The Effect of Prestimulation on Milking Characteristics in Simmental, Holstein-Friesian and Brown Swiss Cow Breed

Dragica SALAMON [1]
Igor MATOKOVIC [1]
Vinko BATINIC [2]
Alen DZIDIC [1] (✉)

Summary

The objective of this study was to determine the differences in milking characteristics between Simmental, Holstein-Friesian and Brown Swiss cow breed, when 0, 30 or 60 s of prestimulation was applied. The experiment was conducted on the commercial farm Kovažik, where 12 cows (four cows per breed) were randomly assigned to three prestimulation treatments. Each treatment was performed during two days and followed by a one day of rest. Milking characteristics (main milking phase duration, milking time, milk yield, peak flow rate and average flow rate) were measured. Additionally, bimodality of milk flow curves was evaluated. The results of this experiment show that the highest number of bimodal curves was observed in the treatment without prestimulation. Prestimulation duration did not influence observed milking characteristics. However, treatment without prestimulation had numerically the largest number of bimodal curves, longest duration of main milking phase and total milking time with the lowest peak and average flow rate. Milk yield was the highest in Holstein-Friesian breed. The highest peak and average flow rate with the shortest main milking phase duration and total milking time was observed in Brown-Swiss breed. Breed specific premilking teat preparation routine should be performed to remove highest milk yield in shortest time.

Key words

cow, prestimulation, milking, milkability

[1] University of Zagreb, Faculty of Agriculture, Department of Animal Science, Svetošimunska 25, 10000 Zagreb, Croatia
✉ e-mail: adzidic@agr.hr
[2] University of Mostar, Faculty of Agriculture and Food Technology, Biskupa Čule 10, 88000 Mostar, Bosnia and Herzegovina

Received: June 15, 2011 | Accepted: July 20, 2011

ACKNOWLEDGEMENTS
The authors are expressing their gratitude to commercial dairy farm Kovažik in Laminac, Bjelovarsko - Bilogorska County, Croatia. This study was supported by the Ministry of Science, Education and Sports of the Republic of Croatia (Grant nr. 178-1780460-0407).

Introduction

Optimal machine milking ensures the removal of the secreted milk, quickly and completely, with good hygiene maintaining high milk yield and animal health at low cost (Bruckmaier and Blum, 1998). Proper milking routine should provide unstressful environment for the cow and ensure that the premilking teat preparation is performed in the same sequence of events to result in complete milk ejection before the milking starts and to minimize the amount of milk that should be removed by stripping. The milking routine directly affects milk ejection and therefore the amount of the alveolar milk that can be collected during the milking process. Without the milk ejection, only cisternal milk fraction can be collected. Manual teat stimulation or action of the liner during the milking evokes oxytocine (OT) release which causes alveolar milk ejection. OT release above the threshold level of 3-5 ng/l is sufficient to evoke milk ejection. Once the OT concentration is above the threshold, no additional effect of high OT concentration was documented (Schams et al., 1984). Therefore, the right timing of the OT release is more important than the absolute concentration (Mayer et al., 1984). However, continuous milk ejection during the milking occurs only by continuous contraction of the myoepithelium induced by continuously elevated OT concentration during the whole milking procedure (Bruckmaier et al., 1994; Weiss et al., 2003). Milking on empty teats can occur at the start of milking in case of too short pre-stimulation. Moreover, milking on empty teats reduces milkability during further milking, even after occurrence of delayed alveolar milk ejection (Bruckmaier and Blum, 1996). Optimally, the milking machine should be attached shortly after prestimulation if milk ejection is evoked. Influence of duration of premilking teat preparation on milk yield was found in Jersey, Holstein-Friesian and their crosses (Phillips, 1986). On contrary, Göft (1991) found no differences in high-yielding Holstein and German Braunvieh cows. In Croatia there is only scarce information available about prestimulation requirement of the main dairy breeds, which are Simmental, Holstein-Friesian and Brown Swiss.

Aim

The objective of this study was to determine the differences in milking characteristics during milking between Simmental, Holstein-Friesian and Brown Swiss breed, when 0, 30 or 60 s of prestimulation was applied.

Material and methods

Experiment was conducted on the commercial dairy farm Kovažik in Laminac, Croatia. Milking was preformed two times a day (7am and 7pm) in a herringbone milking parlour 2x3 using the Westfalia equipment (42 kPa, pulsation rate: 58-62 cycles/min, pulsation ratio 60:40). Stripping started when milk flow decreased below 200g/min. Three treatments were randomly assigned to twelve cows (four of each breed) using change-over design. Each treatment was performed during two days when it was randomly changed and followed by a one day of rest. The cows were in their second to fourth lactation. Three cows were in their early (<100 days in milk), six were in mid (100-200 days in milk) and three were in late (>200 days in milk) lactation. LactoCorder (WMB, Balglach, Switzerland) was used to measure milking characteristics: main milking phase duration, milk yield, peak flow rate, total milking time and average flow rate.

The following model was used in experiment:

$$y_{ijk} = \mu + \tau_i + P_k + sub(P * \tau)_{ijk} + \varepsilon_{ijk}$$

where:

y_{ijk} is the observation of the animal *j* with the treatment *i* and the breed *k;* μ is the total average; τ_i is the fixed effect of the treatment *i;* P_k is the fixed effect of the breed *k;* $sub(P * \tau)_{ijk}$ is the random effect of the animal *j* of breed *k* and the treatment *i*; and ε_{ijk} is the random error. Pairwise differences between treatment means were tested by using Tukey-Kramer test with multiple comparison adjustment. The analyses were performed by using the MIXED procedure of SAS (SAS Institute, 1999).

Results and discussion

A bimodality showing delayed milk ejection when cisternal milk fraction is present, was detected when milk flow curve had a flow pattern with two increments separated by a clear drop of milk flow below 200 g/min shortly after the start of milking (Bruckmaier and Blum, 1996; Dodenhoff et al., 1999; Dzidic et al., 2004).

Bimodal curves were observed with highest frequency in treatment without pre-milking teat preparation. During milking without prestimulation, milk ejection is induced after attachment of the teat cup and action of the liner. Bimodality negatively influences milking efficiency causing longer milking time (Bruckmaier and Blum, 1996). Additionally, it can negatively affect teat and udder health when milking on empty teats occurs (Bruckmaier et al., 1995). Treatment with 30 s of prestimulation resulted in lower number of bimodal milk flow curves compared to treatment without prestimulation. Longest time spent on prestimulation (60 s) resulted in the lowest number of bimodal milk flow curves (Table 1). Prolonged interval between premilking teat preparation and milking unit attachment resulted in decreased number of bimodal milk flow curves (from 45% for interval shorter than 30 s to 26.7% for interval longer than 60 s; Sandrucci et al., 2005; Sandrucci et al., 2007). The reason for reduced number of bimodal curves with prolonged interval between onset of the premilking teat preparation and teat cup attachment could be that the time from the start of tactile stimulation until the occurrence of milk ejection is between 40 s and 120 s (Bruckmaier and Wellnitz, 2008). Moreover, during the milking with low udder filling (short milking interval or late lactation), the cisternal milk fraction is small or missing and additionally alveolar milk ejection is prolonged (Bruckmaier and Hilger, 2001). Therefore, degree of udder filling should be considered when prestimulation requirement is set. Main milking phase duration, total milk yield, total milking time, peak and average flow rate did not differ between the treatments (Table 2). However, numerically longest main milking phase duration and total milking time together with lowest peak and average milk flow were observed in treatment without prestimulation. Longer duration of prestimulation resulted in higher peak and average flow rates and reduced machine on-time, similar to what others have found (Gorewit and Gassman, 1985; Sagi et al., 1980 a, b; Rothenager et al., 1995). Our results demonstrate lower peak and

Table 1. Frequency of bimodal and non bimodal milk flow curves in different prestimulation treatments during milking

Treatment	Bimodality*	Frequency	Percentage
0	0	17	36.96
	1	29	63.04
30	0	21	45.65
	1	25	54.35
60	0	26	55.32
	1	21	44.68

* 0 – milking without bimodality; 1 – milking with bimodality

Table 2. Least square means of milking characteristics in different treatments and breeds

		Milking characteristics				
		tMHG	MGG	HMF	tMGG	DMHG
Treatment	0	7.371	16.621	3.455	8.771	2.32
	30	7.033	16.525	3.565	8.195	2.428
	60	6.886	16.789	3.536	8.2	2.478
Breed	Brown Swiss	5.208[a]	14.307[a]	4.047[a]	6.222[a]	2.693[a]
	Holstein-Friesian	8.468[b]	20.382[b]	3.642[ab]	9.453[b]	2.625[a]
	Siemental breed	7.614[ab]	15.245[a]	2.867[b]	9.492[b]	1.908[b]
Standard error		0.73	1.11	0.27	0.81	0.19

[a, b] Least square means without common superscript within column are significantly different (P<0.05); tMHG – main milking phase duration (min); MGG – total milk yield (kg); HMF – peak flow rate (kg/min); tMGG – total milking time (min); DMHG – average milk flow (kg/min)

average flow rates in Simmental compared to Brown-Swiss and Holstein-Friesian breed. Therefore, the milkability of Simmental breed is worse than in other two breeds. Peak flow rate does not change throughout lactation, while average flow rate decreases up to 17% together with milk yield which is reduced up to 50% (Mayer et al., 1991). Milk yield is more affected by the breed (Bruckmaier et al., 1995; Wellnitz et al., 1999) difference than the time spent on prestimulation on udder and quarter level (Tančin et al., 2006). Addition of the forestripping during the premilking teat preparation did not affect milking characteristics in high producing cows (Wagner and Ruegg, 2002).

Milking duration was only slightly influenced by the duration of the premilking teat preparation, while more pronounced effect was observed when attachment delay was applied after the prestimulation when milking time decreased (Rasmussen et al., 1992). However, attachment delay after prestimulation did not affect milk yield (Weiss and Bruckmaier, 2005).

Conclusions

There were no differences found in milking characteristics between the treatments. However, numerically the longest main milking phase duration and total milking time with the lowest milk yield, peak and average flow rate was observed in the treatment without prestimulation. Moreover, the treatment without prestimulation resulted in the highest incidence of the bimodal milk flow curves. The highest milk yield was observed in Holstein-Friesian breed. The shortest main milking phase duration and total milking time with the highest peak and average flow rate was observed in Brown-Swiss breed. Therefore, breed specific duration of the prestimulation before the start of milking should be applied to ensure fast and complete milk removal and to maintain proper udder health.

References

Bruckmaier R. M., Blum J. W. (1996). Simultaneous recording of oxytocin release, milk ejection and milk flow during milking of dairy cows with and without prestimulation. J Dairy Res 63: 201–208.

Bruckmaier R. M., Blum J. W. (1998). Oxytocin Release and Milk Removal in Ruminants. J Dairy Sci 81: 939-949.

Bruckmaier R. M., Hilger M. (2001). Milk ejection in dairy cows at different degrees of udder filling. J Dairy Res 68: 369–376.

Bruckmaier R. M., Rothenanger E., Blum J. W. (1995). Milking characteristics in dairy cows of different breeds from different farms and during the course of lactation. J Anim Breed Genet 112: 293–302.

Bruckmaier R. M., Schams D., Blum J. W. (1994). Continuously elevated concentrations of oxytocin during milking are necessary for complete milk removal in dairy cows. J Dairy Res 61: 323–334.

Bruckmaier R. M., Wellnitz O. (2008). Induction of milk ejection and milk removal in different production systems. J Anim Sci 86: 15-20.

Dodenhoff, J., Sprengel D., Duda J., Dempfle L. (1999). Studies of udder health using Lactocorder. Zuchtungskunde 71: 459–472.

Dzidic, A., Macuhova J., Bruckmaier R. M. (2004). Effects ofcleaning duration and water temperature on oxytocin release and milk removal in an automatic milking system. J Dairy Sci 87: 4163–4169.

Göft H. (1991). Untersuchungen zur Präzisierung der Milchabgabeparameter von Kühen unter besonderer Berücksichtigung der Verlaufs von Milchflusskurven. PhD thesis, Technical University Munich, Germany.

Gorewit R. C., Gassman K. B. (1985). Effects of duration of udder stimulation on milking dynamics and oxytocin release. J. Dairy Sci 68: 1813–1818.

Mayer H., Bruckmaier R. M., Schams D. (1991). Lactational changes in oxytocin release, intramammary pressure and milking characteristics in dairy cows. J Dairy Res 58: 159–169.

Mayer H., Schams D., Worstorff H., Prokopp A. (1984). Secretion of oxytocin and milk removal as affected by milking cows without manual stimulation. J Endocrinol 103: 355-361.

Phillips D. S. M. (1986). Studies on pre-milking preparation. 8. A comparison of 10-seconds and 45-seconds of wash and stimulus. N Z J Agric Res 29: 667–672.

Rasmussen M. D., Frimer E. S., Galton D. M., Petersson L. G. (1992). The influence of premilking teat preparation and attachment delay on milk yield and milking performance. J Dairy Sci 75: 2131–2141.

Rothenager E., Bruckmaier R. M., Blum J. W. (1995). Association and dissociation of single quarter and total milk flow in dairy cows: effects of milking with and without pre-stimulation. Milchwissenschaft 50: 63 – 66.

Sagi R., Gorewit R. C. Merrill W. G., Wilson D. B. (1980a). Premilking stimulation effects on milking performance and oxytocin and prolactin release in cows. J. Dairy Sci. 63: 800–806.

Sagi R., Gorewit R. C., Zinn S. A. (1980b). Milk ejection in cows mechanically stimulated during late lactation. J Dairy Sci 63: 1957–1960.

Sandrucci A., Bava L., Tamburini A., Zanini L. (2005). Milking procedures, milk flow curves and somatic cell count in dairy cows. Ital J Anim Sci 4 (Suppl. 2): 215-217.

Sandrucci A., Tamburini A., Bava L., Zucali M. (2007). Factors affecting milk flow traits in dairy cows: Results of a field study. J Dairy Sci 90: 1159–1167.

SAS Institute (1999). Version 8. SAS Inst., Inc., Cary, NC, USA

Schams D., Mayer H., Prokopp A., Worstorff H. (1984) Oxytocine secretion during milking in dairy cows with regard to the variation and importance of a threshold level for milk removal. J Endocrinol 102: 337-343.

Tančin V., Ipema B., Hogewerf P., Mačuhova J. (2006). Sources of variation in milk flow characteristics at udder and quarter levels. J Dairy Sci 89: 978–988.

Wagner A. M., Ruegg P. L. (2002). The effect of manual forestripping on milking performance of Holstein dairy cows. J Dairy Sci 85: 804-809.

Weiss D., Bruckmaier R. M. (2005). Optimization of individual prestimulation in dairy cows. J Dairy Sci 88: 137–147.

Weiss D., Dzidic A., Bruckmaier R. (2003). Effect of stimulation intensity on oxytocin release before, during and after machine milking. J Dairy Res 70: 349-354.

Wellnitz O., Bruckmaier R. M., Blum J. W. (1999). Milk ejection and milk removal of single quarters in high yielding dairy cows. Milchwissenschaft 54: 303-306.

acs76_61