HEAT STRESS AND HEAT ABATEMENT TIPS FOR DAIRIES

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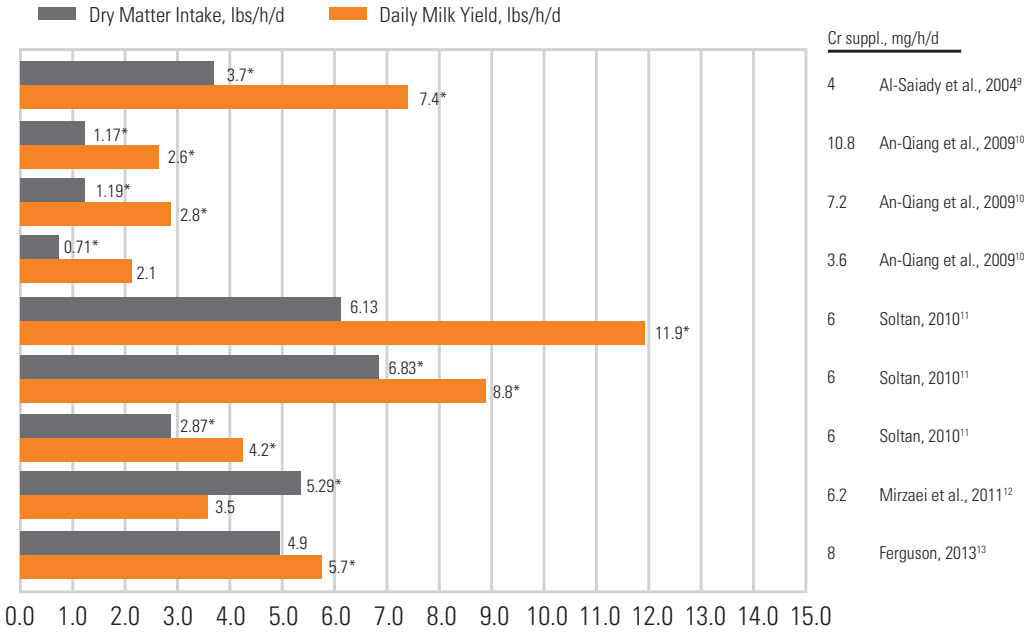
EFFECT ON CHROMIUM SUPPLEMENTATION ON HEAT STRESS

The influence of chromium on milk production has been attributed to its effects on energy metabolism reflected through decreased mobilization of NEFA from adipose tissue and increased insulin sensitivity. During extended periods of heat stress at different stages of lactation, increased glucose availability and utilization may have significant benefits to milk production. Research studies, designed to test the effect of chromium on milk yield under heat stress conditions, have shown cows supplemented with chromium yield more than control cows (Figure 3).[9-13]



Cr suppl., mg/h/d	
4	Al-Saiady et al., 2004[9]
10.8	An-Qiang et al., 2009[10]
7.2	An-Qiang et al., 2009[10]
3.6	An-Qiang et al., 2009[10]
6	Soltan, 2010[11]
6	Soltan, 2010[11]
6	Soltan, 2010[11]
6.2	Mirzaei et al., 2011[12]
8	Ferguson, 2013[13]

Response in daily milk yield, lbs/h/d and dry matter intake, lbs/h/d compared to the control within the study.
** Denotes significant difference from control.*

Figure 3: Effect of chromium supplementation in lactating dairy cow diets on response in daily milk yield and dry matter intake, lbs/h/d under heat stress conditions.

Summary

- Dairy cattle have historically been selected for traits contributing to productivity. As a result of this selection strategy, dairy cattle have become less heat tolerant.
- Climate controlled experiments indicate milk yield starts to decrease at a THI of 68.
- Keeping cows cool and eating are the two most important strategies for cows facing heat stress.
- There are multiple management and nutritional strategies available to dairy producers to combat heat stress.
- Kemin provides the solutions producers need to help optimize animal performance.

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WHY HEAT STRESS MATTERS

Dairy cattle have historically been selected for traits which contribute to productivity. In general, body mass has increased to accommodate a large mammary system and other internal organs that contribute to milk synthesis.[1] As a result, this selection strategy has decreased heat tolerance of dairy cattle because the body heat produced to meet maintenance needs is directly proportional to the body weight and surface area of an animal.[2] Therefore, as a cow increases in size, metabolic heat production increases. Metabolic heat production also escalates as the productive capacity of a dairy cow increases. In the United States, approximately $1 billion is lost annually as a result of poor performance during periods of heat stress.[3]

TEMPERATURE HUMIDITY INDEX (THI)

It was traditionally thought lactating cows become heat stressed when conditions exceed a temperature humidity index (THI) of 72.[4] However, recent climate controlled experiments indicate milk yield starts to decrease at a THI of 68.[5,6] Table 1 examines human and dairy cattle experience heat stress under conditions that typically are not thought of as stressful and the consequences can be severe.[7]

Table 1: Dairy cow and human temperature humidity index.[7]

DAIRY COW TEMPERATURE HUMIDITY INDEX (THI)																				HUMAN HEAT INDEX											
Humidity %																				Humidity %											
Temp °F	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	Temp °F	40	45	50	55	60	65	70	75	80	85	90
72	64	65	65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71	72											
74	65	66	66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73	74											
76	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76											
78	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76	78											
80	68	69	69	70	70	71	72	72	73	74	75	75	76	76	77	78	78	79	79	80	80	80	81	81	82	82	83	84	84	85	86
82	69	69	70	70	71	72	73	73	74	75	75	76	77	77	78	79	79	80	80	82	81	82	83	84	84	85	86	88	89	90	91
84	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83	84	83	84	85	86	88	89	90	92	94	96	98
86	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84	86	85	87	88	89	91	93	95	97	100	102	105
88	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86	88	88	89	91	93	95	98	100	103	106	110	113
90	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88	90	91	93	95	97	100	103	105	109	113	117	122
92	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90	92	94	96	99	101	105	108	112	116	121	126	131
94	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92	94	97	100	103	106	110	114	119	124	129	135	
96	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94	96	101	104	108	112	116	121	126	132			
98	76	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95	98	105	109	113	117	123	128	134				
100	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98	100	109	114	118	124	129	136					
102	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100	102	114	119	124	130	137						
104	79	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98	99	100	101	104	119	124	131	137							
106	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103	106	124	130	137								
108	81	82	83	85	86	88	89	90	92	93	94	96	97	98	100	101	103	104	105	108	130	137									
110	81	83	84	86	87	89	90	91	93	95	96	97	99	100	101	103	104	106	107	110	136										

Image used with permission by University of Minnesota Dairy Extension, April 2016.

68-71 Mild

Stress threshold for lactating cows. Respiration rate may exceed 60 BPM. Milk losses begin ~ 2.5 lbs/cow/day. Reproductive losses are detectable and rectal temperature exceeds 101.3°F. **Caution for people depending on age, exposure and activity.** People may not feel heat stress until 80°F and 40% humidity.

72-79 Moderate

Mild to moderate stress for lactating cows. Respiration rates may exceed 75 BPM. Milk loses ~ 6 lbs/cow/day. Rectal temperatures will exceed 102.2°F. **Extreme caution for people depending on age, exposure and activity.**

80-89 Severe

Moderate to severe stress for lactating cows. Respiration rate exceeds 85 BPM. Milk loses ~ 8.7 lbs/cow/day. Rectal temperature exceeds 104°F. **Danger for people depending on age, exposure and activity.**

>90 Danger

Severe stress! Life threatening conditions for lactating cows. Respiration rates are 120-140 BPM. Rectal temperatures may exceed 106°F. **Extreme danger of heat exhaustion and/or heat stroke for people when working in these conditions.**

HEAT ABATEMENT TIPS

The two most important things to do for cows facing heat stress:

1. Keep cows cool using fans, shade and water (for drinking, and spraying and/or soaking their bodies).
2. Do whatever is necessary to keep cows eating.

Heat Stressed Cow.[14]

Water

- Drinking water should be available in multiple places in every pen and exit alleys from the parlor. In a pen, there should be at least 3 inches of linear water trough space per cow.
- Clean waterers every day during the warm months. A cow's water needs increase dramatically when she is under heat stress. Make sure water is available, appealing and palatable.

Shade

- Provide shade for all animals housed outside: place shades over feed bunks, waterers and resting areas.

Fans and Sprinklers or Soakers (areas needing cooling intervention are listed in order of importance)*

- Holding pens.
- Far-off and close-up dry cows — cooling in these areas has been shown to increase milk production in the subsequent lactation and improve immune function. The advantage of cooling dry cows is carried into the next generation as well. Calves carried by cooled dams versus heat stressed dams have been shown to be healthier, grow better and perform better in their first lactation.[8]
- Maternity pens.
- Fresh cow and heifer pens.
- High production milking pens.
- Milk parlor.
- Milk parlor exit lane.
- Hospital pen.
- Work areas, such as cattle chutes and palpation rails.

*For specifics regarding fan placement, size and type as well as specifics regarding appropriate design of soakers and sprinklers, consult the Elanco publication "Heat Abatement" which is available at https://www.elanco.us/pdfs heatabatementguide.pdf. The Extension.org website has several useful pieces including "Evaluating and selecting cooling systems for different climates" available at http://articles.extension.org/pages/17586/evaluating-and-selecting-cooling systems-for-different-climates.

Management Changes

- Add extra waterers, either temporary or permanent, in the parlor return lanes if necessary.
- Clean all waterers daily.
- Begin mixing feed for lactating cow pens twice a day.
- Deliver fresh feed to the lactating cow pens in the early morning and late in the day.
- Push up often and remove leftover feed every day. Clean feed bunks thoroughly.
- Use high quality forages in all diets. Better quality forages are easier to digest and provide more nutrients pound for pound than poor forages. Moldy and spoiled feeds interfere with the proper functioning of the rumen, are prone to heating, decrease dry matter intake and can cause off-feed events.
- Do whatever is possible to decrease other stressors facing the herd: control flies, minimize lock-up times, work cattle during the coolest parts of the day or delay cattle work if possible.
- Herds using rBST should continue to use it in summer months.

Nutritional Strategies

- Ensure diets have sufficient effective, digestible fiber. Avoid diets likely to induce subclinical acidosis.
- Chromium should be in all transition and lactating cow diets. Chromium has been shown to alter insulin action, increase dry matter intake and increase milk production under heat stress conditions.[9-13]
- Discuss with your nutritionist: increasing potassium, sodium bicarbonate and zinc levels in the diet.
- Consider adding products which have demonstrated ability to increase dry matter intake (e.g., yeast products), feed efficiency and/or improve gut integrity.

FEED QUALITY

Just as heat can impact animal performance, it can also impact the feed ingredients used in dairy rations. Moldy or spoiled feed should not be fed to any group of animals during periods of heat stress, preserving these feed and feed ingredients becomes of utmost importance. Reports from Dairyland Labs indicate wild yeast counts are higher in 2016 versus previous years.[15] Nearly 20% of corn silage samples tested during the first three months of 2016 have more than 10 million CFU/gram of wild yeast.[16] Research by Limin Kung shows wild yeast starts a cascade of events leading to TMR heating[17] and spoiled feed. Research also shows acetic acid, along with propionic acid, helps control the growth of wild yeast and mold (Figures 1, 2).[18,19] Ultra CURB® Dry and Ultra CURB® Liquid have high levels of acetic and propionic acid to help control the growth of spoilage organisms.

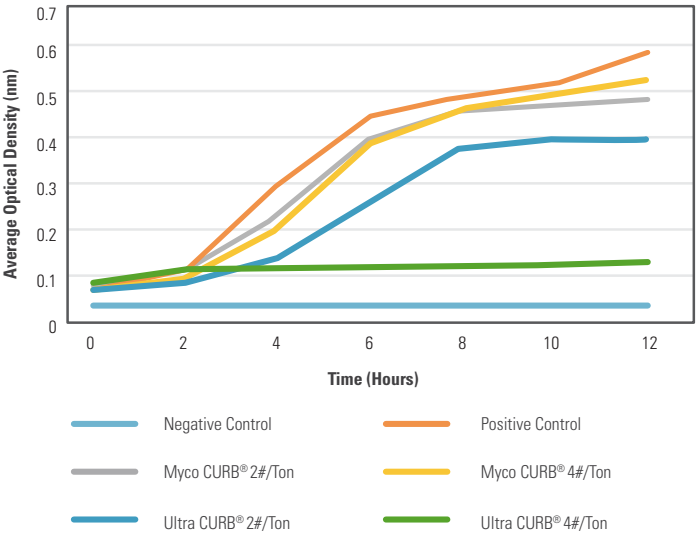

Figure 1: Optical density at 600 nm by treatment[18] (optical density is a measure of yeast growth).

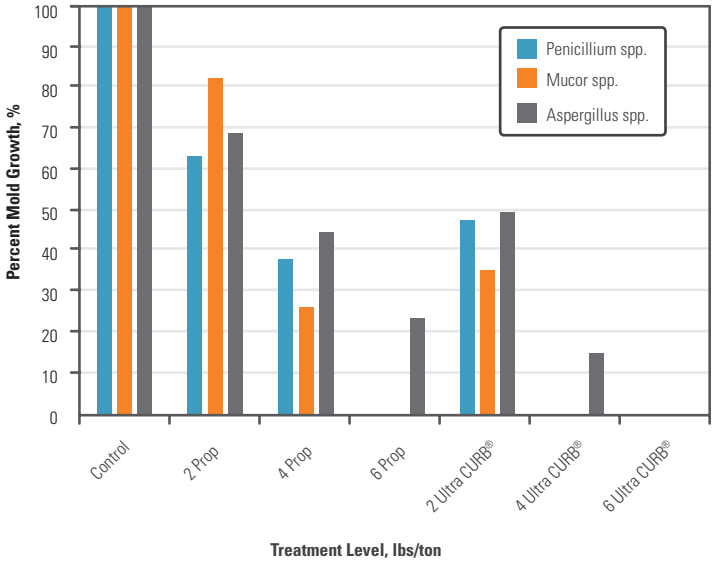

Figure 2: Control of mold growth[19] using propionic (prop) acid or Ultra CURB® Liquid.

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- Gut Health
- Risk Management

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