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Heat Stress In Late Gestation Affects Calf Health and Performance

Nutritional Support Coupled with Heat Stress Abatement Can Improve Animal Performance

by Rob Costello

The conversation about environmental heat stress on dairy cows usually focuses on early lactation where it has serious effects on feed intake, milk production, health and reproductive performance. Heat stress in this group usually has an immediate effect on farm income, so it gets much of the attention. Other groups, such as dry cows, may not have as high a priority. But overlooking their needs as temperatures rise can have serious implications for the cow and the calf she is carrying.

We don't usually think about how stress in one group of animals can have adverse affects on another. But in fact, heat stress in late gestation can have many short and long term effects on her calf as well as the cow. Research studies on effects of late gestation heat stress on calves *(Monteiro et al. 2013, 2016)* have demonstrated:

1. **lower birth weights** – due to shorter gestation length and/or direct effects on fetal development
2. **reduced starter intake** – heifer calves from non-heat stressed dams ate 117 total pounds of starter feed by eight weeks of age compared to 68 pounds by calves from heat stressed dams
3. **lower growth rate** – body weight at eight weeks of age was 157 pounds versus 135 pounds for calves from heat stressed dams
4. **impaired function of the placenta** – such as reduced oxygen available to the fetus
5. **lower hematocrit** – fewer red blood cells means less oxygen-carrying capacity of the blood
6. **altered glucose and fatty acid uptake and utilization** – plasma concentrations of non-esterified fatty acids (NEFA) and beta hydroxybutyrate (BHB) were higher in calves from heat-stressed dams after 32 days of age. This coincided with significant starter intake, suggesting increased glucose and decreased fatty acid utilization compared to calves from non-heat stressed dams
7. **impaired passive and cell-mediated immune functions** – compromised overall health
8. **greater chance of leaving the herd prior to puberty** – due to sickness, malformation and growth retardation
9. **greater services per conception**
10. **lower milk production in first lactation**

Providing shade, misters, sprinklers and fans for evaporative cooling can go a long way toward reducing the effects of high ambient temperatures. Even so, these strategies may not be enough to keep cows cool. Nutritional strategies that include increasing dietary potassium, DCAD and protein – especially rumen undegradable protein – are also important for helping cows cope with heat stress.

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How Cows Respond to Heat Stress

During heat stress, insulin increases in the cow's bloodstream causing higher glucose uptake and metabolism *(Wheelock et al., 2010)*. Elevated insulin prevents fat from being mobilized from adipose tissue, preventing it from being used as an energy source. In addition, dry matter intake decreases during heat stress, reducing nutrients available for production and cooling functions. Associated weight loss is due to water loss and the breakdown

of tissue proteins since the cow cannot mobilize body fat. In lactating cows, we also see decreased milk production, increased body temperature, poor reproductive performance, increased metabolic disorders, rumen acidosis and elevated somatic cell counts.

For dry cows, environmental heat stress can cause dysregulation during mammary gland involution in the early dry period and during mammary cell proliferation in the late dry period *(Wohlgemuth et al., 2016)*. This compromises mammary gland growth and negatively affects milk yield in the following lactation. Heat stress abatement during the entire dry period increases subsequent milk yield.

Nutritional Strategy During Heat Stress In Late Gestation

It is difficult to improve dry matter intake as a method of providing nutrients the cow needs during heat stress. Even so there is a nutritional strategy that can help mitigate the effects of high environmental temperatures on cows in early lactation which provides additional benefits in late gestation. Research studies on dietary fat supplementation during heat stress and on late gestation cows and their calves show very interesting results.

A word of caution: some fat supplements depress dry matter intake – that is one thing we don't want to do. A large volume of research on calcium salts correlates their use in dairy cow rations to a drop in dry matter intake. This correlation to intake depression is described for calcium salts on page 31 of the 2001 Dairy NRC. High palmitic acid (C16:0) supplements can also depress dry matter intake. Fifty percent of published research studies on high palm products (>80% palmitic acid) have shown a drop in intake. A large body of research on free fatty acid products show no negative effect on dry matter intake when a blend of long chain fatty acids is used (C18:0 and C16:0).

Lactating Cows

Heat stressed cows can utilize fatty acids from dietary sources, they just have trouble mobilizing fatty acids from adipose tissue. Feeding supplemental fat during heat stress lowered body temperature a full degree (103.6° to 102.6° F) in lactating cows and increased solids corrected milk production from 56 pounds to 64.1 pounds per day *(Wang et al., 2010)*.

Late Gestation Cows

Feeding supplemental fat during late gestation without reported heat stress resulted in less body condition loss and less negative energy balance during the next lactation. Higher pregnancy rates and fewer days to pregnancy were also observed. One study found the pregnancy rate for fat supplemented cows during late gestation was 86% compared to 58% for non-supplemented cows. Days open for these cows was 110 days vs 141 days, respectively *(Frajblat and Butler, 2003)*.

Another study on the effects of fat supplementation to late gestation cows on passive immunity of newborn calves demonstrated heavier birth weights, higher concentrations of serum IgG and improved efficiency of IgG absorption with fat supplementation *(Garcia et al., 2014)*. This study compared the effects of a calcium salt (Megalac-R) and a prilled blend of long chain fatty acids (Energy Booster 100) and found that both provided a benefit, but the prilled blended fatty acid supplement resulted in higher serum IgG and better efficiency of absorption than the calcium salt.

Summary

Heat stress in late gestation has adverse effects on both the cow and her calf. Adding a supplemental fat to the dry cow ration that does not depress dry matter intake can be used along with heat stress abatement processes to help reduce the harmful effects of rising environmental temperature and humidity on animals. Performance results for cows include lower peak body temperatures, higher pregnancy rates, fewer days open, improved mammary gland development, higher milk yield, less body condition loss and less negative energy balance in the following lactation. Calves not only avoid the long list of harmful effects of heat stress in utero, but will also benefit from improved serum IgG levels and absorption efficiency.