The Impact of Feeding OmniGen® in Dry Cows Heat Stressed with an Electric Blanket Model

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Abstract

Heat stress (HT) in the dry period of dairy cows reduces milk yield and impacts health in the next lactation. Previous work indicates that feeding OmniGen® (OMN) nutritional specialty product helps mitigate the detrimental effects of HT. Electric blankets (EB) can induce HT in lactating cows, but the EB model had not been previously used with dry cows. The objective of this study was to examine the impacts of feeding OMN to dry cows experiencing a HT challenge induced by EB. We hypothesized that OMN would ameliorate the impacts of HT induced by EB. Fifty Holstein cows were housed individually in a tie-stall barn upon dry-off (225 ± 3 d carried calf) and half of the cows were outfitted with EB to simulate HT or no blanket (NB) to simulate cooled conditions (CL). Within HT and CL, cows were fed OMN (OMN; 56 g/d) or did not receive OMN (CON), which resulted in a 2x2 factorial of four treatments: HTCON (n=13), CLCON (n=13), HTOMN (n=12), and CLOMN (n=12). All cows remained in the barn with EB on or NB until calving except for one hour a day where they were allowed to exercise outside with the EB unplugged. Throughout the dry period, DMI (kg/d) and respiration rate (RR: breaths per minute [bpm]) were measured daily, as well as rectal temperature (RT:°C), which was measured twice daily. Data were analyzed using the GLIMMIX procedure in SAS. Use of EB increased RT (CLCON = 38.17; HTCON = 38.39; CLOMN = 38.07; and HTOMN = 38.36 °C; $P < 0.0001$), and RR (CLCON = 37.47; HTCON = 49.51; CLOMN = 37.24; and HTOMN = 51.84 bpm; $P < 0.0001$) relative to NB regardless of diet. Prepartum DMI was reduced by HT (CLCON = 25.97; HTCON = 23.23; CLOMN = 25.82; and HTOMN = 25.27 kg/day) and OMN feeding overcame this effect ($P = 0.07$). Water intake varied by main effect of HT vs CL ($P < 0.01$). Dry period HT conditions reduced milk yield in the subsequent lactation, but OMN overcame this effect (CLCON = 47.63; HTCON = 41.63; CLOMN = 48.29; and HTOMN = 48.54 kg/d; CL vs HT $P = 0.07$; HTCON vs HTOMN $P = 0.04$). These data support the hypotheses that EB induce HT in dry cows and that feeding OMN throughout the dry period effectively helps mitigate the detrimental effects of HT on dry period DMI and milk yield in the next lactation.

Introduction

It is well established that heat stress through the entire dry period can have profound negative effects on milk production in the subsequent lactation (do Amaral et al., 2009; Tao et al., 2011; 2012). Previous research at the University of Florida has demonstrated the benefits of heat abatement for dry cows on milk yield and immune function following calving. Feeding OmniGen, an immunomodulator, before, during, and after heat stress in the dry period, helped lower respiration rates and rectal temperatures of dry cows and helped increase milk yield in the subsequent lactation (Fabris et al., 2017).

The objective of this study was to determine if feeding OmniGen only during the dry period would alter thermoregulation of mature dairy cows under controlled heat stress conditions using electric blankets (EB) and impact cow performance after parturition.

Materials and Methods

This study was conducted at the University of Florida Dairy Unit, starting in January 2021 and ending in May of 2022. No treatments were imposed during the summer months (i.e., May through November) such that all cooled cows were under relatively mild conditions of the fall, winter and spring months in Florida. Fifty (50) multiparous Holstein cows were blocked by genomic PTA and assigned randomly at dry-off (56 days prior to expected calving) in a factorial design to evaluate main effects and interactions. Treatments included being fed a top-dress base of soybean meal and ground corn including 56 g/d OmniGen (OMN) or fed a top dress with no OmniGen (CON) and either exposed to heat stress (HT) conditions or no heat stress (CL) conditions using EB, resulting in four treatments.

- Treatment 1: Electric heat blanket + No OmniGen (HTCON, n = 13)
- Treatment 2: No electric heat blanket + No OmniGen (CLCON, n = 13)
- Treatment 3: Electric heat blanket + 56 g/d OmniGen (HTOMN, n = 12)
- Treatment 4: No electric heat blanket + 56 g/d OmniGen (CLOMN, n = 12)

Treatments began at the start of the dry period and continued until calving. All cows remained in the barn with EB on or NB until calving except for one hour a day where they were allowed to exercise outside with the EB unplugged. Throughout the dry period, DMI (kg/d) and respiration rate (RR: bpm) were measured daily, as well as rectal temperature (RT: °C), which was measured twice daily. A negative DCAD diet, urine pH 5.5 - 6.0, was fed during the close-up period using Animate® nutritional specialty product as the sole source of supplemental anions. The average diet composition across all five blocks of the study was soybean meal (12.0%), corn silage (56.9%), hay (24.5%) and mineral mix (5.7%) for a TMR that was fed at 10.6 kg/DM/d. After calving, all cows entered the general milking group, housed in a sand-bedded freestall, fed the same lactation diet, and monitored for milk production and health through 60 days in milk (DIM). During lactation, cows were provided with active cooling whenever environmental conditions warranted it.

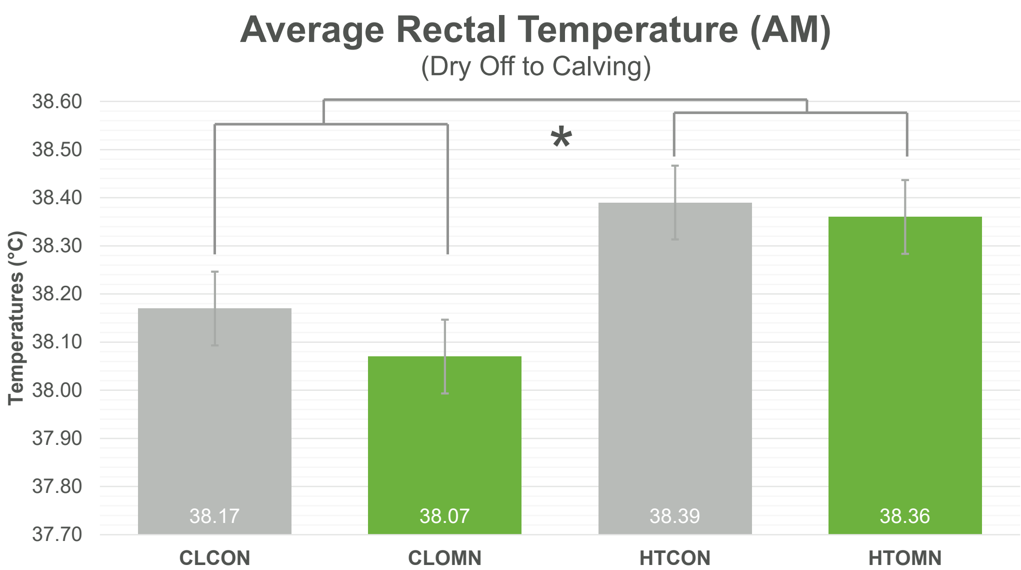
Data were analyzed using PROC GLIMMIX procedure of SAS.

Results

The Effectiveness of Electric Blankets to Induce Heat Stress

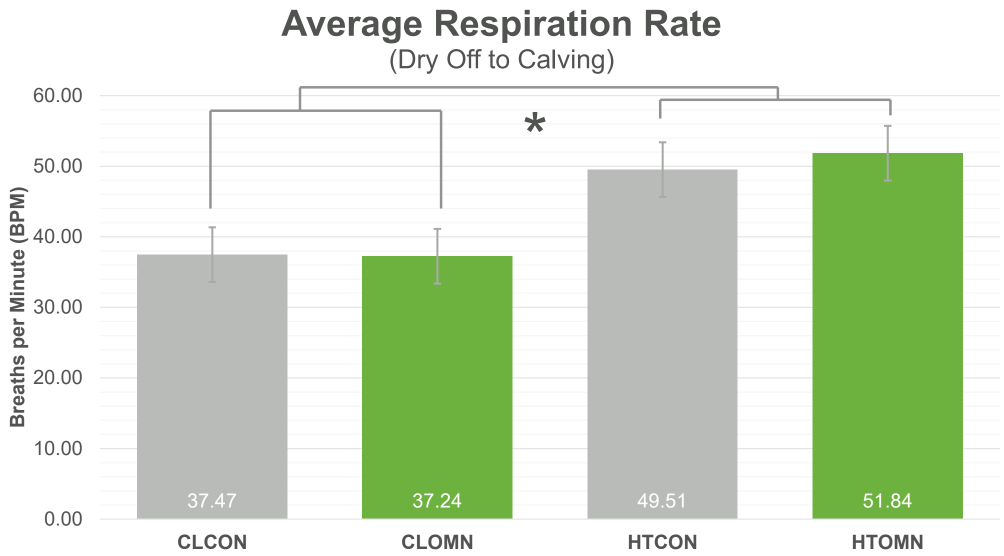
According to the design of the study, the EB were used to induce HT as assessed by rectal temperature and respiration rate. Figure 1 shows the significant increase in rectal temperatures measured in cows with induced HT. An increase in respiration rates was also observed in cows wearing EB but the mean respiration rate did not exceed 60 bpm (the threshold at which HT is experienced) for any treatment group (Figure 2).

Figure 1. Average Rectal Temperatures (RT) of Cows by Treatment in the Prepartum Period



Overall means: CLCON = 38.17 ± 0.08 HTCON = 38.39 ± 0.08 CLOMN = 38.07 ± 0.07 and HTOMN = 38.36 ± 0.08 C. | CL x HT. *(P < 0.0001). | Source: PHIBRO-JDE-424289.

Figure 2. Average Respiration Rate (RR) of Cows by Treatment in the Prepartum Period

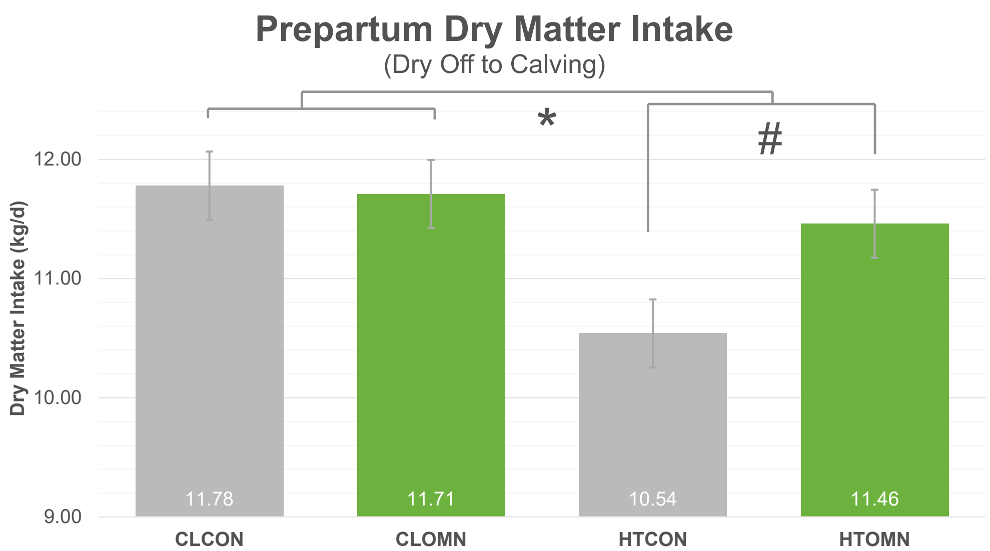


Overall means: CLCON = 37.47 ± 1.70; HTCON = 49.51 ± 1.82; CLOMN = 37.24 ± 1.52; and HTOMN = 51.84 ± 1.73 bpm. | CL vs HT. *(P < 0.0001). | Source: PHIBRO-JDE-424289.

Effects of Heat Stress and Feeding OmniGen on Prepartum Intake

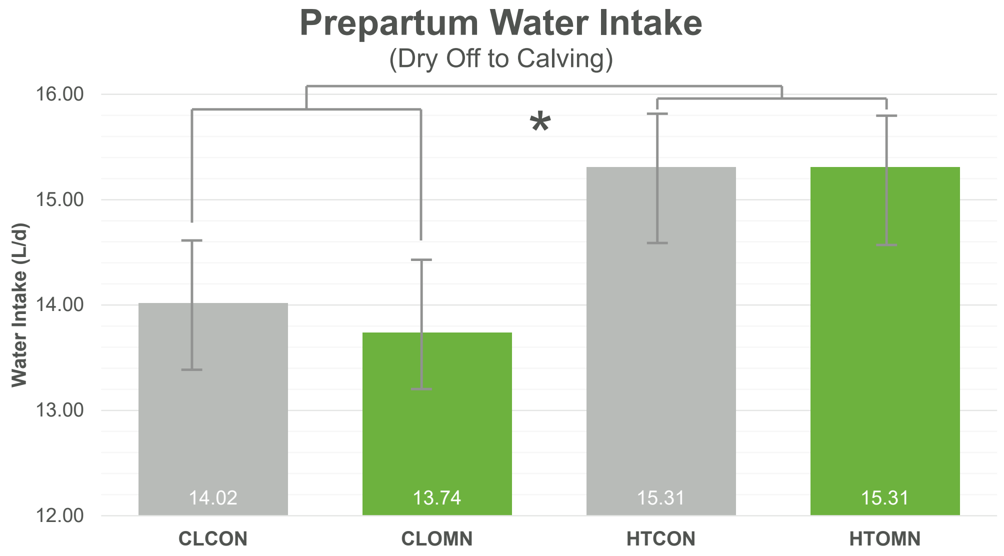
Figure 3 shows prepartum DMI was decreased in cows experiencing HT conditions compared with cooled cows (P = 0.04). However, when comparing within the EB treatment groups, cows fed OmniGen tended to have greater DMI compared to the control cows experiencing a HT challenge (P = 0.07). Water intake was increased in cows experiencing HT conditions compared to the cooled cows with no differences based on OmniGen supplementation (Figure 4).

Figure 3. Mean Prepartum Dry Matter Intake by Treatment



Overall means: CLCON = 11.78 ± 0.35; HTCON = 10.54 ± 0.37; CLOMN = 11.71 ± 0.33; and HTOMN = 11.46 ± 0.33 kg/day. | CL vs HT *(P = 0.04), HTCON vs HTOMN #(P = 0.07). | Source: PHIBRO-JDE-424289.

Figure 4. Mean Water Intake by Treatment

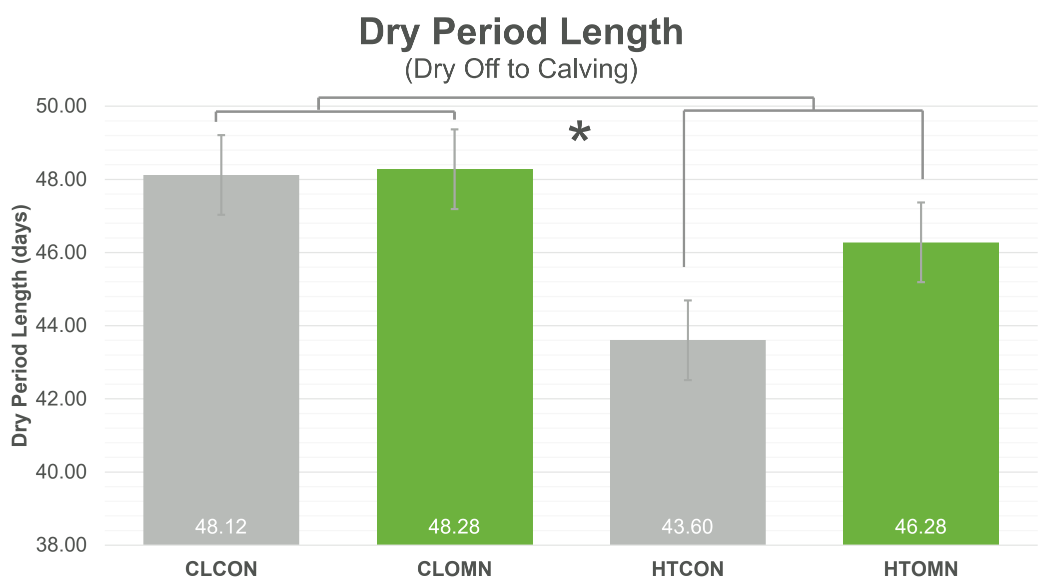


Overall means: CLCON = 14.02 ± 0.56; HTCON = 15.31 ± 0.56; CLOMN = 13.74 ± 0.52; and HTOMN = 15.31 ± 0.53 g/day; CL vs HT *(P = 0.01). | Source: PHIBRO-JDE-424289.

Production Effects of Heat Stress Challenges

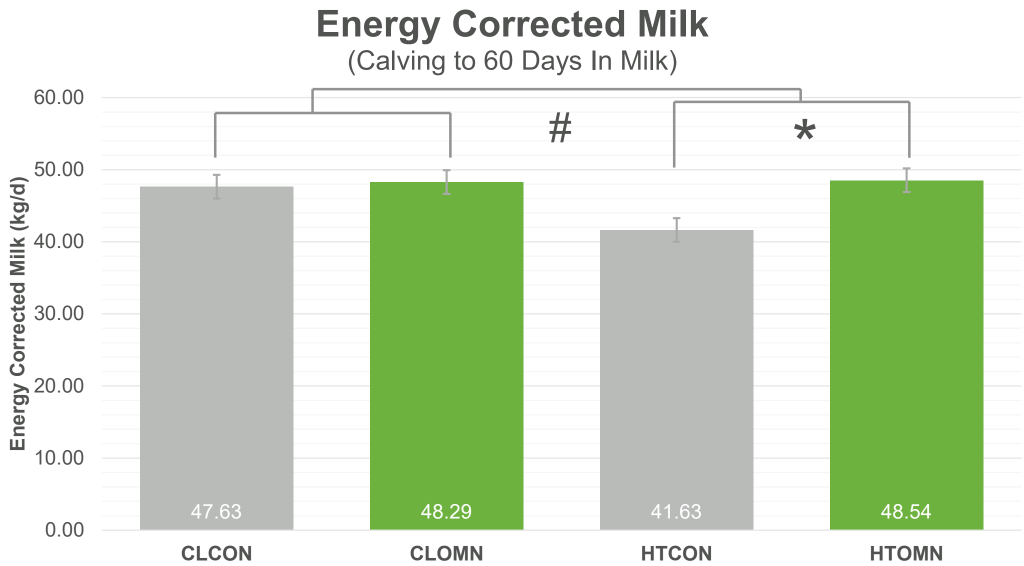
Figure 5 reports cows with EB had a shorter average dry period compared to cooled cows (P = 0.10). Postpartum ECM tended to be reduced in cows experiencing HT conditions when compared to cooled cows (P = 0.08). However, when comparing within the EB treatment groups, cows fed OmniGen had greater ECM compared to the control cows experiencing HT conditions (Figure 6; P = 0.04). Feeding OmniGen during the dry period overcame the negative impacts of dry period HT conditions on milk production in the subsequent lactation.

Figure 5. Mean Dry Period Length by Treatment



Overall means: CLCON = 48.12 ± 2.30; HTCON = 43.60 ± 2.55; CLOMN = 48.28 ± 2.17; and HTOMN = 46.28 ± 2.15 days. | CL vs HT *(P = 0.01). | Source: PHIBRO-JDE-424289.

Figure 6. Mean Energy Corrected Milk by Treatment



Overall means: CLCON = 47.63 ± 3.04; HTCON = 41.63 ± 3.30; CLOMN = 48.29 ± 3.08; and HTOMN = 48.54 ± 2.96 kg. | CL x HT #(*P* = 0.07), HTCON X HTOMN *(*P* = 0.04). | Source: PHIBRO-JDE-424289.

Discussion

The EB were able to induce a controlled HT response, increasing RT and RR in the EB treatment groups, as seen in a lactating cow model (Al-Qaisi et al., 2019). However, mean RR did not reach 60 bpm which has been used as a threshold indicator of HT from environmental conditions (Zimbelman et al., 2009). Further, the humidity during the current study was below that observed in the summer in Florida. Thus, the electric blanket heat stress model is useful for controlled research studies but may not completely match HT conditions experienced by dairy cows. There were no main effects of OmniGen vs Control, but an interaction effect showed the greatest difference for HTOMN vs HTCON.

Prepartum DMI was reduced in cows under HT conditions compared to cooled cows, but feeding OmniGen to HT challenged cows mitigated the reduction in DMI. All EB cows increased water intake compared to cooled cows and reported a shorter dry period.

Postpartum production was reported as energy corrected milk (ECM). There was a tendency for cows under HT conditions in the dry period to produce less ECM relative to cooled dry cows. Within the HT challenged group of cows, cows fed OmniGen produced significantly more ECM compared to HT challenged cows not fed OmniGen. This confirms the effect of feeding OmniGen to help mitigate the negative impact of dry period HT on production.

Based on these production results, and previous research with dry cows experiencing HT conditions, feeding OmniGen to dry cows at the same time as the HT challenge starts, may help overcome the negative impact of HT on prepartum intake and postpartum production in early lactation.

Previous research demonstrated cows fed OmniGen before, during, and after the dry period were able to overcome the negative effects of dry period HT on milk yield in the subsequent lactation (Fabris et al., 2017). The research reviewed here showed similar responses in early lactation milk yield when OmniGen is fed only during the dry period to dry cows exposed to a heat stress challenge.

References

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