USDA-ARS-MWA Livestock Behavior Research Unit

Dairy Cow Welfare Fact Sheet

Livestock Behavior Research Unit

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Pre-natal Heat Stress of Cows Affects the Well-Being of Offspring

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When Heat Stress Events Occur: Heat stress can be problematic for both intensively-housed and pasture-based animals. For dairy animals, the pregnant cows are frequently on pasture systems or sometimes in feedlot type systems. Some of those environments do not allow the opportunities for management intervention during heat events as do many confinement systems where sprinkling and fans are in place in the housing areas. Besides the housing environment, many dry cows are transported during the last months of pregnancy. A common time for animals to experience adverse effects of high temperatures is during transport.

Transport is a multifaceted stressor that can create or exacerbate existing heat loads. Truck design can influence the environmental impact on animals. Previous housing experience of the animal increases heat stress experienced during transport. The impact of other stressors, also affects heat production. For instance, handling of animals, in and of itself, increases body temperature. Additionally, because the temperature humidity index (THI) increases during vehicle stationary periods (such as meal breaks for drivers, truck inspection stations, or border crossings), this is a time that cattle need to be accommodated with some type of heat relief because the THI can approach critical ranges. Although effects of heat stress on reproduction and milk production have been studied extensively, little research has investigated the effects of heat events during the later pregnancy on the morbidity and mortality of the calf.

Effects of Pre-natal Heat Stress on the Neonate: Effects of heat stress on neonate well-being begin before birth. Calves born to cows that have experienced heat stress during later pregnancy are generally smaller than those born during thermal neutral environments. Additionally, altered immunity of calves born after heat stressors has been demonstrated. Recent data have shown that important immune signaling molecules were less in calves born to cows during a high solar load (UV). These molecules are important in the early immune defenses. Additionally, the types of immune cells of calves are altered by high UV conditions. Studies demonstrated that although adequate antibodies may be available in colostrum, pre- or post-natal heat stress can impact protective absorption. Similarly for other species, heat stressed sows produced pigs that had lower antibodies for up to 20 days after birth. Studies in humans have shown the prenatal heat stress not only leads to low birth weight, but alters immune development such that heat tolerance is changed later in life.

Besides suppressed immunity, bacterial loads are changed under high UV conditions, resulting in more environmental bacteria. This may be because heat stress conditions are associated with intestinal permeability for pathogens residing in the gut or for commensal bacteria such as *E. coli* which then may become opportunistic pathogens. These environmental conditions result in greater disease incidence of severe diarrhea for calves born during summer than those born in winter. Additionally, respiration rates were greater for calves born during high UV months, even though they were not being subjected to heat stress.

Conclusions and Recommendations: Currently, prevention is the only solution. Recommendations for dry cows are similar as for other extensively and intensively raised cattle. U.S. recommendations include monitoring changing conditions and weather forecasts, managing cattle based on the coat color, body condition, adjusting rations, and transport early in the day (prior to 0600). It is advised that a comfort zone be created in housing, use sprayers or sprinklers (keeping in mind that additional wetting is usually, but not always beneficial because humidity can exacerbate disease), and maximize airflow. Change feeding schedules or rations, control flies and parasites, and provide cooling for cattle in very confined areas such as sick pens or small groups being handled individually. Prior to reaching that crucial point, management recommendations are to provide shade at temperatures greater than 24°C (75.2°F) and THI greater than 70; provide adequate water (allowing for at least 2 visits per day for grazing cattle). Dairy cows and calves both have decreased mortality when their environmental temperature is between 14 and 24°C. *Finding a beneficial intervention for offspring born after a heat event has not been addressed.* However, given the unpredictable nature of environmental heat stress, solutions are needed.

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Further Reading:

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The mission of the LBRU is to develop scientific measures of animal well-being, through the study of animal behavior, stress physiology, immunology, neurophysiology, and cognition, that will allow an objective evaluation of animal agricultural practices. This method of study will allow the improvement of existing practices and invention of new practices that can enhance animal well-being and increase animal productivity. In addition, this unit will use and develop its knowledge of stress physiology and animal behavior to address concerns of pathogen contamination of livestock carcasses due to the stress of handling and transportation. The optimization of animal well-being will assist in improving animal health, increasing productivity and decreasing human exposure to dangerous pathogens.

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