Conductive Cooling Technology Applied to Free-stall Beds for Holstein Cows in Central California

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Introduction

Most dairies with free-stall barns in central or southern California use cooling systems consisting of fans combined with water soakers or misters to deal with the effects of heat stress on lactating dairy cattle during hot summer temperatures. Although these systems have been widely adopted and have been shown to be effective for minimizing losses in milk production related to summer heat stress, these systems require consumption of significant amounts of electricity and water for their operation. Conductive cooling technology was retrofitted into a free-stall barn to evaluate its potential effectiveness for cooling cows compared to a conventional cooling system. An overall purpose of this study was to explore the feasibility of installing heat exchanger mats in beds of an existing free-stall barn. The primary research objective was to measure milk production for a short period of time during the summer in a randomized clinical trial comparing cows using free-stall housing with fans and soakers with cows having access only to free-stall beds with heat exchanger mats providing conductive cooling.

Materials and Methods

Heat exchangers were installed in 52 beds in one section of a free-stall barn, with a total of 208 beds which were used for a group of early-lactation, high-producing cows that were milked twice daily. The cooling fans and water soakers located along the lock-up stanchions were not operated for cows in the conductive cooling section. Well water at approximately 72°F (22°C) was circulated continuously through the heat exchanger mats which were buried approximately 1 foot (30 cm) below the surface of the free-stall beds which contained composted manure bedding material. Milk production performance, feed delivery and weigh-back data, body temperature, and activity measurements were collected during the month of September 2010 for this pilot project. Weather data were also collected during this same time period. Statistical significance was determined at a P-value of ≤ 0.05.

Results

The ambient temperatures during most of the study period peaked at or near the low 90°F (32°C) limit for the daily high temperatures, except for the last week of the study when the weather was very hot with high daytime temperatures at or above 100°F (38°C). Observations of cow behavior were similar between the two groups for most of the study period, except during the last week when cows in the conductive cooling section showed greater occurrence of signs of severe heat stress, including open-mouth breathing. Overall, there were no significant differences in average milk production (80.8 lb [36.7 kg] and 78.7 lb [35.7] solids-corrected milk/day) or somatic cell counts (211,000 and 178,000 cells/mL) between the conventional and conductive cooling groups, respectively. There was a tendency for cows housed in the conductive cooling section of the free-stall barn to have less lying time compared to cows in the conventional cooling section.

Significance

Modifications were successfully completed to adapt existing free-stall beds to heat exchangers for conductive cooling purposes. Although average milk production and somatic cell counts were not significantly different between the groups for this pilot study, a study period spanning the summer season will be needed to fully evaluate the ability of conductive cooling to replace or supplement conventional cooling systems for control of heat stress in lactating dairy cows.