
Comparison between conventional and automated milking systems – udder health, milk secretion and milk yield

J. Hamann¹, H. Halm¹, F. Reinecke², R. Redetzky¹ & N.Th. Grabowski¹

¹ Institute of Food Quality and Safety, University of Veterinary Medicine Hanover, Foundation, Hanover, Bischofsholer Damm 15, D-30173 Hannover, Germany, E-mail: jha9112c@ki.tng.de

² DeLaval GmbH, Wilhelm-Bergner-Str. 1, D-21503 Glinde, Germany

Approximately 80 German Holstein Frisian cows were milked robotically (VMS[®], DeLaval) and 40 cows conventionally (CON) throughout 400 days. During 20 session days at 20-days intervals, samples (quarter foremilk [QFM], quarter composite milk [QCM] and cow composite milk [CCM]) were drawn during the two milkings (CON) or during the session day (24 hours; VMS). QFM were examined cytobacteriologically. Somatic cell count (SCC) was also determined in QCM and CCM. Milk NAGase activity, lactate, fat, protein and lactose were analysed in QCM. Mean daily yield per cow was 26 kg for both groups despite different milking intervals (VMS: 2.7 and CON: 2 milkings/d). Data analysis (SAS, PROC GLM) evaluated SCC, milk secretion and milk composition in relation to milking intervals (MI).

The overall SCC in QCM in both groups (VMS and CON) with < 4.8 lg cells/ml shows clearly that an automated milking system is not causing an increase in SCC *per se*. Milk secretion rate showed significant ($p < 0.05$) differences between all five MI as higher secretion rates occurred for shorter MI (i.e. MI = 6 h: 356 g/h; MI > 12 h: 232 g/h), amounting this difference to 35 %. Moreover, a non-linear secretion pattern was observed at all MI.

Keywords: Milking systems VMS, CON, udder health, milk secretion, milk yield

Besides genetics, feeding and management, the udder health status is also strongly determined by the milking system and, possibly, the corresponding milking interval (MI). It is assumed furthermore that factors like the variation of MI as well as the frequency and the degree of

Summary

Introduction

incomplete milkings may cause marked reductions in milk secretion and therefore reduced milk yields. Also, very little information is available on milk constituents in relation to different MI. Therefore, this study was performed to detail the influences of CON and VMS milking systems on udder health, milk secretion and milk yield as the most important economic factors determining the efficacy of dairying.

Material and methods

The 120 German Holstein Frisian cows at different lactation stages and numbers were randomly distributed to the milking systems. Study 1 (S1) was conducted mainly to compare udder health and milking performance of CON and VMS, while study 2 (S2), performed 1 year later than S1, included 40 cows using the same VMS system and focused on a detailed analysis of the milk components. The milking systems were operating with 43 kPa and 42 kPa vacuum (CON and VMS, resp.), 60 cycles/min and a pulsation ratio of 65 %. The milk yield was assessed on cow (CON) or quarter (VMS) level. The different milk constituents were measured by corresponding systems, i.e. Fossomatic (somatic cell count, SCC), Fluorometer (NAGase activity), AutoAnalyser (lactate) and Milkoscan (fat, protein, lactose).

Results

Table 1 compares the SCC and NAG values in QFM between the CON and VMS groups (S1) regarding four udder health categories (20 session days; ~30 cows/group).

Udder health

Table 1. Comparison of SCC and NAG in QFM between CON and VMS.

Health status	Normal secretion		Latent infection		Unspecific mastitis		Mastitis	
	CON	VMS	CON	VMS	CON	VMS	CON	VMS
System	CON	VMS	CON	VMS	CON	VMS	CON	VMS
n =	2124	1780	369	415	512	391	382	267
SCC [lg]	4.21	4.28	4.46	4.50	5.48	5.39	5.43	5.48
NAG-U [lg]	0.18	0.15	0.23	0.20	0.71	0.62	0.53	0.56

The mean SCC and NAGase values showed no significant ($p < 0.05$) differences between CON and VMS, ranging the overall SCC mean for the two groups below 40,000 cells/ml.

Table 2 details the SCC in different milk fractions for S2 (VMS) in order to evaluate the repeatability of results in different milk fractions (QFM, QCM and CCM) considering the udder health category.

Table 2. Comparison of SCC in different milk fractions (VMS; 33 cows, 400 days).

Health status	Normal secretion	Latent infection	Unspecific mastitis	Mastitis
Quarters: n=	3212	1592	703	687
QFM: SCC [lg]	4.24 ^c	4.41 ^b	5.31 ^a	5.34 ^a
QCM:SCC [lg]	4.49 ^c	4.63 ^b	5.46 ^a	5.49 ^a
CCM: n=	312	499	309	562
CCM:SCC [lg]	4.39 ^d	4.46 ^c	5.17 ^b	5.23 ^a

*) different letters within lines indicate significant differences ($p < 0.05$)

In both studies, the mean milking frequency was significantly ($p < 0.05$) higher (2.7 milkings/day) in the VMS group (CON: 2 milkings/d). The secretory activity means (i.e. g/h and cow) in relation to lactation stage (days in milk; DIM) and milking system (CON, VMS) are summarized in Table 3.

Milk secretion

Table 3. Comparison of secretory activity [g/h and cow] in relation to lactation stage (days in milk; DIM) for study 1 (S1) and study 2 (S2).

Study	MF/24 h	1 - 100 d	101 - 200 d	201 - 300 d	> 300 d	Total
S1: CON	2.00	1332 ^a	1190	910	708	1098 ^a
S1: VMS	2.74	1444 ^b	1222	938	706	1142 ^b
S2: VMS	2.86	1485 ^c	1237	926	736	1136 ^c

*) different letters indicate significant differences ($p < 0.05$) within columns

Significant differences ($p < 0.05$) between studies and milking systems were observed merely for the early lactation (DIM 1-100) and the complete lactation. The secretory activity was reduced by approx. 50 % from DIM 1 - 100 to DIM > 300 in all milking systems.

The influence of different MI on milk secretion and milk components (QCM) under VMS conditions is summarized in Table 4.

Table 4. Comparison of secretory activity [g/h and quarter] and milk components related to different milking intervals (QCM; VMS).

Interval	< 6 h	6 – 8 h	8 -10 h	10 – 12 h	> 12 h
Milkings: n =	490	1880	1859	1081	884
g/h/quarter	356 ^{a*}	310 ^b	286 ^c	260 ^d	232 ^e
SCC [lg]	4.77 ^a	4.72 ^b	4.73 ^b	4.78 ^a	4.79 ^a
NAGase [lg]	0.19 ^e	0.22 ^d	0.26 ^c	0.33 ^b	0.37 ^a
Lactate [lg]	1.43 ^a	1.43 ^a	1.43 ^a	1.42 ^a	1.48 ^a
Lactose [%]	4.83 ^a	4.81 ^b	4.79 ^b	4.74 ^c	4.73 ^c

*) different letters within lines indicate significant differences (p < 0.05)

Significant (p < 0.05) differences occurred between the quarter secretion rates at all MI. Regarding milk constituents, a basically non-linear pattern of secretion in relation to the different MI was observed for all parameters but lactate.

Milk yield

Milk secretion rates were significantly (p < 0.05) different between healthy and diseased udder quarters (347 vs. 266 g/h). Despite this, the milk yield of the two systems were rated, under practical aspects, as comparable.

Discussion

Based on these two studies, each lasting 400 days, the tendential udder health, milk secretion and milk yield was compared between CON and VMS milking systems (Reinecke, 2003; Halm, 2003), and while udder health was the same, secretion rate increased significantly in the VMS group for the first 100 DIM. Yet, the lactational yield was practically identical in both systems. Since higher yields were one reason for the implementation of VMS, this data should incite to further improve this innovative system. Against common assumption, the secretion pattern was not time-linear, neither for yield nor for milk composition. More study is needed to investigate this phenomenon.

References

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