

Use of an Ear Tag Based Behavioral and Temperature Monitor (Cow Manager™) During a Heat Stress Induction Trial Using Electric Heat Blankets (EHB): (Preliminary Results)

A.S. Leaflet R3166

Mohammad Al-Qaisi, Animal Science Graduate Student;
Dr. Leo Timms, Morrill Professor in Animal Science

Summary and Implications

Heat stress (HS) is an annual environmental issue which negatively affects a variety of production parameters including milk yield and composition, growth, and reproduction. A study was conducted to explore the efficacy of an electric heat blanket (EHB) as an alternative method to study HS and to determine whether EHB-induced hyperthermia affects production parameters similar to natural HS. During this study, the animals were fitted with an ear tag based behavior and temperature monitor (Cow Manager, Agis Automatisering, Netherlands) to evaluate behavior and ear temperature changes through the heat stress study and understand the potential use of behavior monitors in the field for early heat stress identification and mitigation. Also 24 hr continuous time lapse video was captured on all animals during their time in the trial barn. Data from this trial is being analyzed. This paper presents behavior and temperature graphs, data, and comments from one animal over her trial period. When animals were moved to the trial barn, ear temperatures increased to 80-95°F and remained there for the 2 week barn period indicating increased blood flow to the ear for heat dissipation. Ear temperatures were highest during the blanketed period. There were some daily and diurnal changes associated with external temperatures (barn had curtains). Mostly animals rested with heads toward outside cooler walls, evidencing animal behavior to mitigate heat load. Ear temperatures dropped immediately and returned to normal when returned to colder herd free stall barn. Compared to baseline daily normal activity % (eating, ruminating, non-active, active, and highly active), changes were seen when animal were moved to the barn or in the barn (increased activity, perceived increased eating but related to more head movement due to environment adjustments rather than truly eating). During week 1 in the barn (warmer barn but no blankets), behavioral changes captured included decreased eating times (15-18% vs. 25-27% normally) but uniquely increased rumination times (which were associated with increased respiration and panting activity rather than rumination). Once the blanket was applied for 1 week, further behavioral changes were seen with daily eating times decreased to 8-10% (also changes when animals ate - mostly only when moved to milk) but rumination times increased (65-75%) but was associated with increases in

respiration and panting movement rather than rumination. When blankets were removed and animals returned to normal freestall, ear temperatures immediately adjusted and dropped to normal but behavior changes to normal took 1-6 days. Overall, the electric blanket heat stress model was successful and behavior and ear temperature monitors were very successful in quantifying changes associated with heat stress (early with slightly warm temperatures through higher temperatures associated under the blanket). Accelerometers were excellent in measuring movement but newer algorithms need to separate random head movements from true eating, and mouth movements with no other movements associated with panting from rumination to improve diagnostic performance. Overall, the monitors look like an excellent technology to observe changes in early moderate heat stress and provide a tool for implementing early heat stress management and mitigation strategies.

Introduction

Heat stress occurs when environmental variables such as ambient temperature, humidity, and air movement create a heat load that exceeds the upper limit of the thermoneutral zone. Dairy cows are more susceptible to HS than most farm animals due to the high metabolic heat production and low surface area to mass ratio. There are large economic losses associated with heat stress in all animals, especially dairy. Cow behavior monitors are commercially available that monitor animal movements through accelerometer technology, then use algorithms to categorize those movements into different behaviors (active, highly active, non-active, ruminating, eating). Hence, our objectives were to explore the use of behavior monitors to assess behavioral changes during an induced electric blanket heat stress model study and heat stress situations. If behavior monitors are effective in finding heat stress changes, they may be used as information to implement early heat stress mitigation strategies.

Materials and Methods

Animals and Experimental Design for Electric Blanket heat stress study: Animals, experimental design and measured parameters for the electric blanket heat stress study are in a companion 2017 ISU Animal Industry report (Baumgard et al., 2017 ASL R3154). Pictures of animals with the electric blanket are shown in Figure 1.

Animals: Eartags (Cow Manager SensOor, Agis Automatisering, Netherlands) were placed in the left ears of heat stress trial cows (n=8) with 6 placed prior to trial barn entry and 2 on trial barn entry (1) or 3 days following barn

entry. Tags were on continually through the cow trial period (2 weeks) and remained on when returned to their original barn to monitor and evaluate post heat stress recovery.

Behavior monitoring system: A graphical representation of the Cow Manager Behavior Monitoring system is shown in Figure 2. Eartags that encompass an accelerometer and temperature sensor (SensOor) are placed strategically in the ear. Data is transmitted to a wireless router, and ultimately to a hard wired router coordinator at the computer. Raw data is sent via the Internet to Agis and proprietary algorithms transcribe the data into appropriate graphs and behavior and temperature charts for evaluation and alerting. Behavioral data is also stored as hourly data (behaviors and ear temperature) for every animal in an Excel database for subsequent SAS statistical analysis.

Video capture of animal behavior: 24 hr. continuous time lapse video was taken on all cows during their time in the trial barns. Video data will be correlated to behavior data to validate tag and behavior performance.

Results and Discussion

Animal health and performance: Animal health and performance data for the electric blanket heat stress study are in a companion 2017 ISU Animal Industry report (Baumgard et al., 2017 (ASL R3154).

Ear temperature data: Ear temperature data of Cow 9421 before, during heat stress trial (warmer barn and electric blanket applied during week 2), and after return to her normal free stall barn is shown in Figure 3. Temperature in the normal freestall barn prior to moving was 30-50°F. Ear temperatures prior to trial barn were 45-75°F, reflecting both changes due to daily and diurnal temperature differences. Upon entry into the trial barn (60-70+ °F), ear temperatures immediately increased to 85-90°F, indicating increased blood flow and potential heat dissipation via ear. Ear temperatures remained between 85-95°F during the trial barn period with slight changes seen to external daily and diurnal temperatures (barn had radiant heaters but curtain sidewalls so external barn walls showed diurnal and daily variations). Animal videos also showed animals lied down mostly with their head next to the outside wall, possibly as a means to regulate temperatures and possible heat stress. The graph notes that the external temperature during this 2 week period had 2 high values with low temps sandwiched in between (60 and 72°F with 45-50°F in between). The green line reflects ear temperature of animal herdmates in the normal freestall barn (ear temperatures up and down with ambient temperatures), but these changes can also be slightly seen in the trial barn cow. Over the trial barn period, animals always had elevated ear temperatures, indicating blood flow and heat transfer to ears. Upon return to her normal colder freestall barn, ear temperatures immediately dropped to reflect this and great hourly variation was seen which is normal when animals are in colder temperatures.

Animal behavior data: Daily behavior graph and comments of Cow 9421 before, during heat stress trial

(warmer barn and electric blanket applied during week 2), and after return to her normal free stall barn are shown in Figure 4. Prior to trial barn entry, cow 9421 spent (on average) 25% of her daily time eating, 40-45% time ruminating, 27% non-active, and 1-3 % in normal or high activity. On the days animal were moved into the barn (or moved to a different pen when the blanket was put on), behavioral changes or % occurred with slight increases in normal and high activity (10-15%) associated with adjustments in changing environments, less inactive time, and a slightly higher eating time (associated with increased head movements associated with environmental change and environment and not actually “eating” activity (accelerometer correct in capturing movement but incorrectly categorized as eating)). During the initial week (warmer barn but no blanket), Cow 9421 showed a decrease in eating time (15-18% compared to initial 25%). Interestingly, inactive time decreased because “rumination time” increased (55-65% of daily activity). Based on video and animal respiration measurements, these animals had increased respirations associated with higher temps and very mild heat stress but this movement was classified as rumination due to how movement data is categorized. This data combined with ear temperature data showed animals were utilizing mechanisms to dissipate heat via periphery (ears) or respiration (panting). Once the blanket was applied during the second week in the barn, eating behavior changed (8-10% of daily activity as well as altered times when animals ate (usually only when being milked)). Daily rumination times were higher (60-75%) but this movement was associated with significantly increased respirations (video as well as measured cow data) and not rumination. Upon movement back to the herd freestall, behavior changes adjusted to pre-trial normal but was variable between cows (1-6+ days).

Overall Summary and Conclusion:

A study was conducted to explore the efficacy of an electric heat blanket (EHB) as an alternative method to study HS and to determine whether EHB-induced hyperthermia affects production parameters similar to natural HS (ASL R3154). During this study, the animals were fitted with an ear tag based behavior and temperature monitor (Cow Manager, Agis Automatisering, Netherlands) to evaluate behavior and ear temperature changes through the heat stress study and understand the potential use of behavior monitors in the field for early heat stress identification and mitigation. When animals were moved to the trial barn, ear temperatures increased to 80-95°F and remained there for the 2 week barn period indicating increased blood flow to the ear for heat dissipation. Ear temperatures were highest during the blanketed period. There were some daily and diurnal changes associated with external temperatures (barn had curtains). Mostly animals lied with heads toward outside cooler walls, evidencing animal behavior to mitigate heat load. Ear temperatures

dropped immediately and returned to normal when returned to colder herd free stall barn. Compared to baseline daily normal activity % (eating, ruminating, non-active, active, and highly active), changes were seen when animal were moved to the trial barn or in the trial barn (increased activities, perceived increased eating but related to more head movement due to environment adjustments rather than truly eating). During week 1 in the barn (warmer barn but no blankets), behavioral changes captured included decreased eating times (15-18% vs. 25-27% normally) but uniquely increased rumination times (which were associated with increased respiration and panting activity rather than rumination). Once the blanket was applied for 1 week, further behavioral changes were seen with daily eating times decreased to 8-10% (also changes when animals ate - mostly only when moved to milk) but rumination times increased (65-75%) but was associated with increases in

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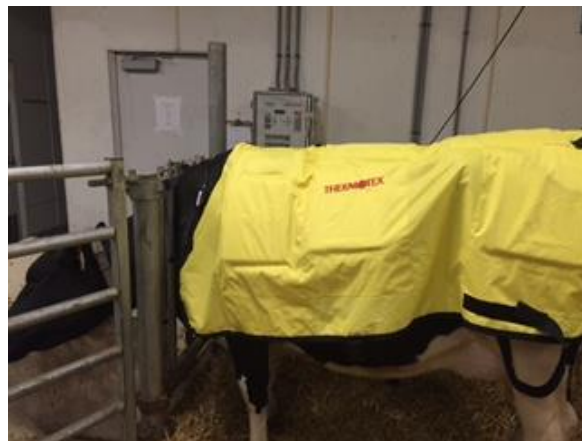


Figure 1. Cow Pictures when the blanket was on



Figure 2. Cow Manager Behavioral Monitoring System (Agis Automatisering, Netherlands).

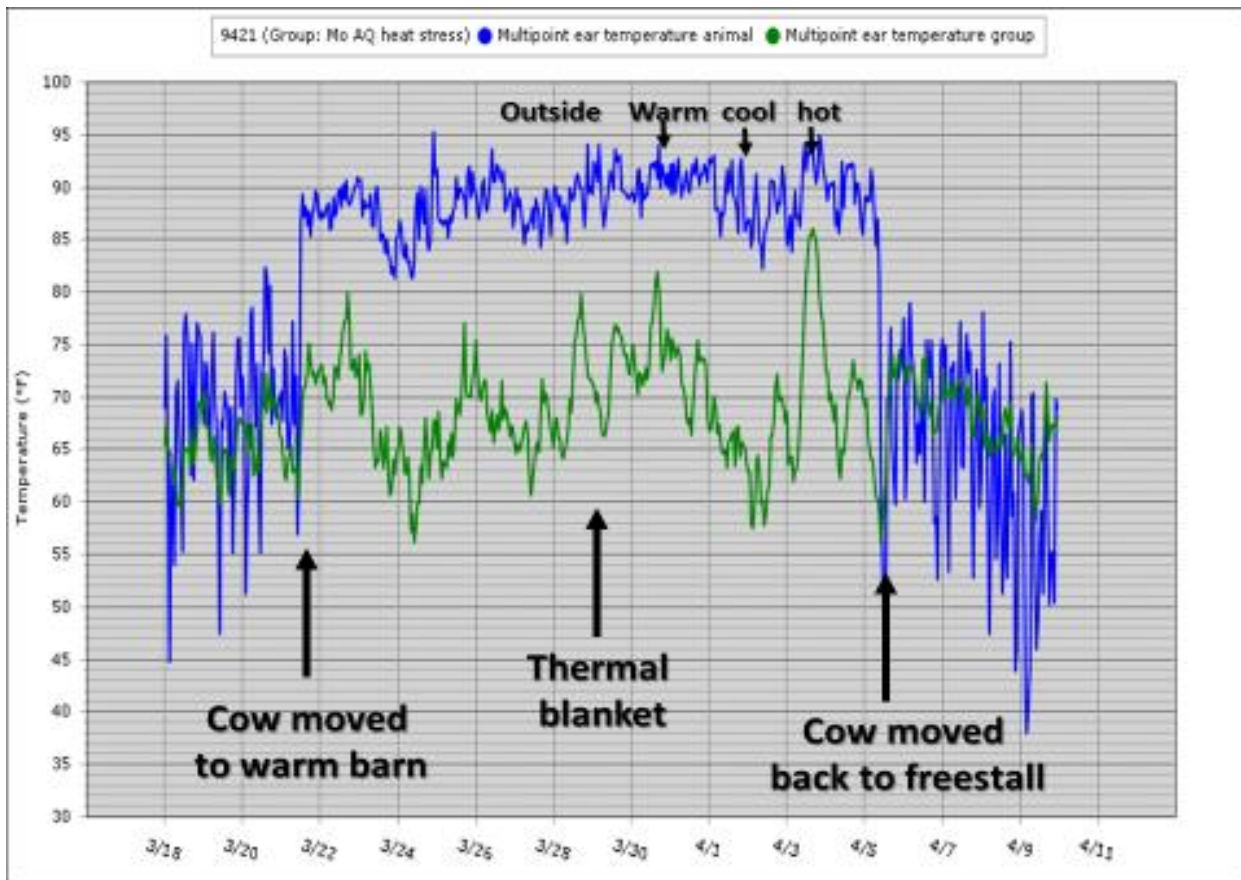


Figure 3. Ear temperature data of Cow 9421 before, during heat stress trial (warmer barn and electric blanket applied during week 2), and after return to her normal free stall barn.

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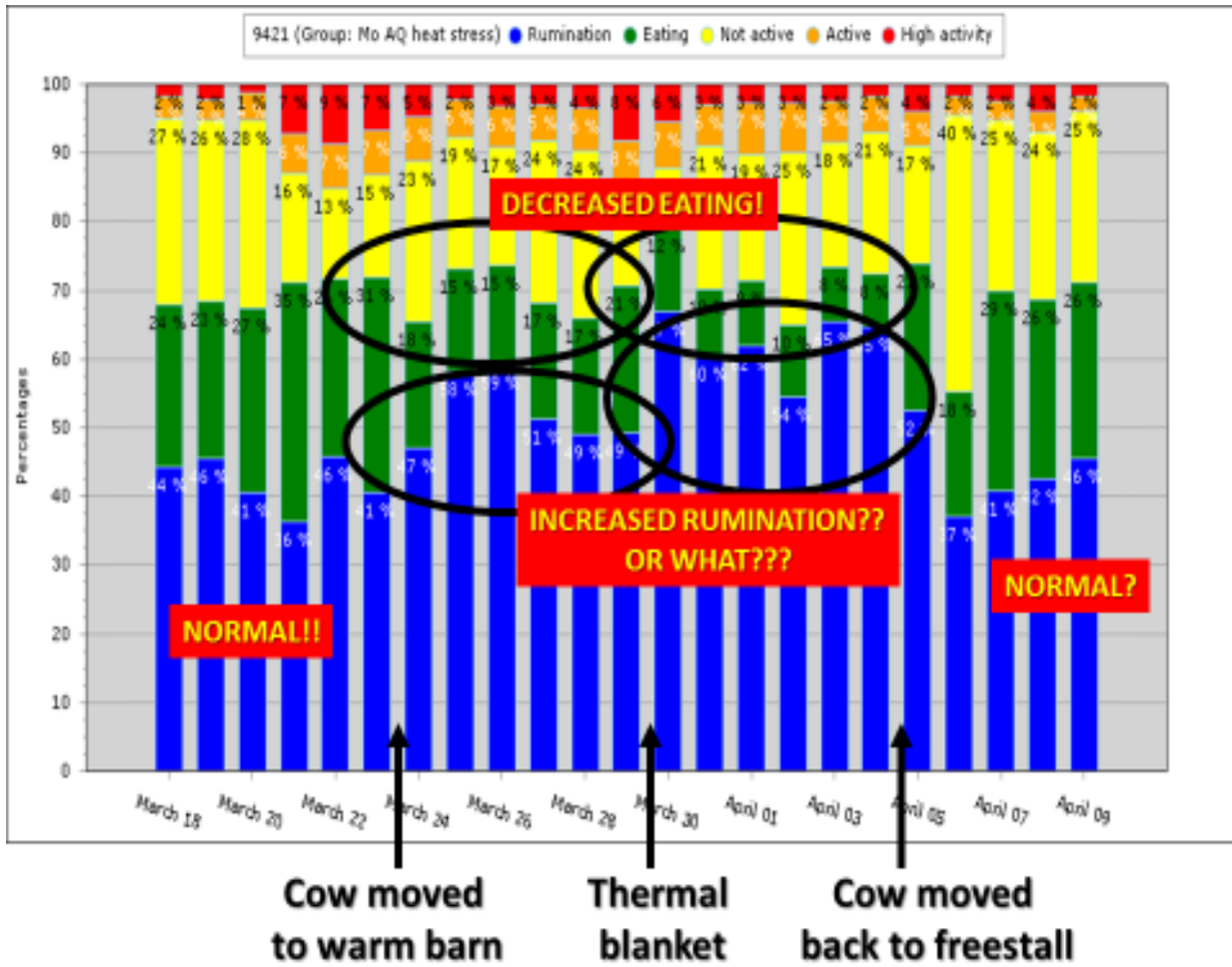


Figure 4. Daily behavior graph and comments of Cow 9421 before, during heat stress trial (warmer barn and electric blanket applied during week 2), and after return to her normal free stall barn.