Innovative cooling strategies for dairy cows

Alycia Drwencke[1], Matthew Stevens[2], Vinod Narayanan[2], Theresa Pistochini[2], Grazyne Tresoldi[1] and Cassandra Tucker[1]

[1]University of California, Davis, Animal Science, One Shield Ave, Davis, CA 95616, USA, [2]Western Cooling Efficiency Center, 215 Sage St Ste 100, Davis, CA 95616, USA; amdrwencke@ucdavis.edu

Producers in the Western U.S. commonly use spray water at the feed bunk and fans in the lying area to mitigate heat stress in dairy cows. Spray water cycles on and off and fans turn on once a pre-set activation air temperature is reached. While this can be an effective method of mitigating heat stress, innovative methods are needed to improve sustainability by reducing water and energy use. Our objective was to evaluate the effectiveness and resource efficiency of 4 cooling treatments on behavioral and physiological responses in dairy cows housed in a free-stall barn. We also measured water and energy use of the treatments. The 4 treatments we tested were: (1) conductive cooling, where cooled water mats were buried under the lying area (Mat; activated at 19 °C); (2) targeted convective cooling where cool air was directed toward the cows through fabric ducts at both the feed bunk and lying areas (Targeted Air; activated at 22 °C); or (3) a combination of spray water and fans described above (Baseline, activated at 22 °C); and (4) spraying half the amount of water as in Baseline and moving the fan to the feed bunk to improve evaporation (Optimized Baseline; activated at 22 °C). In a crossover design, groups of cows averaging (± SD) 34.9±5.3 kg/d of milk (n=8 groups; 4 cows/group) were tested for 3 d/treatment. For ethical reasons, both the Mat and Targeted Air also had spray water beginning at 30 °C. We recorded body temperature, posture, and location within the pen every 3 min 24 h/d, and respiration rates every 30 min daily from 10:00 to 19:00 h when air temperature averaged, respectively, 26.2±2.3 and 33.5±2.9 °C. Pairwise comparisons within a mixed model were used to compare each treatment to the Baseline. Average time spent lying and milk production were not affected by treatment ($P>0.1$). Respiration rates did not differ across treatments overall (58±2 breaths/min), but on an hourly basis, cows on Mat had a significantly higher rate compared to Baseline, at h 10 and 11 ($P<0.03$). Body temperature averaged 38.7±0.2 °C across treatments and was higher when on Mat compared to Baseline at h 10, 11, 20, 21, 22, with a difference of 0.2-0.3 °C ($P<0.04$). Average lying time was 51±2.4%/d across treatments but was 56%/h for the Mats during the hours body temperature was higher, indicating that they were being used during those periods. Taken together, these results indicate that the Mat treatment did not effectively reduce early indicators of heat load, compared to Baseline. In contrast, both Targeted Air and Optimized Baseline were both effective, but differed in other aspects of sustainability. Targeted Air used the least amount of water, but the most energy of all options tested. In conclusion, more efficient heat abatement options can be identified, particularly an Optimized Baseline strategy, which cut water use in half, used the same amount of energy as the Baseline, and maintained similar responses in cows.