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Research Update

Heat stress, competitive cow environment, calf feeding

Diamond V Dairy Research and Technical Services Team

Members of the Diamond V Research and Technical Service Teams attended a large number of American Dairy Science Association scientific presentations at the Joint Annual Meeting, July 20-24, 2014 in Kansas City, MO.

In order to bring new knowledge and practical applications to Diamond V customers, they reviewed nearly 20 presentations, writing the following summaries of recent research into dairy heat stress, feeding environment, and calf feeding.

Complete ADSA 2014 abstracts available here:

Metabolic and health consequences of heat stress: Knowledge gaps and opportunities

Abstract 0062: L.H. Baumgard, J.W. Ross, N.K. Gabler, S.M. Lonergan, A.F. Keating, J.T. Selsby (Iowa State University) and R.P. Rhoads (Virginia Tech)

Objectives: To provide data on effects of heat stress on feed intake and to show that the effects on intake are not solely related to high temperatures.

Summary: Feed intake often decreases during heat stress and results in decreased production and performance. However, the decrease in performance during heat

stress is not fully caused by a decrease in intake, which only accounts for about 50% of the decrease in performance. This has been shown in studies where non-heat stressed animals (pair-fed) were fed the same amounts of feed that heat stressed animals consumed. In these studies, the pair fed animals did not have as big a drop in performance as the heat stressed animals.

The authors state that heat stressed animals adapt to the environmental stressors and change metabolism and use of nutrients/energy to deal with the heat stress. Normally, when animals consume adequate feed (and are not heat stressed), insulin levels increase and NEFA production and catabolic hormones decrease. This situation favors lipid disposition (or fat production). With lower intake, insulin levels decrease and NEFA production and catabolic hormones increase. This situation favors lean tissue maintenance. In studies where animals were fed the same amount of feed that heat stressed animals consumed, NEFA levels increased, BHBA decreased, insulin levels were not changed, and there was a decreased susceptibility to catabolic signals. Heat stressed animals had an increased insulin and small increase in BHBA, but no change in NEFA.

Use of glucose also shifts during heat stress. Typically glucose is used for milk production in mammary gland and energy. However, during heat stress (along with a decrease in intake), they saw a shift to use of glucose more so for energy, as energy from NEFA is decreased. Heat stress can cause issues with gut integrity, which can lead to greater susceptibility to endotoxins, leaky gut and LPS production. However, this area is not well researched, especially in animals, and mechanisms need to be determined.

Citation: Baumgard, L.H., J.W. Ross, N.K. Gabler, S.M. Lonergan, A.F. Keating, J.T. Selsby and R.P. Rhoads. 2014. Metabolic and health consequences of heat stress: Knowledge gaps and opportunities. J. Dairy Sci. 97(E-Suppl. 1):31-32. (Abstr.)

Reviewer's notes: Authors remarked with conclusion that heat stress is one of the primary hurdles to efficient animal production. Defining the physiology and mechanisms that underlie how heat stress jeopardizes animal performance is critical for developing approaches to ameliorate current production issues and a prerequisite for generating future strategies (genetic, managerial, nutritional, and pharmaceutical) to improve animal well-being and performance.

Mitigating heat stress in dairy cattle via conductive cooling

Abstract 1490: K.M. Perano, K.G. Gebremedhin, J.G. Usack, T.J. Shelford, C.A. Gooch, and L.T. Angenent (Cornell University)

Objective: To measure the impact of conductive cooling on physiological and production traits of heat stressed dairy cattle.

Methods: Eight 1st lactation Holstein cows in 100 to 190 days in milk were assigned to a seven-week study with 1 week of baseline measures followed by six 1-week cooling treatments. Cows were housed in climate-controlled rooms with high heat stress (THI = 81.3) then later moderate heat stress (79.7) for 8 hours per day. Four cows were conductively cooled by chilled water to 10˚C or 4.5˚C pumped through modified waterbeds and four were not cooled.

Results: There was a numerical stair-step response at each cooling temperature but only the 4.5˚C cooling was significantly different from non-cooled control cows in this study. Cows cooled with 4.5˚C water during high heat stress had 14% higher milk yield, 23% higher dry matter intakes, 1.1˚C lower rectal temperatures, and 22 breaths per minute lower respiration rates than non-cooled cows. During heat stress, cooled cows laid down for 62% of the time, whereas control cows only laid down 52% of the time. The authors calculated that when a cow layed down, cooling with 4.5°C removed approximately 600 Watts out of 1400-1500 Watts of metabolic heat (about 40-45% of body heat removal).

Citation: Perano, K.M., K.G. Gebremedhin, J.G. Usack, T.J. Shelford, C.A. Gooch, and L.T. Angenent. 2014. Mitigating heat stress in dairy cattle via conductive cooling. J. Dairy Sci. 97(E-Suppl. 1):732. (Abstr.)

Reviewer's notes: Heat stress is one of the major bottlenecks to dairy cow performance and well-being. Evaporative cooling is the most common method being employed but is less effective in humid and very windy areas and can consume large amounts of water during the cooling period. Conductive cooling looks like a promising alternative method to effectively cool cows. It provides the additional benefit of water conservation, encourages cows to lay down more, and can significantly improve production. More research is needed on the optimum temperatures to cool cows via conductive cooling.

A competitive and unpredictable feeding environment pre-calving increases inflammation and endometritis in Holstein dairy cows

Abstract 101: K. Proudfoot (Ohio State University), S.J. LeBlanc (University of Guelph), D. Weary and N. von Keyserlingk (University of British Columbia), B. Bradford and L. Mamedova (Kansas State University)

Objective: The objective was to determine the effects of a competitive and unpredictable feeding environment on inflammation and uterine health in dairy cows. Pre-calving management may influence the risk of disease after calving.

Results: From 4 wk before calving until calving, control cows were given ad libitum access to 6 feed bins. For treatment groups, 4 non-experimental cows were added to the pen; after 2 wk, treatment groups were moved into a pen with 4 new cows. Throughout the treatment period, morning feeding times were delayed at random 0,

1, or 2 h on alternate days. Cows were excluded if they calved twins, aborted, or calved >2 wk early.

There was no difference in the number of cases of endometritis or differences in TNF-α between control and treatment in first-calf heifers. For cows, treatment groups had a higher percentage of endometritis cases (64% vs. 17% cases/group; *P* = 0.02) and higher TNF-α (2.1 vs. 1.8 log pg/ml; *P* = 0.02) compared to controls. These results indicate that management practices that create a competitive and unpredictable feeding environment such as regrouping, overstocking, and variable feeding times can disrupt immune function and increase disease risk in cows but not first-calf heifers.

Citation: Proudfoot, K., S.J. LeBlanc, D. Weary, B. Bradford, L. Mamedova, N. von Keyserlingk. 2014. A competitive and unpredictable feeding environment pre-calving increases inflammation and endometritis in Holstein dairy cows. J. Dairy Sci. 97(E-Suppl. 1):51. (Abstr.)

Reviewer's notes: This study had a "sister" study that was presented as a poster (Abstract 816) that looked at feeding and social behavior. The results of that study showed that competitive and unpredictable feeding environment disrupted feeding and social behavior of dairy cows. Note, however, that it was cows, not heifers, that were significantly affected in the study reviewed.

Rumen morphology measurements in periruminant Holstein bull calves fed a fermentation extract of *Aspergillus oryzae*

Abstract 1147: T.T. Yohe, E.M. Dudash, K.M. O'Diam, and K.M. Daniels (Ohio State University)

Objective: Determine if age and dietary inclusion of an extract of *Aspergillus oryzae* (AO) affect organ size, muscle and sub-mucosal thickness of rumen tissue, and papillae area in periruminant Holstein bull calves.

Methods: 52 Holstein bull calves were randomly assigned to a slaughter date of 4 weeks (n = 16) or 8 weeks (n = 36) of age and to a treatment (n = 25) or control (n = 27) group. Treatment group was fed a liquid AO product in the milk replacer at a 2 g per day rate until 4 weeks of age and then fed 2 g per day of a solid AO product top-dressed on the starter grain.

Results: Treatment and the interaction of treatment and age did not affect full or empty rumen weights. Full and empty weights were greater at 8 weeks than at 4 weeks. Muscle thickness and sub-mucosal thickness were both affected by age but not by AO treatment or interaction. Treatment also had no effect on papillae area.

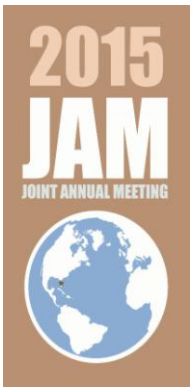
	Age	N	Diet			*P*-value		
			CON	AO	SEM	Trt	Age	Trt x Age
Rumen wt, kg								
Full	4 wk	16	1.76	1.86	0.42	0.48	0.001	0.586
	8 wk	36	5.04	5.54	0.29			
Empty	4 wk	16	0.53	0.50	0.08	0.881	0.001	0.579
	8 wk	36	1.29	1.34	0.05			
Tissue thickness, µm								
Sub-mucosal layer	4 wk	16	270.1	225.0	61.5	0.977	0.001	0.382
	8 wk	36	559.6	607.7	52.1			
Muscle layer	4 wk	16	917.6	870.7	98.3	0.706	0.001	0.354
	8 wk	36	1043.1	1154.0	67.4			
Papillae area, mm^2	8 wk	36	6.52	6.65	0.40	0.829	0.829	

Dietary inclusion of 2 g/d of an extract of AO did not affect rumen morphology when compared to controls.

Citation: Yohe, T.T., E.M. Dudash, K.M. O'Diam, and K.M. Daniels. 2014. Rumen morphology measurements in periruminant Holstein bull calves fed a fermentation extract of *Aspergillus oryzae*. J. Dairy Sci. 97(E-Suppl. 1):568. (Abstr.)

Reviewer's notes: Data was not shown but the researchers found that population of *Megasphaera elsdenii*, rumen pH, and rumen lactate was not affected by treatment. It is possible that the dose of 2 g was not high enough to elicit a response.

For additional ADSA 2014 scientific presentation reviews and summaries, contact your Diamond V representative.



And join members of the Diamond V Research and Technical Service Teams at JAM 2015, July 12-16 in Orlando, FL.

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