Milking Time During Periods of Heat Stress: Part of the Solution or Part of the Problem?

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Summary

Milking time may be a stressful event for lactating dairy cows during summer. Increases in body temperatures because of crowding in the milk parlor holding pen may contribute to increased heat stress. The objective of this extension project was to evaluate the effectiveness of heat stress abatement in milking facilities from two Kansas commercial dairies. Vaginal temperatures at milking were lower than vaginal temperatures before milking in one of the dairies. The lower vaginal temperatures at milking, however, were not observed in the other dairy at all milkings, likely because of differences in efficacy of heat abatement strategies. Milking facilities may be one of the factors to aggravate or alleviate heat stress in lactating dairy cows during summer.

Key words: dairy cattle, heat stress, milking parlor, cooling

Introduction

Heat stress has a tremendous economic impact in the dairy industry worldwide. A 2003 analysis estimated an annual loss of $897 million for the U.S. dairy industry due to heat stress. Decreased milk production, low reproductive efficiency, and increased mortality are the main causes of economic loss to dairy producers that have herds affected by heat stress.

Strategies to cool lactating dairy cows have been the focus of several research studies. The use of fans and sprinkler systems may effectively reduce body core temperature during summer heat stress. The use of evaporative cooling systems in the milk parlor holding pen is highly recommended because the holding pen is the location where cows are crowded, which greatly increases the risk of heat stress because of increased body temperatures. Cooling cows in the holding pen is considered a top priority when dairy producers strive to alleviate heat stress in lactating dairy cows. Although the holding pen may be perceived as a contributor to heat stress of lactating dairy cows, it also may be considered the area where good evaporative heat loss can be achieved by investing resources for an optimal ambient condition. The purpose of this extension project was to compare the effectiveness of milking facilities to achieve cow cooling in two commercial dairies.

Experimental Procedures

Two commercial dairies located in Southwest Kansas were used in this study. Cows that met the following criteria were eligible to be used in the study: 70 to 100 days in milk, non-pregnant, and average daily milk production of 70 to 140 lb. Six lactating Holstein cows from second- (2^{nd}) and third-lactation (3^{rd}) cohorts were randomly selected from each dairy, and vaginal temperature was collected every 5 minutes for 5 consecutive days (August 15 through August 19, 2014). Blank CIDR inserts and calibrated iButton temperature loggers (DS1922L, Embedded Data Systems, Lawrenceburg, KY) were used to collect vaginal temperature. During the study period, evaporative cooling systems were used in the holding pen. At site A, cows were housed in free-stall barns equipped with fans and sprinklers, with exercise lots adjoining the free-stall barns, and at site B, cows were housed in dry lots with shade in the lounging area. Cows were milked thrice daily at site A and twice daily at site B. The time of each milking was collected from a parlor management software program (DairyPlan C21, GEA Farm Technologies, Naperville, IL). Ambient temperature and relative humidity data were collected from the meteorological station nearest to the dairies. Data were analyzed by ANOVA for repeated measures using the HPMIXED procedure of SAS, or by ANOVA using the GLM procedure of SAS.

Results and Discussion

Three cows lost the temperature loggers and were removed from the study. Days in milk and daily milk yield of cows used in the study are outlined in Table 1. Temperature, humidity, and temperature-humidity index (THI) during the study period are outlined in Figure 1. The average THI during the study period was 86.5 ± 0.54. Cows were under conditions of heat stress during the entire period of the study.

There was no ($P = 0.54$) difference in vaginal temperatures of 2nd-lactation cows from sites A and B (Figure 2A). Third lactation cows from site A had higher ($P < 0.01$) vaginal temperatures compared with 3rd-lactation cows from site B (Figure 2B). Interestingly, at site B, 2nd-lactation cows had higher ($P = 0.05$) temperatures than 3rd-lactation cows (Figure 3B). No difference was detected ($P = 0.51$) in vaginal temperatures between lactations at site A (Figure 3A). Other studies have shown differences in vaginal temperatures between primiparous and multiparous cows; however, to our knowledge, no research study has compared vaginal temperatures of 2nd- and 3rd-lactation cows. Although one could hypothesize that 3rd-lactation cows have higher body temperatures during early lactation compared with 2nd-lactation cows because of higher peak milk yield, heat dissipation of cows from the 2nd- and 3rd-lactation may be different. Body size and surface area may influence heat dissipation, and, consequently, affect body core temperature.

Vaginal temperatures of 2nd- and 3rd-lactation cows from site B were 0.7–0.9°F lower at milking time than temperatures 3 hours before milking (Table 3). At site A, this difference was not detected for all milkings (Table 2); lower temperatures at milking time were observed only during the first milking shift for 2nd-lactation cows. Third-lactation cows had lower vaginal temperatures at milking compared with 3 hours before milking in the first and second milking shift. This difference was not observed for the third milking shift. At site B, vaginal temperatures of cows 3 hours after milking were lower compared with vaginal temperatures 3 hours before milking, except for 2nd-lactation cows in the first milking shift. This result suggests that milking time for cows in site B was beneficial to alleviate heat stress. On the other hand, the same benefit was not observed for cows in site A. At site A, the lower temperature after milking, compared with before milking, was observed only in the first milking shift. In the second milking shift, cows had higher temperatures after milking. In the third shift, there was no change in temperature; cows experienced significant heat stress before, during, and after milking because vaginal temperatures were >103.5°F.

We speculate that facilities (holding pen and parlor) at site B cooled cows more efficiently than the facilities at site A. Various factors may have influenced the effectiveness of each dairy to cool cows at the holding pen and parlor. Cows at site B were housed in larger groups than cows at site A, which influenced the amount of time spent in the holding pen. In addition, parlor efficiency was different between sites; site A had a more rapid parlor turnover. Thus, time spent in the holding pen and parlor may have influenced the efficiency of the facilities to cool cows.

In conclusion, milking time during summer may positively or negatively affect vaginal temperatures of lactating cows. Dairies should evaluate the efficacy of cooling systems and ventilation in the holding pen and parlor to maximize cow cooling during milking time. Moreover, vaginal temperature loggers attached to blank CIDR inserts may be used as an assessment tool to evaluate heat stress at milking time.

Acknowledgments
The authors would like to thank the owners and staffs from both dairies.

Table 1. Milk yield and days in milk of cows used in the study (mean ± SE)

	Site A		Site B		*P*-value		
Item	2nd lactation	3rd lactation	2nd lactation	3rd lactation	Lactation	Site	Lactation × site
Milk yield (lb/day)	103.6 ± 4.14	111.5 ± 4.63	97.0 ± 3.78	113.2 ± 3.78	< 0.01	0.56	0.33
Days in milk	81.0 ± 4.09	85.5 ± 4.58	87.2 ± 3.74	88.3 ± 3.74	0.49	0.28	0.69

Table 2. Vaginal temperatures of cows from 2nd and 3rd lactation at site A (mean ± SE)

		Vaginal temperature (°F)	
Item		2nd lactation	3rd lactation
First milking shift	3 hours before milking	103.3 ± 0.15[a]	103.7 ± 0.20[a]
	Milking	102.5 ± 0.15[b]	103.1 ± 0.19[b]
	3 hours after milking	102.8 ± 0.15[b]	102.3 ± 0.19[c]
Second milking shift	3 hours before milking	102.3 ± 0.15[a]	102.3 ± 0.16[a]
	Milking	102.3 ± 0.15[a]	101.8 ± 0.15[b]
	3 hours after milking	103.3 ± 0.15[b]	102.8 ± 0.15[c]
Third milking shift	3 hours before milking	103.6 ± 0.20	103.6 ± 0.20
	Milking	103.8 ± 0.20	103.7 ± 0.20
	3 hours after milking	103.7 ± 0.20	103.7 ± 0.20

[a,b,c] Values within a column with different superscripts differ ($P < 0.01$).

Table 3. Vaginal temperatures of cows from 2nd and 3rd lactation at site B (mean ± SE)

		Vaginal temperature (°F)	
Item		2nd lactation	3rd lactation
First milking shift	3 hours before milking	101.9 ± 0.18[a]	101.9 ± 0.10[a]
	Milking	101.1 ± 0.18[b]	101.2 ± 0.10[b]
	3 hours after milking	101.8 ± 0.18[a]	101.3 ± 0.11[b]
Second milking shift	3 hours before milking	103.5 ± 0.18[a]	103.5 ± 0.15[a]
	Milking	102.6 ± 0.18[b]	102.7 ± 0.15[b]
	3 hours after milking	102.8 ± 0.18[b]	102.5 ± 0.15[b]

[a,b,c] Values within a column with different superscripts differ ($P < 0.01$).

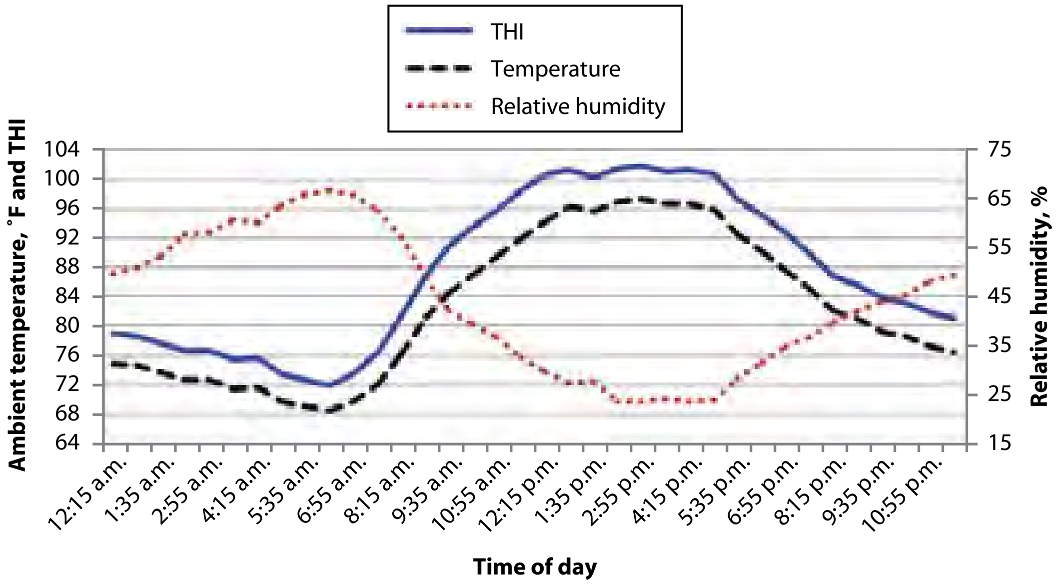

Figure 1. Temperature, relative humidity, and temperature-relative humidity index (THI) during the study period.

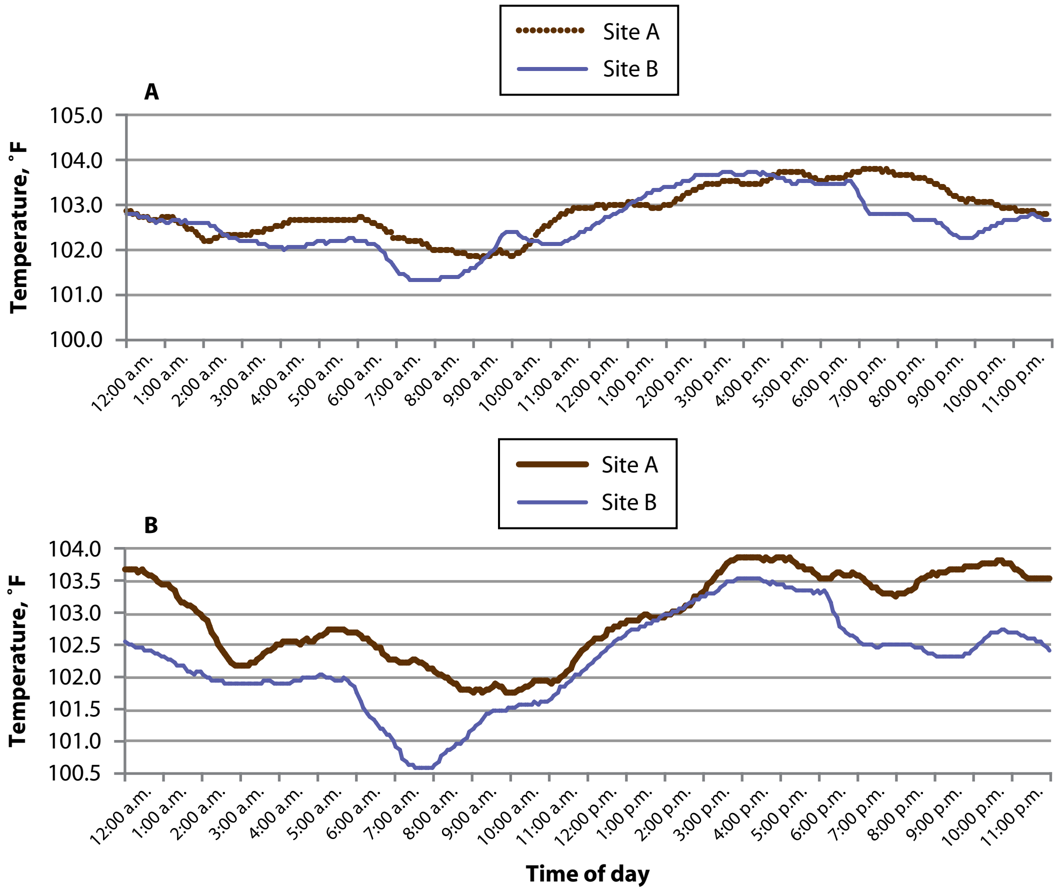

Figure 2. (A) Vaginal temperatures of 2nd-lactation cows from sites A and B. Site was not associated with temperature (P = 0.54), but the interaction between site and time of the day (P < 0.01) was associated with vaginal temperature; SEM = 0.19. Cows were milked at site A at approximately 1:30 a.m., 10:00 a.m., and 6:00 p.m. Cows were milked at site B at approximately 7:45 a.m. and 7:45 p.m. (B) Vaginal temperatures of 3rd-lactation cows from sites A and B. Site and the interaction between site and time of the day were (P < 0.01) associated with vaginal temperature; SEM = 0.10. Cows were milked at site A at approximately 1:30 a.m., 10:00 a.m., and 6:00 p.m. Cows were milked at site B at approximately 6:25 a.m. and 6:25 p.m.

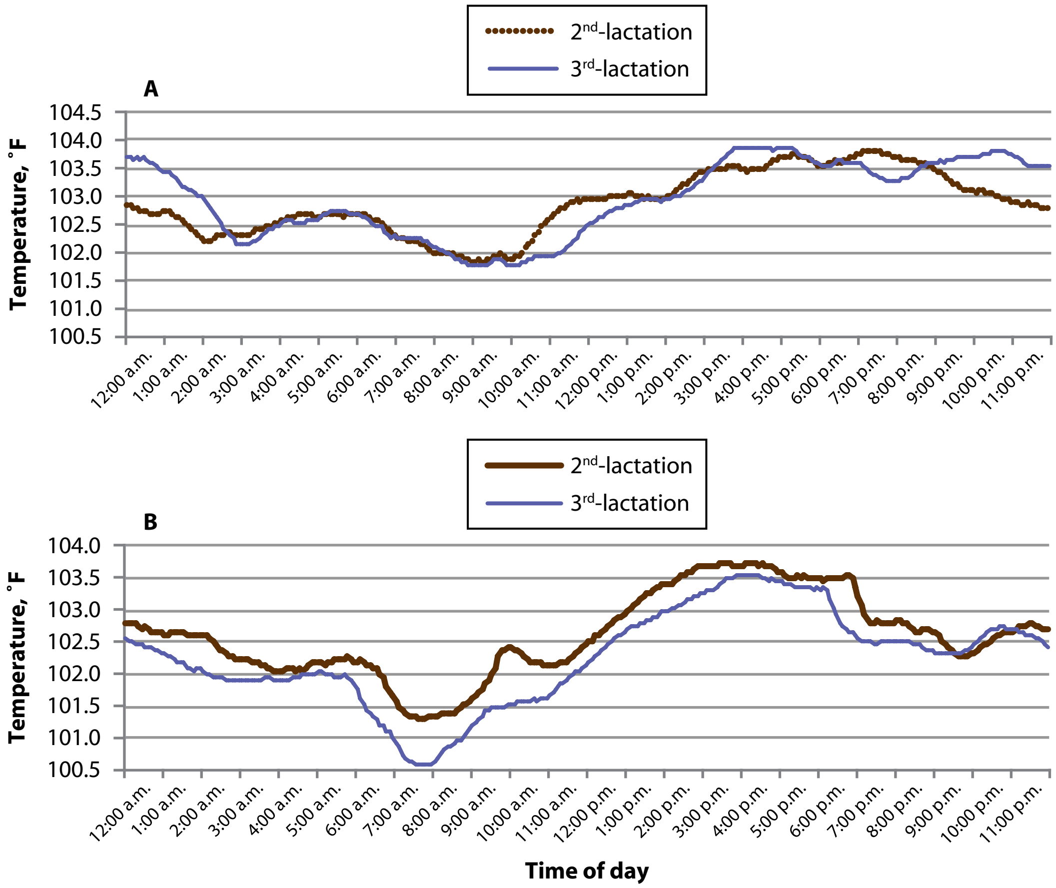

Figure 3. (A) Association between lactation number and vaginal temperature at site A. Lactation number was not ($P = 0.51$) associated with vaginal temperature, but the interaction between lactation number and time of the day was ($P < 0.01$) associated with vaginal temperature; SEM = 0.15. (B) Association between lactation number and vaginal temperature at site B. Lactation number and the interaction between lactation number and time of the day were ($P \leq 0.05$) associated with vaginal temperature; SEM = 0.16.