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NiaShure™

Precision Release Niacin

Balchem Research Summary

Effects of encapsulated niacin on evaporative heat loss and body temperature in moderately heat-stressed lactating Holstein cows

Effects of utilizing rumen-protected niacin on core body temperature as well as milk production and composition in lactating dairy cows during heat stress

Zimbelman, R. B., L. H. Baumgard and R. J. Collier. 2010. J. Dairy Sci. 93:2387–2394.

Zimbelman, R. B., R. J. Collier and T. R. Bilby. 2013. Anim. Feed Sci. Tech. 180:26-33.

Background

An animal's thermal neutral zone is the range in environmental temperature at which the animal can maintain a normal body temperature without significantly having to modify its metabolism or physiology. Heat stress begins when an animal is exposed to a combination of temperature and humidity exceeding its thermal neutral zone. This combination of temperature and humidity is referred to as the Temperature Heat Index (THI). For a dairy cow producing about 75-80 pounds of milk, heat stress begins at a THI of about 68 (Zimbelman et al., 2008). The consequences of heat stress include increased maintenance energy requirement, reduced feed intake, decreased milk production (10 to 35%), reduced milk components and poorer reproductive performance.

Cows experiencing heat stress are primarily dependent on evaporative cooling to control rises in body temperature. Evaporative cooling results from the evaporation of liquid (sweat, water) from the skin surface of the cow, which removes heat in the process. Niacin has been shown to cause vasodilation, particularly in peripheral tissues. Di Costanzo et al. (1997) reported that cows fed niacin had significantly lower skin temperatures measured at the rump. The objective of these two studies was to measure the impact of feeding NiaShure™ Precision Release Niacin on lactating cows exposed to moderate heat stress.

Materials and Methods

Study 1 was conducted at the University of Arizona (Zimbelman et al., 2010). Twelve lactating multiparous Holstein cows producing approximately 68 pounds of milk were housed in individual stalls in environmentally controlled rooms. After a 4 d adjustment period, cows were exposed to a thermoneutral THI of <72 (24 h/d) for 7 d (period 1). Cows were then exposed to heat stress (HS) for 7 d (period 2), which consisted of a THI >72 for 12 h/d. At the beginning of Period 1, 6 cows (3 per room) were assigned to either 0 or 12 g/day of NiaShure. The 12 g/day of NiaShure was evenly split between the two daily feedings.

Milk yield was measured twice daily and the morning milk sampled and analyzed for fat, protein and lactose. Water and feed intakes were measured daily. Surface temperatures of shaved and unshaved areas (rump, shoulder and tail head) were taken 4 times a day using an infrared temperature gun. Vaginal temperatures were monitored using temperature loggers and rectal temperatures were measured 4 times a day using a rectal thermometer. Respiration rates were obtained 4 times/d at 0800, 1000, 1400 and 1600 h. Evaporative heat loss (EVHL) from shaved and unshaved areas was measured 4 times/d.

Study 2 was conducted on a commercial dairy located in Arizona between August 7 and October 7 (Zimbelman et al., 2013 Anim. Feed Sci. Tech.). Four hundred and twenty-seven lactating multiparous and primiparous cows were balanced by days in milk (DIM), parity and milk yield. Cows were fed a TMR three times/d and were assigned to treatments of either 0 or 12 g/h/d of NiaShure. The study was a crossover design with two pens. Periods were 30 days and treatments were switched at the end of the first 30 d period. Individual milk yields were measured three times per day and one milking during each 30 d period was sampled for milk components (SCC, fat, true protein, lactose and SNF). Cows were housed in large open lots with shades and Korral Kool coolers and shaded feed bunks. There was no cooling over the feed bunks. During August and September, coolers turned on when the temperature exceeded 78°F and off when it dropped below 75°F. However, during the month of October, the coolers turned on when the temperature exceeded 80 °F and off when it dropped below 78°F. Cows were milked three times/d and cows were cooled in the holding pen. In each period, temperature data loggers were vaginally placed in a cohort of 16 cows (8 heifers and 8 multiparous cows) per pen 2 weeks after going on treatments, and temperature data was collected for 8 days.

Results and Discussion

In Study 1, DMI was not affected by treatment but was lower during the HS period for both treatments. Milk yield was not affected by either environment or NiaShure supplementation. Milk fat content did not differ by treatment, but milk fat tended ($P<0.06$) to be lower during heat stress regardless of treatment. Milk fat yield was decreased by HS. Milk protein content was decreased by NiaShure supplementation vs. control (2.84% and 2.93%, respectively) and was higher during HS. However, milk protein yield was not different between treatments or environments. While DMI was decreased during the HS period, the lack of impact on milk production and relatively small impact on components suggest either the level of heat stress was relatively mild or the treatment period was not long enough to express significant effects. The fact that the cows' environmental temperature was allowed to go back below THI 72 at night could allow the cows to cool during the night, which would mitigate the negative effects of daytime heating.

Cows fed NiaShure during the HS period had significantly lower core body (vaginal) temperatures (Figure 1). The lower body temperatures particularly during the HS application may reflect the increased sweating rate noted in Figure 2, particularly at or near peak HS (1400 hr).

Mean daily THI for the two periods in Study 2 are shown in Figure 3. The mean daily THI never got below 68 (the cutoff the authors used for HS); however, daily minimum and maximum THI were not reported so no assessment of the potential for nighttime cooling can be made. It is apparent that Period 2 average daily THI was much lower (75.6) than Period 1 (85.2), which may impact the interpretation of the data. During Period 1, milk yield was significantly increased in cows fed NiaShure (4.06 lbs, P<0.05); however, yields were lower in Period 2 in NiaShure-fed cows. Milk protein percent was not affected by treatment (Control 3.05% vs. NiaShure 3.09%). Percent milk fat was not impacted in Period 1 but was significantly higher in Period 2 for NiaShure-fed cows (3.28% vs 3.85%).

Vaginal temperatures were lower (P<0.01) for NiaShure-fed cows *regardless of period* and were lower in Period 2 (P<0.01) compared with Period 1, which could be expected in light of the differences in THI.

Summary

Research has shown that heat stress can cause decreases in DMI, milk production and reproductive performance. These studies show that NiaShure Precision Release Niacin significantly decreases core body (vaginal) temperature during periods of heat stress.

Figure 1. Pattern of vaginal temperatures at 1-h intervals of lactating Holstein cows supplemented with 0g (●) or 12 g (O) of encapsulated niacin per day during d 4 to 7 of heat stress. The SEM derived from the pooled vaginal temperature was 0.02. Treatments differ at p<0.001.

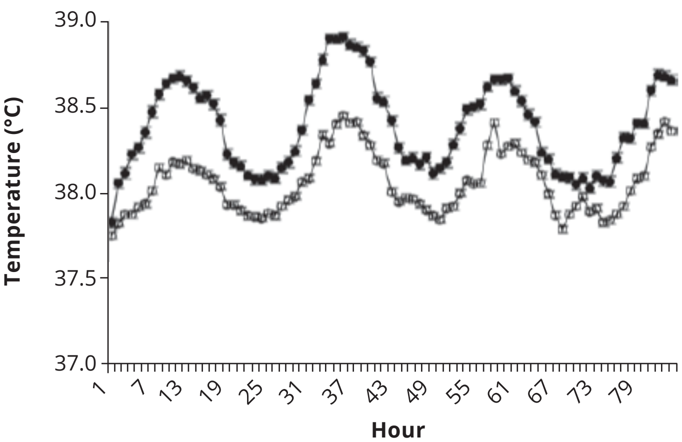


Figure 2. Effect of temperature-humidity index (THI) on mean evaporative heat loss in control (white bars) and niacin-fed (purple bars) cattle at 0800, 1000, 1400, and 1600 h during heat stress. THI values in boxes represent THI at time of measurement (THI at 0800 h = 73.4; THI at 1000 h = 75.1; THI at 1400 h = 78.9; and THI at 1600 h= 77.5; SEM = 6.6).

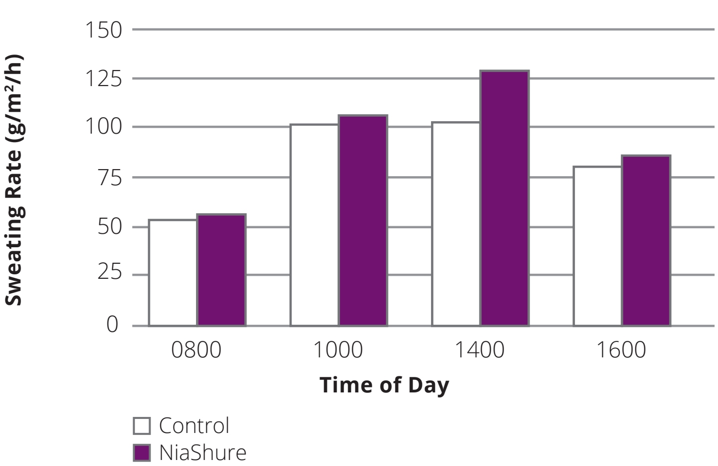
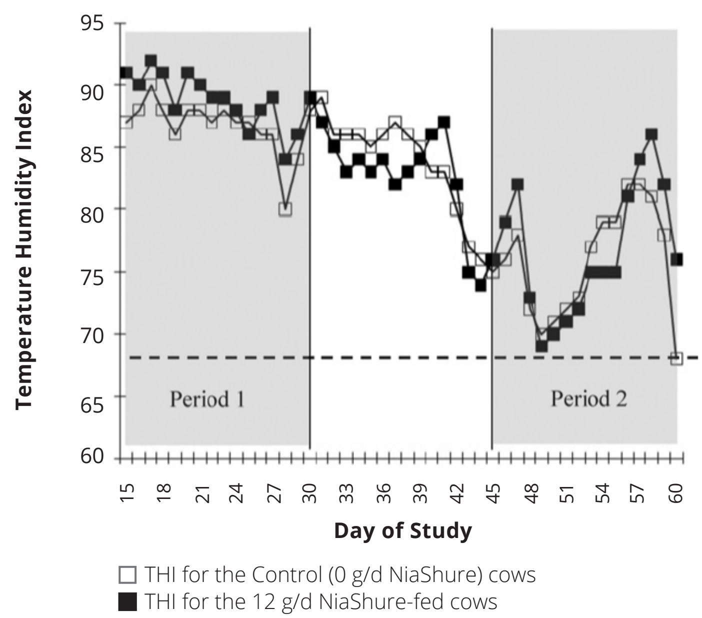


Figure 3.



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