



Managing heat stress in dairy cows

By: Brad Clyburn Ph.D.
Chr. Hansen Animal Health & Nutrition

In North America, heat stress is a significant cow health issue with economic consequences. The combination of lost milk and components, poor reproductive performance, rumen acidosis, increased health care costs and reduced heifer growth rates can have a significant financial impact on the dairy.

Ambient temperature is well known to affect milk production, and its effect is compounded by relative humidity. A better predictor of whether a cow is adversely affected by heat is the

temperature-humidity index (THI), which is a combination of relative humidity and ambient temperature.

A cow shows signs of heat stress when the THI is as low as 68 (*Zimbelman et al., 2009*). Productivity can start to decrease with mild to moderate heat stress when observed THI levels are between 72 and 79. When relative humidity is high, this point can be achieved at moderate temperatures (see THI chart).

Temperature	% Relative Humidity																					
°F	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
72	22.0	64	65	65	65	66	66	67	67	67	68	68	69	69	70	70	71	71	72	72	73	73
73	23.0	65	66	66	66	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74
74	23.5	66	66	66	67	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75
75	24.0	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
76	24.5	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76
77	25.0	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76	77
78	25.5	67	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77	77	78
79	26.0	67	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78	78	79
80	26.5	68	69	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	79	80
81	27.0	68	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80	80	81
82	28.0	69	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	80	80	81	81	82
83	28.5	69	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	82	83
84	29.0	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83	83	84
85	29.5	70	71	72	73	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84	84	85
86	30.0	71	72	73	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84	84	85	86
87	30.5	71	72	73	73	74	75	75	76	77	78	79	80	81	81	82	83	84	85	85	86	87
88	31.0	72	72	73	74	75	75	76	77	78	79	80	81	82	83	84	85	86	86	87	88	88
89	31.5	72	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87	88	89
90	32.0	72	73	74	75	75	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89	90
91	33.0	73	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89	90	91
92	33.5	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	87	88	89	90	91	92
93	34.0	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	93
94	34.5	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
95	35.0	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
96	35.5	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
97	36.0	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
98	36.5	76	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95	96	98
99	37.0	76	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	99
100	38.0	77	78	79	81	82	83	84	85	86	87	88	89	91	92	93	94	95	96	98	99	100
101	38.5	77	79	80	81	82	83	84	86	87	88	89	90	92	93	94	95	96	98	99	100	101
102	39.0	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	98	99	100	102	102
103	39.5	78	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98	99	101	102	103
104	40.0	79	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98	99	100	101	103	104
105	40.5	79	80	82	83	84	86	87	88	89	91	92	93	95	96	97	99	100	101	102	103	105
106	41.0	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103	104	106
107	41.5	80	81	83	84	85	87	88	90	91	92	94	95	96	98	99	100	102	103	104	106	107
108	42.0	81	82	83	85	86	88	89	90	92	93	94	96	97	98	100	101	103	104	105	107	108
109	43.0	81	82	84	85	87	89	89	91	92	94	95	96	98	99	101	102	103	105	106	108	109
110	43.5	81	83	84	86	87	89	89	91	93	94	96	97	99	100	101	103	104	106	107	109	110
111	44.0	82	83	85	86	88	90	91	92	94	95	96	98	99	101	102	104	106	107	108	110	111
112	44.5	82	84	85	87	89	90	91	93	94	96	97	99	100	102	103	106	108	109	111	112	112
113	45.0	83	84	86	87	89	91	92	93	95	96	98	99	101	102	104	106	108	110	111	113	113
114	45.5	83	85	86	88	89	92	92	94	96	97	99	100	102	103	105	106	108	109	111	112	114
115	46.0	84	85	87	88	90	92	93	95	96	98	99	101	102	104	106	107	109	110	112	113	115
116	46.5	84	86	87	89	90	93	94	95	97	98	100	102	103	105	106	108	110	111	113	114	116
117	47.0	85	86	88	89	91	93	94	96	98	99	101	102	104	106	107	109	111	112	114	115	117
118	48.0	85	87	89	90	92	94	95	97	98	100	102	103	105	106	108	110	111	113	115	116	118
119	48.5	85	87	89	90	92	94	96	97	99	101	102	104	106	107	109	111	112	114	116	117	119
120	49.0	86	88	89	91	93	95	96	98	100	101	103	105	106	108	110	111	113	115	117	118	120

Stress Threshold Respiration rate exceeds 60 BPM. Milk yield losses begin. Repro losses detectable. Rectal temperature exceeds 38.5°C (101.3°F)

Mild-Moderate Stress Respiration rate exceeds 75 BPM. Rectal temperature exceeds 38°C (102.2°F)

Moderate-Severe Stress Respiration rate exceeds 85 BPM. Rectal temperature exceeds 40°C (104°F)

Severe Stress Respiration rate 120-140 BPM. Rectal temperature exceeds 41°C (106°F)

Individual cows can be affected differently by heat stress. For instance, higher-producing cows are more likely to exhibit signs of heat stress than lower-producing cows because higher-producing cows generate more heat as they consume more feed for higher levels of production. Dairy cows have a need to dissipate extra heat generated as a result of metabolizing more nutrients from feed. Approximately two pounds of milk production is lost for every pound of decreased dry matter intake when temperature and humidity levels are high (*Pennington and Van Devender 2011*).

Reduced dry matter intake (DMI) has a financial impact on milk production and when cows are heat stressed they will tend to eat less often and more at each feeding, which can lead to acidosis. Dr. Lance Baumgard (Innovations, April 2007, Iowa State University) had the following comments on how significant heat stress can be on the disruption of a cow's normal feeding pattern:

- “A disruption in feeding patterns is very significant for several reasons.
 - First you'll see a reduction in feed intake, which is a natural mechanism designed to reduce the cow's metabolic heat.
 - You'll see her feeding in bouts (during the cool evening), and this may alter her lactic acid production.
 - Reduced rumination means less saliva production and therefore, less buffering capacity in the rumen.
 - Drooling also reduces the amount of high quality saliva used in buffering as well.

All these factors can put her at an increased risk of developing rumen acidosis.

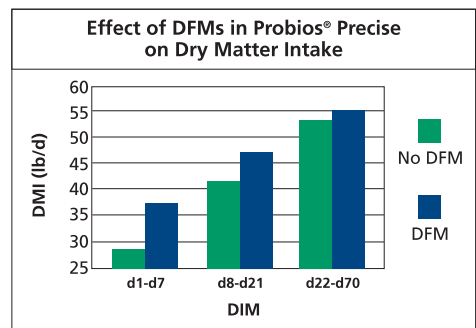
When asked to further explain the physiological effect behind these observations, Dr. Baumgard responded with the following comments: “The increased respiration also

“...nutritional strategies to increase ruminal propionate production and liver glucose output or reduce sensitivity to insulin are very important.”

expired. To compensate, the kidney dumps HCO₃ which is required to buffer the rumen. Combined with the loss of saliva the potential for rumen acidosis increases greatly. Our research has also shown that the heat stressed cow becomes hypersensitive to insulin and has decreased NEFA levels along with an increase in glucose disposal. The cow appears to preferentially burn glucose because that may create less metabolic heat (up to 13% less) than burning fatty acids, which is normal when she has reduced feed intake. Heat stressed cows require extra energy however, especially from glucose which is now in short supply. Ultimately she ends up with less glucose going to the mammary gland from the liver, which reduces lactose production. It's like “survival mode” for the cow, in that she partitions her nutrients in a different way. Therefore, nutritional strategies to increase ruminal propionate production and liver glucose output or reduce sensitivity to insulin are very important.”

“The scientific literature suggests that Probios® Precise fed cows have increased DMI and a more stable rumen environment.”

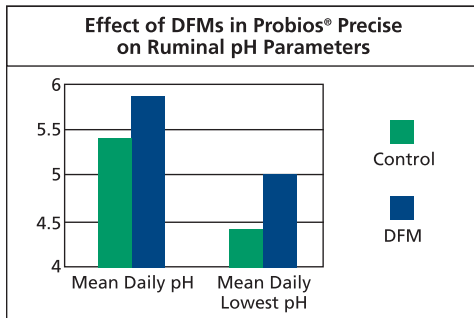
When asked if a DFM like Probios® Precise can help with heat stress, Dr. Baumgard concluded: “I think so. The scientific literature suggests that Probios Precise fed cows have increased DMI and a more stable rumen



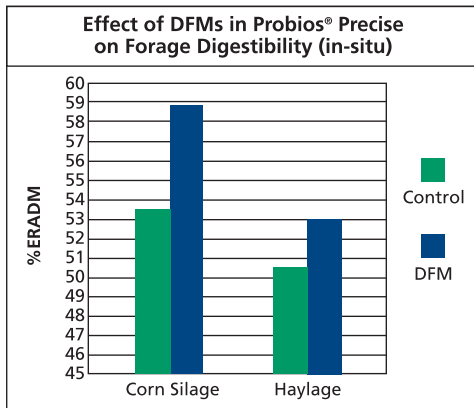
Journal of Dairy Science, 2003

environment. During heat-stress this should minimize the negative effects of heat stress on production and help maintain a healthy rumen.”

The ingredients in Probios® Precise and Probios® Complete have been shown through research and field observations to decrease fecal starch with rations containing moderate to high levels of starch (>25% DM basis). Additionally, research feeding Probios® brand DFMs demonstrates improved digestion, feed utilization and dry matter intake (Nocek *et al.*, 2002; Nocek *et al.*, 2003; and Nocek and Kautz 2006).



Journal of Dairy Science, 2002



Journal of Dairy Science, 2006

References:

Nocek *et al.*, 2002, *JDS* 85:429-433

Nocek *et al.*, 2003, *JDS* 86:331-335

Nocek and Kautz 2006, *JDS* 89:260-266

Pennington and Van Devender 2011 - www.extension.org/pages/11047/heat-stress-in-dairy-cattle

Zimelman *et al.*, 2009 Proc 24 Southwest Nutrition and Management Conference, Tempe, AZ, pp 158-168.