TBC and TLC occurred, while corresponding TEC value differences were not significant.

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Table 2 details the means of SCC and NAG in QFM. Statistically significant differences ($p < 0.05$) were encountered, but they ranged within the physiological levels.

Table 2. Comparison of SCC and NAG in QFM between CON and VMS cows.

Parameter	CON	VMS	Significance
SCC [lg]	4.43 ± 0.78	4.33 ± 0.81	$p < 0.0001$
NAG [lg]	0.26 ± 0.28	0.21 ± 0.34	$p < 0.0001$

As shown in Table 3, the distribution of percentage changes in teat tissue parameters expressed as values indicating an increase (+) or decrease (-) is not homogenous for changes in teat barrel and length (chi-square test) between CON and VMS.

Table 3. Distribution of percentage changes (PC) in different teat parameters as increase (+), decrease (-) and zero changes (0) after application of CON or VMS.

Parameter	Distribution of changes in percentages (chi-square test)					
Changes	PC (+)		PC (-)		PC (0)	
System	CON	VMS	CON	VMS	CON	VMS
Teat end	41.6	38.8	52.0	55.3	6.4	5.9
Teat barrel	65.2	52.4	31.3	43.4	3.5	4.2
Teat length	69.4	53.0	21.6	36.9	9.0	10.1

Therefore, it is difficult to interpret the mean values of machine-induced changes for the two milking systems adequately. In general and for the milking intervals (MI) between 8 and > 14 h, the mean values for all percentage changes (TEC, TBC, TLC) were significantly ($p < 0.001$; Ryan-Einot-Gabriel-Welsch-multiple-range test) lower in the VMS group than in the CON group.

Table 4. Comparison of percentage changes (+, -) in teat parameters related to different milking intervals (MI) and milking systems (CON, VMS).

Parameter	Teat end		Teat barrel		Teat length	
System	CON	VMS	CON	VMS	CON	VMS
MI 8-10h	-0.47	-1.19	5.47	0.74	5.50	1.53
MI 10-12h	-0.57	-0.97	5.85	-0.02	6.44	1.87
MI12 -14h	-0.43	-2.12	4.70	-1.57	5.90	3.54
Mi > 14h	-0.35	-3.14	3.42	-3.00	5.75	3.03

All differences between CON and VMS significant different, except teat end changes MI 8-10h and 10 -12h (Ryan-Einot-Gabriel-Welch-multiple-range test ($p < 0.05$).

The application of a two-factorial analysis of variance (separately for CON and VMS) pointed out the quarter position as the main factor of influence for CON, but the MI for the VMS.

Table 5. Results ($p < 0.05$) of two factorial analyses of variance (CON or VMS) of percentage changes (+, - or absolute) in teat parameters (TEC, TBC, TLC) related to MI and quarter positions.

Parameter	Milking interval		Quarter position		Interactions	
	CON	VMS	CON	VMS	CON	VMS
TEC (+/-)	n.s.	**0.041**	**<0.001**	n.s.	n.s.	n.s.
TEC (abs.)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
TBC (+/-)	**0.003**	**<0.001**	**<0.001**	n.s.	n.s.	n.s.
TBC (abs.)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
TLC (+/-)	n.s.	**0.013**	n.s.	n.s.	n.s.	n.s.
TLC (abs.)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Discussion

Despite varying durations of the trial (85 days in CON, 253 days in VMS), the general physiological condition during lactation was nearly identical in both groups (not shown here). Teat conformation, mean SCC and NAG in both groups were in a physiological range. Tables 3 and 4 show that the application of VMS always resulted in lower teat parameters values. In so far, these values indicate that the application of automated milking systems *per se* does not lead to greater changes in teat morphology (i.e. a higher risk for new infections) than a conventional system does. Teat thickness changes up to ± 5 % have been postulated as threshold for an increased mastitis risk (Zecconi et al., 1992). During the present study, this level was not reached in VMS at all and rarely in CON.

References

Hamann, J., 1985: Measurement of machine milking induced teat tissue reactions. Milchwissenschaft 40, 16-18.

Hamann, J., Mein, G.A. & Wetzel, S., 1993: Teat tissue reactions to milking: effects of vacuum level. Journal of Dairy Science 76, 1040–1046.

Zecconi, A., Hamann,J., Bronzo,V. & Ruffo, G., 1992: Machine-induced teat tissue reactions and infection risk in a dairy herd free from contagious mastitis pathogens. Journal of Dairy Research 59, 265-271.