EFFECT OF SOAKING AND MISTING ON RESPIRATION RATE, BODY SURFACE TEMPERATURE, AND BODY TEMPERATURE OF HEAT STRESSED DAIRY CATTLE

M.J. Brouk, J.P Harner[1], J.F. Smith, A.K. Hammond, W.F. Miller, and A.F. Park

Summary

Reducing heat stress is a key issue for dairy producers. Use of feedline soaking and supplemental airflow effectively reduces heat stress and increases milk production and profitability. High-pressure misting allows water to evaporate in the air, reduces air temperature, and increases relative humidity. Misting also soaks the skin of cattle, resulting in additional cooling as water evaporates from skin surfaces, similar to the cooling effect of feedline soaking. Impact of soaking frequency (5-, 10-, or 15-minute intervals) was compared to continuous high-pressure misting. Cows cooled with either system had lower respiration rates, body surface temperatures, and internal body temperatures than controls. Soaking cattle every 5 minutes or 5-minute soaking plus high-pressure misting produced similar body temperatures, but lower ($P<0.01$) than those when soaking occurred every 10 or 15 minutes. Skin surface temperatures from the thurl, shoulder, and rear udder were less when cattle were cooled with high-pressure misting. Cattle cooled with high-pressure misting became soaked, thus the cooling effect is the combination of cooler air and water evaporation from the skin. These results indicate that either frequent soaking (every 5 minutes) or continuous high-pressure misting that soaks the skin could be equally effective in reducing heat stress in dairy cattle.

(Key Words: Cow Comfort, Cow Cooling, Environment)

Introduction

Heat stress significantly reduces milk production, reproductive efficiency, and profitability of dairy farms. Several Kansas State University studies have shown the benefits of utilizing feedline soaking and supplemental airflow (fans) at the feedline and over free stalls. These benefits include decreased respiration rates, decreased body temperatures, decreased skin surface temperatures, and increased milk production. Correct system designs can increase profitability for Kansas' dairy producers.

Effective cow cooling occurs when body heat is efficiently transferred from the skin to the environment. Cow soaking and supplemental airflow increase heat transfer from the cow to the environment through water evaporation from the skin and hair. Decreasing air temperature with evaporative cooling also can reduce heat stress. However, air is a poorer conductor of heat than water. High-pressure misting systems combine the benefits of

[1]Department of Biological and Agricultural Engineering.

evaporative air cooling and skin soaking. The objective of this study was to evaluate the effects of increased soaking frequency and high pressure misting on respiration rate, body surface temperature, and internal body temperature of heat-stressed dairy cattle.

Procedures

Ten lactating Holstein cows, five primiparous and five older cows, were arranged in a replicated 5×5 Latin square design. Treatments were control (C), a low-pressure soaking cycle every 5 (F + 5), 10 (F + 10), or 15 (F + 15) minutes, plus continuous high-pressure misting (F + HP). The soaking and misting treatments also received supplemental airflow (650-690 feet/minute). Cows were housed in free-stall barns and milked twice daily. During testing, cows were moved to a tie-stall barn for 2 hours starting at 1 p.m. during 5 days of intense heat stress. During the testing periods, respiration rates were determined every 5 minutes by visual observation. Body surface temperature of three sites (shoulder, thurl, and rear udder) were measured with an infrared thermometer and recorded at 5-minute intervals. Body temperature was recorded with a data logger and vaginal probe every 1 minute, and averaged over 5-minute intervals for statistical analyses. Cooling treatments were initiated following three 5-minute intervals.

Results and Discussion

Stall temperature and thermal-humidity index (THI) were lower ($P<0.01$) and relative humidity (RH) greater ($P<0.01$) when high-pressure misting was used (Figures 1, 2, and 3). The rise in THI observed at time period 4 on the F + HP treatment resulted from increased RH before the water from the misting system evaporated and lowered the air temperature. Respiration rates (Figure 4) were lower ($P<0.01$) for the cooled cows than those of controls. Average respiration rates during the final three observation periods differed ($P<0.01$) for all treatments (115.1, 90.0, 81.5, 66.7, and 60.0 breaths/minute for C, F + 15, F + 10, F + HP and F + 5, respectively). Shoulder skin surface temperatures followed similar patterns, except values for F + HP were lower ($P<0.01$) than F + 5. This is a reflection of the combination of skin soaking and reduced air temperature associated with the F + HP treatment. Surface skin temperatures of the rear udder and thurl followed similar patterns (Figures 6 and 7). Body temperature (Figure 8) was lower ($P<0.01$) for cooled cows than for controls. Cows cooled with the F + HP and F + 5 treatments did not differ ($P>0.05$) and were lower ($P<0.01$) than either F + 15 or F + 10, which differed ($P<0.01$) from each other.

High-pressure misting reduced stall temperature and THI while increasing RH, resulting in lower skin surface temperatures than soaking the cows every 5 minutes. Previous Kansas State University studies showed advantages for soaking cows more frequently (every 5 versus every 10 or 15 minutes). Results of this study indicate that continuous high-pressure misting might be more effective in reducing skin surface temperatures if the skin becomes soaked, rather than soaking every 5 minutes. However, continuous high-pressure misting offered no advantage for reducing body temperature. Thus, either frequent soaking (every 5 minutes) or continuous high-pressure misting that soaks the skin could be equally effective in reducing heat stress in dairy cattle.

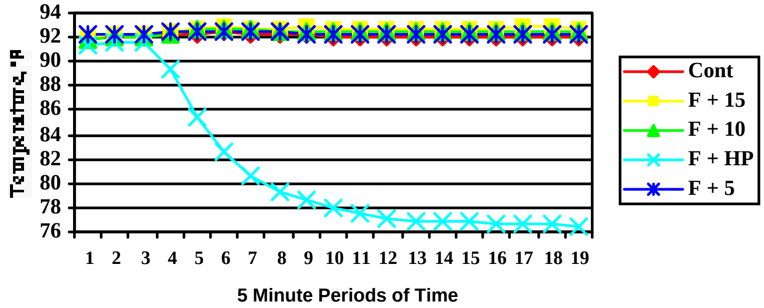

Figure 1. Stall Temperature During Cooling Treatments.

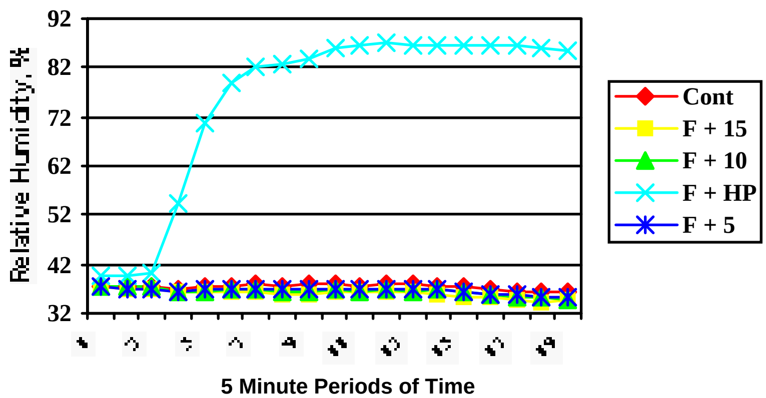

Figure 2. Stall Relative Humidity During Cooling Treatments.

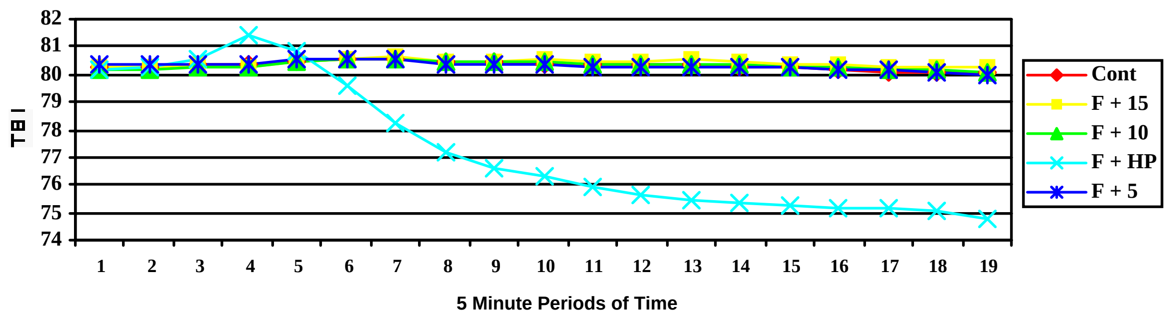

Figure 3. Stall THI During Cooling Treatments.

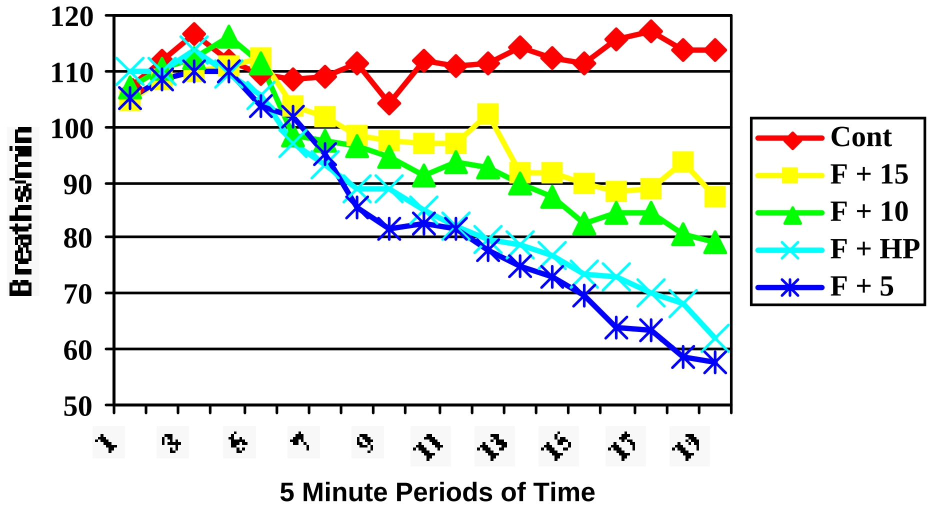

Figure 4. Respiration Rates of Dairy Cows During Cooling Treatments.

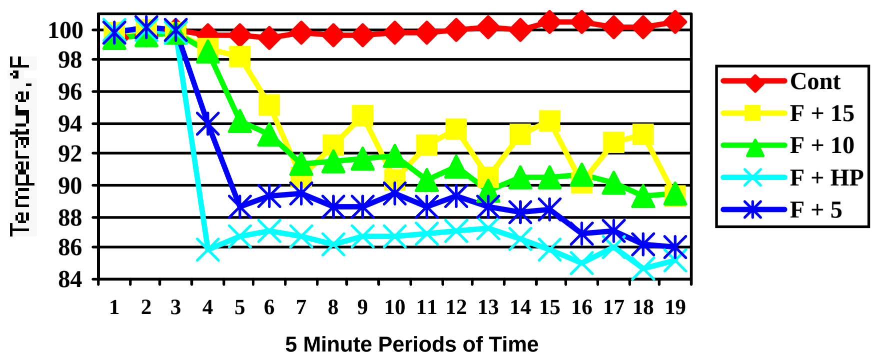

Figure 5. Shoulder Skin Surface Temperatures of Dairy Cows During Cooling Treatments.

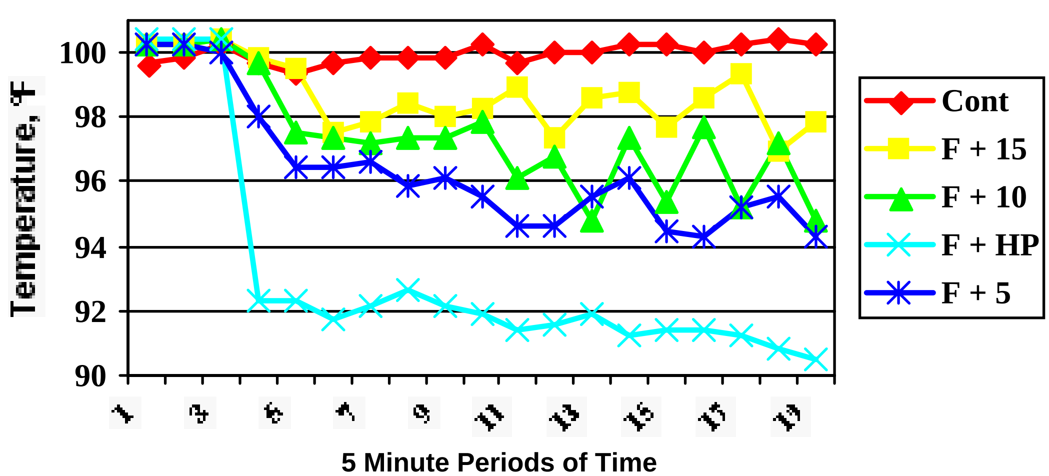

Figure 6. Thurl Skin Surface Temperatures of Dairy Cows During Cooling Treatments.

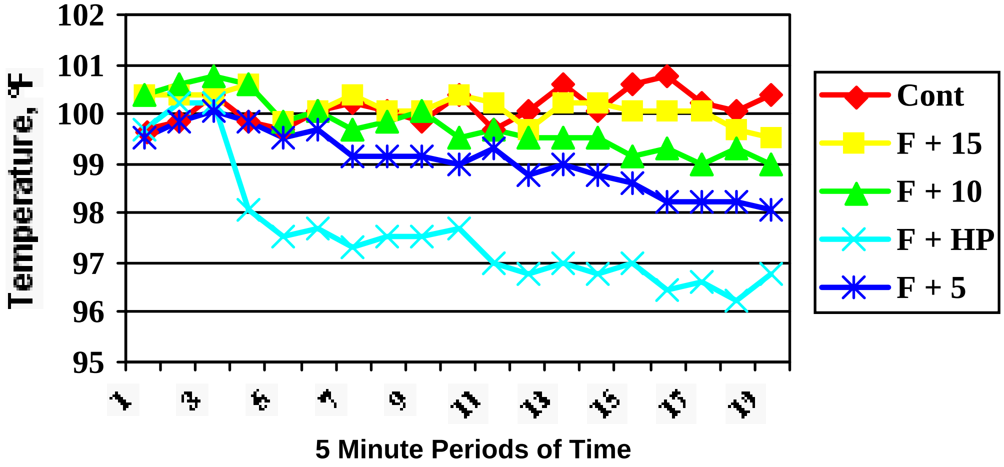

Figure 7. **Rear Udder Skin Surface Temperature of Dairy Cows During Cooling Treatments.**

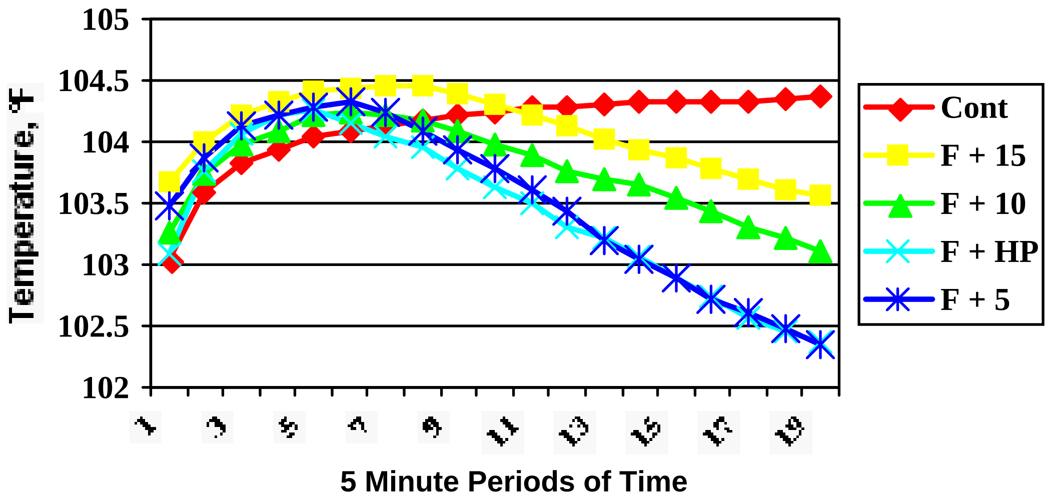

Figure 8. Body Temperature of Dairy Cattle Under Different Cooling Treatments.