

PURINA® HERDSMART® TECHNICAL BULLETIN



Long-term impact of cooling dry cows

Research has shown that heat stress during the dry period can take a toll on the unborn calves well into adulthood.

By Bruno Do Amaral, Ph.D., dairy nutritionist with Purina Animal Nutrition

Results of a series of studies conducted at the University of Florida indicate that recommendations for heat stress abatement efforts for dry cows might – and should – be changing soon.

In each of three consecutive studies at the University of Florida cows were dried off 46 days before expected calving and assigned to one of two treatment groups. Both treatments were exposed to the same amount of heat stress; however, one group had no heat abatement other than shade, while the other had shade available and received cooling via fans and sprinklers. After calving, both groups were housed together in a free stall barn where all animals received the cooling treatment.^{1,2,3}

Milk production was measured for all animals for the first 30 weeks of lactation. The cows that received dry-period heat stress abatement consistently produced more milk in their

subsequent lactations. For the three respective studies, they showed an average of 20.50,¹ 10.36,³ and 11.02² more lbs of fat-corrected milk/day, for an overall average of approximately 14 lbs more milk/day. Furthermore, in Tao et al. (2011), there was a trend for greater protein yield for those cows that received additional heat abatement (Table 1).

The researchers attributed some of the differences in milk production to their findings that heat stress abatement increased mammary epithelial cell proliferation during the close-up dry period.⁴

Table 1. Milk composition of cows exposed to heat stress or cooling during the dry period. Data from Tao et al., 2011.⁴

VARIABLE	HEAT STRESS	COOLING	P-VALUE
Fat, %	3.58	3.52	NS
Protein, %	3.01	2.87	Significant
Fat yield, lb/day	2.25	2.56	Trend
Protein yield, lb/day	1.92	2.11	NS

1. do Amaral, B.C., E. E. Connor, S. Tao, J. Hayen, J. Bubolz, and G. E. Dahl. 2009. Heat-stress abatement during the dry period: Does cooling improve transition into lactation? *J. Dairy Sci.* 92:5988-5999.
2. B.C. do Amaral, E.E. Connor, S. Tao, J. Hayen, J. Bubolz, G.E. Dahl. 2010. Heat stress abatement during the dry period influences prolactin signaling in lymphocytes. *Domestic Animal Endocrinology.* 38 (2010) 38–45.
3. do Amaral, B.C., E. E. Connor, S. Tao, J. Hayen, J. Bubolz, and G. E. Dahl. 2011. Heat stress abatement during the dry period influences metabolic gene expression and improves immune status in the transition period of dairy cows. *J. Dairy Sci.* 94:86-96.
4. Tao, S., J. W. Bubolz, B. C. do Amaral, I. M. Thompson, M. J. Hayen, S. E. Johnson, and G. E. Dahl 2011. Effect of heat stress during the dry period on mammary gland development. *J. Dairy Sci.* 94:5976-5986.

IMMUNE FUNCTION

Heat stress during the dry period also impaired cows' immune systems. When immune function was evaluated at 20 days postpartum, the Florida researchers found that both neutrophil phagocytosis and neutrophil oxidative burst were reduced early in lactation when cows were heat stressed when dry compared with the cooled cows.² Lymphocyte proliferation also was three times higher in the cooled group versus the heat stressed animals, indicating more active postpartum immunity in the cows that had received heat stress abatement treatment prepartum.^{1,2}

This is an important finding, given the fact that the transition period has been identified as a time of immunosuppression, leaving fresh cows vulnerable to a host of early lactation disease challenges. It is apparent from this research that the fresh-cow disease complex could be influenced by the occurrence of heat stress in the prefresh period.

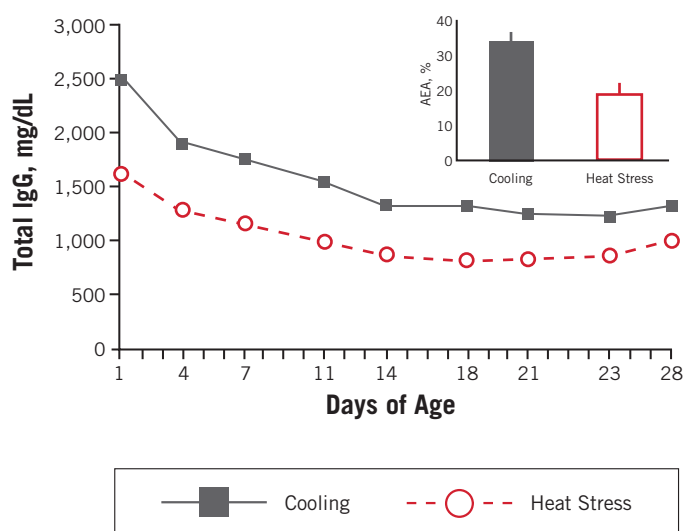
HEAT STRESS IMPACTS OFFSPRING AS WELL

At birth, calves from cooled cows weighed an average of 28.7,¹ 11.0³ and 10.7² lbs more, for an average of approximately 16.8 lbs. The difference in calf weights is likely due, at least in part, to the fact that heat stressed cows calved earlier than their cooled counterparts.^{1,2,3} The result: earlier-term calves born with greater susceptibility to health and performance issues.

The researchers studied the immunity of calves born to the two groups of dams, and found that calves born to heat stressed dams had significantly lower serum immunoglobulin-G

Figure 1. Effect of heat stress and cooling during the dry period on the total serum IgG concentration during the first 28 days of life and the apparent efficiency of absorption (AEA; inset).

Heat stress during the dry period decreased total serum IgG of calves during the first 28 days of age compared with cooling. Calves exposed to heat stress in utero had lower AEA compared with those cooled in utero. Data from Tao et al., 2012.⁵



(IgG) levels from birth through 28 days of age, compared with calves from cooled dams, (Figure 1). IgG, more specifically IgG1, are the actual antibodies that protect a young calf from pathogens that may cause scours and respiratory diseases. And, like their dams, calves exposed to heat stress in utero had suppressed lymphocyte proliferation compared with the cooled group.⁵

MATERNAL HEAT STRESS: CARRYOVER EFFECTS

To further evaluate the impact of maternal heat stress, researchers analyzed the data from 146 calves born during five consecutive years of heat

5. Tao, S., A. P. Monteiro, I. M. Thompson, M. J. Hayen and G. E. Dahl. 2012. Effects of late gestation heat stress on growth and immune function of dairy calves. *J. Dairy Sci.* 95:7128-7136.

6. A.P.A. Monteiro, S. Tao, I.M. Thompson, and G.E. Dahl, 2013 University of Florida, Gainesville, Effect of heat stress in utero on calf performance and health through the first lactation. *J. Anim. Sci.* Vol. 91, E-Suppl. 2/*J. Dairy Sci.* Vol. 96, E-Suppl. 1.

stress research on dry cows at the University of Florida (2007-2011). And the results are clear: Heat stress on calves in utero affects their future productivity.⁶

In calves that were heat stressed in utero, the dead on arrival (DOA) rate when calculated for both steers and heifers was 4.1%. In calves that were cooled in utero, the DOA rate was zero. The differences widened as calves grew. By the time heifers reached puberty, 20.5% of the calves heat stressed in utero left the herd through death, sickness or growth retardation. In comparison, only 4.9% of the calves cooled in utero had left the herd. This is a difference in animals lost of 15.6% (Table 2).

Tracking heifers all the way through first lactation shows that 77.8% of calves cooled in utero completed their first lactation. In comparison, 53.1% of calves heat stressed in utero completed their first lactation. This means that 46.9% of calves heat stressed in utero had left the herd compared to 22.2% of calves cooled in utero leaving the herd. The numbers clearly show that calves which were heat stressed in utero leave the herd in greater numbers than their cooled counterparts.

GROWTH AND REPRODUCTION

Heat stressed calves were lighter at birth and remained that way through the first year. The rate of gain for both groups of calves was virtually the same. The difference in weight and height at year one could be tracked back to their original birth weight and height. Heat stressed calves did not have any compensatory growth during the first year.

The age at first insemination was virtually the same for the two groups (13.3 +/- 0.3 months vs 13.5 +/- 0.3 months) and the difference in the

Table 2. An evaluation of 5 years of research at the University of Florida showed that calves heat stressed in utero have a higher risk to leaving the herd earlier than calves that are cooled in utero.

	HEAT STRESSED IN UTERO	COOLING PROVIDED WHILE IN UTERO
Dead on Arrival (DOA)	4.1%	0
# of animals leaving herd by the time heifers reached puberty through death, sickness or growth retardation.	20.5%	4.9%
Completed first lactation	53.1%	77.8%

age at first parturition was negligible (24.2 +/- 0.5 months vs. 24.9 +/- 0.5 months). However, the number of services per conception was slightly greater in heifers that were heat stressed in utero than for heifers that were cooled in utero. Services per conception were 2.6 +/- 0.3 vs. 1.8 +/- 0.3 respectively.

Additionally, by the time heifers delivered their first calves both groups had similar body condition scores and body weight. This suggests that during pregnancy heat stressed heifers were able to catch up to cooled heifers in size before calving.

MILK PRODUCTION

Researchers tracked the heifers' milk production through the first 30 weeks of lactation, (Figure 2). During that time heifers which were cooled in utero out-produced their heat stressed counterparts by about 10 lbs of milk/day. No difference was observed in the protein, fat or somatic cell count of the milk.



Ten lbs of extra milk/day can really make a difference. Heifers cooled in utero produced 2,100 lbs more milk during their first lactation than their heat stressed counterparts (10 lbs/day x 30 weeks). At a milk price of \$18/cwt, each heifer cooled in utero could add about \$378 to your bottom line.

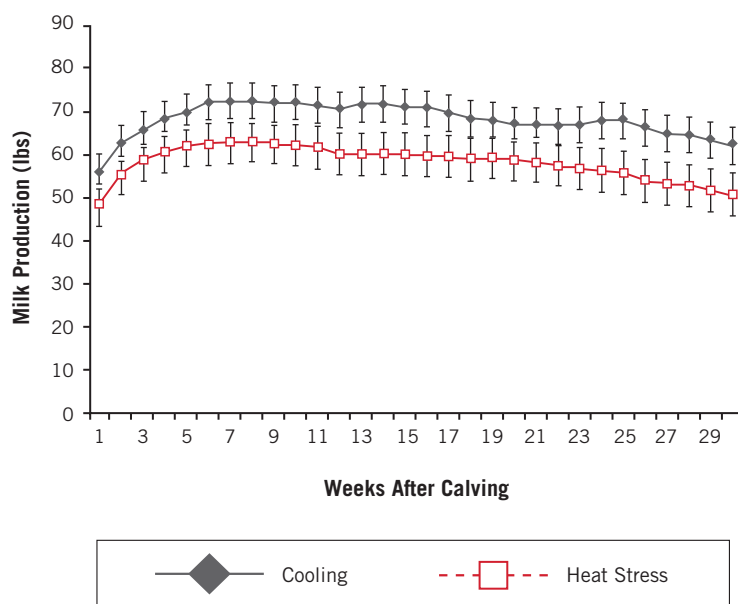
COOLING PAYS

When you weigh the evidence it clearly shows that cooling dry cows pays compared to heat stressed dry cows. In the cooled dry cows benefits may include more milk production, a more robust immune system, heavier birth weight calves and increased mammary gland proliferation.³

Now add in the benefits to the offspring of cooled dry cows. More milk production potential – 10 lbs/day more; about 25% more animals remain in the herd through first lactation and fewer services per conception.

Figure 2. Effect of maternal heat stress or cooling during late gestation on milk production in the first lactation.

Data from five consecutive years were analyzed. Calves born from cows cooled in utero tended to produce more milk up to 30 weeks of first lactation. (Monteiro et al., 2013)⁷



7. Monteiro, A.P.A. 2013, Impact of maternal heat stress during late gestation on calf performance and health. MS Thesis. University of Florida.

IN CONCLUSION: This research shows the value of cooling dry cows goes far beyond the cows themselves, and the benefits to offspring is something you can't afford to ignore. Invest in dry cow cooling. Failure to do so means you are potentially leaving a lot of money on the table.

To learn more about Purina Animal Nutrition dairy feed technologies, visit purinamills.com/dairy-feed.

Purina® dairy feed technologies – from our farm to yours.

Located in Gray Summit, MO, the Purina Animal Nutrition Center operates a 600-head herd of registered Holstein cows, heifers and calves. The research objective at the dairy research facility is to deliver innovative technology, products and programs that will enhance performance and income for dairy producers for all stages of life. To learn more about the Purina Animal Nutrition Center, visit Purinamills.com.



©2016. Purina Animal Nutrition LLC. All rights reserved.

Because of factors outside of Purina Animal Nutrition LLC's control, individual results to be obtained, including but not limited to: financial performance, animal condition, health or performance cannot be predicted or guaranteed by Purina Animal Nutrition LLC.