



UW-Madison Division of Extension * Aerica Bjurstrom, Regional Dairy Educator
920-388-7138 * aerica.bjurstrom@wisc.edu



Short- and Long-term Effects of Heat Stress in Dairy Cattle

There is no doubt that dairy cattle become heat stressed at point during the summer months in the Mid-Atlantic region. The temperature humidity index (THI) is a tool used to assess the risk for heat stress in livestock. The THI threshold for high producing dairy cows is 68; when values are greater than 68, lactating cows are at risk for heat stress. With relative humidity levels ranging between 50 and 80% and average monthly highs of 87°F, 85°F, and 78°F during the months of July, August, and September, respectively, most cows in Maryland easily experience several days where the THI is above 68 during these months.

Signs of heat stress in dairy cattle include panting, excessive drooling/foaming from the mouth, and open-mouth breathing. Heat stress also induces behavioral changes such as increased standing time, bunching, and reduced feed intake, which have direct effects on production.

Temperature (°F)	Relative humidity (%)										
	20	30	40	50	60	70	80	90			
50	54	53	53	52	52	51	51	50		<68	Not Stressed
55	56	56	56	56	56	55	55	55		68-71	Stress Threshold
60	59	59	59	59	60	60	60	60		72-79	Mild Stress
65	62	62	63	63	63	64	64	65		80-89	Moderate Stress
70	65	65	66	67	67	68	69	69		>89	Severe Stress
75	68	68	69	70	71	72	73	74			
80	70	72	73	74	75	76	78	79			
85	73	75	76	78	79	81	82	84			
90	76	78	79	81	83	85	86	88			
95	79	81	83	85	87	89	91	93			
100	82	84	86	88	91	93	95	98			
105	84	87	89	92	95	97	100	102			
110	87	90	93	96	99	101	104	107			

Figure 1. Temperature Humidity Index (THI) for Cattle. Lactating dairy cows are at greater risk for heat stress when the THI exceeds 68.

Short-term Effects of Heat Stress

The most obvious effect of heat stress is reduced milk production. Heat stress is also detrimental to fertility because it reduces display of estrus (heat) behavior and negatively affects oocyte quality and embryo viability. In Maryland, if minimal heat stress abatement strategies for lactating cows were implemented, the predicted result would be a reduction of annual milk production by 950 lb per cow and an increase in the average number of days open by 18 days.

Most producers will attest that bulk tank somatic cell count and the number of mastitis cases usually increase during the summer months. Not only are pathogens more prevalent during the summer months due to conditions more conducive to their growth and proliferation, but high temperatures also depress the immune system by reducing immune cell function, making cows more susceptible to disease. Lameness also often increases during the summer

months, which is likely related to increased standing behavior under periods of heat stress. Because feed intake is reduced and rumination activity is depressed when body temperature rises, risk for sub-acute ruminal acidosis also increases, which further exacerbates immune dysfunctions brought about by heat stress.

Often overlooked when it comes to providing heat stress abatement, replacement heifers and calves are also affected by heat stress. There is evidence suggesting that heat stress negatively affects the growth and immune status of replacement dairy heifers. Furthermore, a recent study from the University of Florida showed that cooling calves under heat stress conditions from birth to weaning reduced total number health events requiring treatment and increased milk and starter grain intake.

Long-term Effects of Heat Stress

In addition to the more obvious, short-term effects, heat stress also has long-term effects that may not be fully realized until months (or even years!) later. While the historical focus of heat stress has been on its effects on lactating cows, recent attention has been given to its effects on dry cows. Heat stress negatively affects mammary cell proliferation and development during the dry period and prolonged heat stress during this time can reduce milk production during the subsequent lactation by as much as 8 to 11 lb/d.

There is also mounting evidence that heat stress during late gestation transcends the dry period and can have effects on the growth and milk production of the calf in utero and her offspring (2 generations). A recent study analyzed production records obtained from 10 years of heat stress research in Florida and showed that calves whose dams were cooled under heat stress conditions during late pregnancy produced an average of 8 lb/d more milk during their first three lactations than calves whose dams were not cooled. Effects on production were also observed in the second generation, where calves whose grand dams were cooled during the dry period produced 2.8 lb/d more milk during their first lactation. Thus, the long-term effects of heat stress during the dry period on milk production may not be fully evident for 3.5 to 4 years!

Combating Heat Stress

As highlighted above, management of heat stress is important for current and future animal productivity, health, and reproduction. When looking at your heat stress mitigation strategies, there are a few key areas you should focus on.

- Ensure ample access to fresh, clean water.** Water is required for all animals to maintain body temperature and, under normal conditions, a high producing cow will drink up to 50 gallons of water per day. Hot weather will increase water consumption by 50 to 100%. To accommodate times of increased water demand, there should be at least 3 inches of accessible water-trough space per cow and flow-rate should be sufficient so that troughs do not run dry during periods of high demand. If possible, provide waterer access near the milking parlor exit.
- Provide shade.** This is most basic component of heat abatement and should be provided for all animals during high temperatures. This is often in the form of a barn or shed for confined animals or in the form of natural shade or shade cloth for animals on pasture. Don't forget about your dry cows, heifers, and calves when it comes to this basic component of heat stress abatement. Calves in hutches can also benefit from supplemental shade by installing a shade cloth or other covered structure over the hutch area.
- Ensure adequate ventilation.** Poor ventilation is often an issue inside barns or other manmade structures. These facilities should be opened up as much as possible to promote natural airflow by raising side curtains, opening/removing glass windows, etc. Fans should also be installed in key areas, such as the feed bunk, over the free-stalls or bedded pack, and holding pen to promote airflow. Additional ventilation can be achieved with calf hutches by propping up the backside of the hutch using 4x4 blocks of wood.
- Consider cooling with water only after there is shade and adequate ventilation.** To be effective, this heat stress abatement strategy must be paired with sufficient airflow or fans to promote evaporative cooling. Simply soaking animals without adequate airflow will only succeed in creating a more humid environment around them. Sprinklers/misters can be strategically placed at the feed bunk and the holding pen for optimal cooling.

Written by Sarah Potts, University of Maryland Extension
<https://extension.umd.edu/resource/short-and-long-term-effects-heat-stress-dairy-cattle>

2022 Kewaunee County Fair Livestock Dates and Times



Tuesday, July 5
 5:30-7:00 PM Hog Weigh-In

Wednesday, July 6
 Entry Day for All Animals
 9:30-10:30 AM Steer & Lamb Weigh-In
 12:30 PM Poultry Weigh-In

Thursday, July 7
 8:30 AM Sheep Show, Open & Jr.
 12:00 PM Beef Show, Open then Jr.
 6:00 PM Hog Show

Friday, July 8
 8:00 AM Dairy Show, Jr. & Open

Saturday, July 9
 1:00 PM Jr. Fair Livestock Auction
 7:00 PM Dairy Futurity

Sunday, July 10
 2:00 PM Kiddie Showmanship



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Heat Hurts Dairy Cows' Feet

Help Your Cows Avoid Lameness and Other Ailments if Summer Weather Puts Them Off Feed

When summer heat takes the edge off your dairy herd's appetite, some of them could wind up limping next fall. Making sure your cows eat right when the thermometer tops 20 degrees Celsius can help them ward off subacute ruminal acidosis [SARA], which can lead to other health issues such as lameness.

Cows are much more comfortable at temperatures below 20 degrees than above compared to people. Heat stress starts to set in above that temperature and nutritionists usually see symptoms that can include reduced dry matter intake, lower butterfat percentage and more selective eating patterns in both component-fed and total mixed ration herds. It's been estimated that summer's hottest, most humid days can increase the maintenance energy requirement of dairy cows by as much as 25 per cent.

In addition to the challenges of nutritional management in hot weather, it's also possible that reduced dry matter intake and slug feeding can make SARA worse. It sometimes shows up as lameness in the autumn after a hot summer.

SARA is a disorder of ruminal fermentation characterized by extended periods of depressed ruminal pH below 5.6 to 5.8. Ruminal pH measures the acidity or alkalinity of ruminal fluid. A lower pH means higher acidity. For optimum ruminal fermentation and fibre digestion, ruminal pH should lie between 6.0 and 6.4, although, even in healthy cows, ruminal pH will drop below this level for short periods during the day.

This fluctuation in ruminal pH results from the breakdown of dietary carbohydrates such as starch, particularly from cereal grains like corn, wheat and barley. Grains are high in readily fermentable carbohydrates that are rapidly broken down by ruminal bacteria, leading to production of volatile fatty acids and lactic acid. Under normal feeding conditions, volatile fatty acids are readily absorbed by papillae—small finger-like projections—on the rumen wall. Once absorbed, volatile fatty acids enter the cow's bloodstream and can be used for milk production.

SARA results from excessive volatile fatty acid production that exceeds the ability of the ruminal papillae to absorb them. Volatile fatty acids therefore accumulate in the rumen causing ruminal pH to drop.

In many cases, SARA symptoms are invisible. But daily occurrences of ruminal pH below 6.0 for prolonged periods can eventually lead to lameness. Low ruminal pH also affects the linings on the walls of the rumen and the small intestine. Reduced feed consumption may intensify the effect of total acid load in the rumen and decrease the ruminal pH further.

A recent University of Guelph study that looked at the effects of heat stress and a high-carbohydrate diet in sheep showed typical responses seen in dairy cattle. The project used a dietary approach developed for dairy cattle that involved feeding a grain supplement at predetermined levels to induce SARA in sheep.

Cattle pant in hot weather and the researchers observed the same reaction in sheep subjected to heat stress. Shallow rapid breathing, or panting, helps dissipate heat by evaporative water loss. Increased respiration rate is also an effective way to exhale carbon dioxide, another mechanism used to adjust the animal's overall pH.

The sheep study results also showed that ruminant animals, such as dairy cattle, try to adjust to conditions of both heat stress and acidosis. They start to use protective mechanisms to remain healthy and comfortable. Countering heat stress includes reducing voluntary activities like walking. They eat less since consuming less feed minimizes heat created by rumen fermentation, digestion, absorption of nutrients and metabolism. The Guelph study also suggested that the animal's panting may also have caused them to consume less feed.

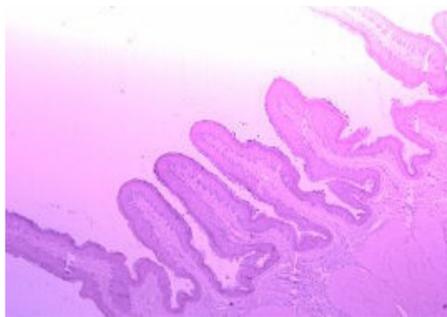
It's been shown that money spent on effective methods to keep a dairy herd's environment cool is almost always a good investment. It can pay off in improved dry matter intake and butterfat percentage along with better overall herd health.

Photos of the ruminal papillae of sheep from the heat stress and subacute ruminal acidosis study at Guelph illustrate the differences in papillae number and length when grain was supplemented, compared with the control diet.

Grain Challenge



Control



The Guelph sheep experiment was the first report on the form and structure of the rumen wall for animals faced with a high-carbohydrate diet under heat-stress conditions. The rumen wall lining not only protects the animal from the rumen's contents but also serves important functions. These include absorption and transportation of nutrients to the bloodstream and some metabolism of volatile fatty acids.

The rumen wall is lined with millions of microscopic, finger-like projections—known as papillae—that do its job. These papillae change shape according to rumen conditions, including pH.

Higher concentrate diets cause these papillae to become longer and there was a trend towards that in the Guelph study. As well, the number of papillae per millimetre of rumen wall was less, as shown in the photos. The differences in length of the papillae and their number did not change the total surface area but the researchers noted that there is a need to better understand the impacts of these changes.

Key points for proper nutritional herd management in hot weather:

- Ensure unlimited access to water. Consumption can increase 25 to 30 percent in hot weather
- Feed more frequently to stimulate feed intake
- Be alert for moldy feed and clean up feed leftovers daily

- Ensure minerals are balanced, particularly sodium, potassium and magnesium. Low ruminal pH can affect magnesium reabsorption.
- Be prepared to increase ration density to offset reduced dry matter intake
- Use rumen additives to promote easier digestion
- Feed more palatable, high-quality forages
- Monitor ration particle size and do not exceed 40 to 42 per cent non-structural carbohydrates in the diet during hot weather

Full article and references can be found here: <http://www.omafra.gov.on.ca/english/livestock/dairy/facts/heathurts.htm>

Majority of farm families worry about major medical expenses, and it could threaten their farm business

Agricultural systems face challenges from weather and markets that can threaten their resilience to shocks and stresses. Researchers in the agriculture sector tend to focus on these big crises, like storms or drops in commodity prices. Yet the “little things” that can impact any farm at any time, such as a barn fire, are seldom studied even though they may also shock and stress farm families.



Then, too, there are personal crises, such as illness, divorce or a loss of an off-farm job, which could affect anyone and certainly would have an effect on the resilience of the farm business.

An important example of these micro, household-level worries is medical debts due to medical expenses associated with a major illness or injury, which is examined in a recently published study in the peer reviewed *Agriculture and Human Values*, a leading journal on food and agriculture research.

An analysis of more than 900 surveys of farm households from 10 U.S. states found “a top worry for farm families is the impact a major illness or injury that leads to medical debt would have on the farm enterprise,” according to authors and rural sociologists Dr. Florence Becot and Dr. Shoshannah Inwood.

Becot is an associate scientist at the National Farm Medicine Center, Marshfield Clinic Research Institute, Marshfield, Wis., and Inwood is an associate professor in the School of Environmental and Natural Resources at The Ohio State University.

These concerns around medical debt are called “medical economic vulnerability.” While one in five (20%) surveyed farm households had a medical debt of at least \$1,000 in 2016, more than half (55%) were not confident that they could pay the cost of a major illness or injury such as a heart attack, cancer or loss of limb without going into debt.

This level of debt and respondent worries about having to take on more medical debt was observed even though more than 90 percent of farmers in this study had health insurance. Another important finding is connected to quality of health insurance. In addition to having health insurance coverage, what seems to matter as much is the level of deductibles and out-of-pocket expenses that people have to pay. These “underlying challenges or worries that people have are connected to the problem of underinsurance,” Becot said, which is particularly problematic considering that agriculture is hard on the body and dangerous.

“We’ve had farmers tell us they wait until 65 and are on Medicare to go take care of long-standing problems,” she said, which may affect their quality of life as well. We often hear that farmers are a “tough crowd” who don’t want to go the doctor, Becot said, when really, health care is expensive and inaccessible for many people.

The Affordable Care Act, or ACA, helped make medical coverage available to more Americans and benefitted farmers. A provision of the ACA uses income and not assets to determine Medicaid and Marketplace subsidy eligibility, which decouples the family from the assets of the enterprise and addresses the “land rich, cash poor” conundrum farmers often face. This provision allowed farm families a wider array of health insurance choices via public health insurance and marketplace options.

However, choices in the insurance marketplace can be limited, and health insurance plans are often confusing. So-called “skinny” plans – those with lower premiums but very high deductibles and out-of-pocket expenses – offer a weak safety net as people might avoid going to the doctor to limit costs, and a major illness or injury can result in medical debt.

Many farmers rely on off-farm employment for income but also as their source of health insurance, Inwood said. However, choices are limited by what the employer provides and may not be the best fit for a farm family. In rural areas it also can be hard to find jobs with good benefits.

The problem of medical economic vulnerability in the agricultural sector isn’t a new problem – but this study indicates like all Americans, farmers need affordable quality health insurance plans that ensure farm families are able to cover medical costs whether preventive or for major illnesses or injuries.

Policies to support the agricultural sector tend to focus on the farm business, yet this study points to the importance of ensuring that farm families facing personal medical crises wouldn’t be left with long-term medical debt. “The reality, too, is if health insurance was to be addressed, it would not only help farmers, it would help everybody,” Becot said.

“There has been a lot of discussions recently about the importance of agricultural programs and policies to support the resilience of farm families, yet this research indicates that one important way to bolster farm families and support their resilience is by ensuring access to affordable health insurance,” Inwood said.

View this press release online at <https://marshfieldresearch.org/nfmc-news/majority-of-farm-families-worry-about-major-medical-expenses-and-it-could-threaten-their-farm-business>