Heating It Up With Heat Stress

By: Elizabeth Eckelkamp and Jeffrey Bewley, Ph.D.

Researchers from around the world gathered in Kansas City, Missouri at the 2014 Joint Annual Meeting of the American Dairy Science Association and the American Society of Animal Science. Some presentations focused on dairy cattle responses to heat stress. Highlights of these discussions are provided below.

Most would agree that managing heat stress is vital in lactating dairy cattle. However, what about dairy calves and dry cows? When do they experience heat stress and what are the consequences of not reducing heat stress?

Heat stress and calves:

Researchers from Missouri and Arizona conducted a study to discover what temperature-humidity index (THI) changes occurred in calf hutches (without calves) in mid-autumn in Tucson, Arizona. These researchers used wooden hutches with three individual, elevated sections to house 3 calves per hutch. They left 4 hutches in direct sunlight and placed 4 hutches under a shade structure. Each hutch was rotated after 24 hours to face north, south, east, or west. Hutches left in direct sunlight had a statistically greater THI than those placed under a shade structure (62.7 vs. 61.5 THI). Although the overall difference in THI may not be biologically significant, the greater volatility in the temperature-humidity index (13-point change per day) also occurred in the hutches left in direct sunlight (direct: 56–69 vs. non-direct: 57–66; Allen and Hall, 2014). This suggests that calves in calf hutches that were not shaded could experience an overall higher THI along with a greater increase in THI over a day.

In Florida, researchers explored the effect that heat stress in dry cows would have on calves after birth. Dams were housed in a freestall barn, and exposed to either a cooling treatment (fans and sprinklers over the feed bunk) or a heat stressed treatment (fans only over the feed bunk) for the 2 months before calving. All calves were weighed immediately after birth. Some bull calves were sacrificed after birth to determine the effects of heat stress on immune function. Overall, no differences were observed between the two groups for calf birth weight (90.4 vs. 89.5 lbs in cool and heat stress groups) or the amount of immune cells in calf blood. However, organs involved in immune function, specifically the thymus, were proportionally heavier in calves from dams provided sprinklers than fans alone (0.18 vs. 0.14% of body weight) which may indicate better immune tissue development when dams are cooled during gestation. Both groups in this experiment experienced some cooling, which may be why the differences were minimal (Ahmed et al., 2014).

Take home message: Cooling cows during the dry period may improve calf immune function after birth. Similarly, providing calves shade when they are housed in hutches will provide a cooler and less variable environment. Leaving calves in direct sunlight allows them to experience up to a 13-point change in temperature-humidity index throughout the day.

Heat stress and milk production, reproduction, and lactating cow health:

Keeping cows cool in the South is a constant struggle. In addition to the effect of heat stressed dams on calves, Florida researchers also compared the effects on the dams in the following lactation. In the cooled and mild heat stress groups, no differences were reported in

body condition score or milk yield. Cows provided sprinklers did have statistically significant lower rectal temperatures and respiration rates than the cow provided only fans and shade, although the differences were small (102.2 vs. 102.4°F and 51 vs. 59 breaths per minute). Conversely, cows provided with no heat abatement during the dry period produced 11.7 lbs./day less than cows that were provided heat abatement during the dry period. Cows provided with no heat abatement also experienced greater respiration rates (76 breaths per minute). However, reproductive performance (metritis, days to first breeding, and pregnancy rates) did not differ among treatments (Thompson et al., 2014).

In Kansas, researchers evaluated the effect of treatment with gonadotropin-releasing hormone (GnRH) on fertility on lactating dairy cows during summer heat stress. Cows were treated on the day of estrus, 5 days after artificial insemination (AI), or treatment at both times. Cows were checked for pregnancy at days 36 and 94. Overall, treatments did not increase pregnancy per AI, except in 3rd lactation cows. When cows were treated with GnRH 5 days after AI, pregnancy per AI was greater than the other groups (25.1 vs. 17.7%; Mendonça et al., 2014).

Take home message: Cooling cows during the dry period may improve milk production in the following lactation. GnRH treatment 5 days after AI may improve pregnancy per AI during summer heat stress in 3rd lactation cows, with no effect of treatment with other lactations having a significant effect. However, the severity and duration of heat stress will provide some volatility in these results.

Cow cooling:

Cow cooling in the South is normally accomplished using shade (either from a housing facility or a shade structure), sprinklers (generally over the feed bunk and/or holding pen), and fans (throughout the facility and over the feed bunk). A novel cooling system was tested by researchers in New York. This system consisted of pumping chilled water (40.1 and 50°F) through waterbeds in a tiestall barn. The water pumped through the beds cooled the cows through conduction, removing ~850 Watts (roughly 60% of the total metabolic heat produced by a lactating Holstein) in the 40.1°F group while cows were lying down (cows' environment kept at a THI of 81.3). The reduction in heat stress improved milk production by 10.6 lbs. per day compared to cows that were not using the novel cooling system. The cooled cows also experienced lower rectal temperatures and respiration rates compared to the cows that were not using the novel cooling system (102.6 vs 104.5°F and 64 vs. 84 breaths/min, respectively; Perano et al., 2014).

Take home message: Cooling cows through conduction shows promise in reducing heat stress and increasing milk production.