Rumen Temperature Boluses for Monitoring Health of Feedlot Cattle

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Story in Brief

The cattle industry loses millions of dollars a year due to health related performance and death loss in receiving cattle. Disease events such as Bovine Viral Diarrhea Virus (BVD) and Bovine Respiratory Disease (BRD) commonly result in an increase in core body temperature. Remote means of detecting increased body temperature due to disease could lead to more rapid and reliable detection, thereby decreasing severity of illness and minimizing reductions in performance. A rumen bolus programmed to read and transmit core body temperature was orally dosed to steers subjected to an immune challenge. The bolus transmitted temperature readings to receivers, installed in the building, that transmit the data to an on-site computer where the temperature, animal identification, date and time can be viewed and are recorded. The data is recorded in real time and continuously records to the computer. As a result, an animal's rise in body temperature from exposure to an immune challenge can be seen without manually taking the animals temperature. The objective of this study was to determine the efficacy of using remote monitored rumen boluses to determine core body temperature in calves exposed to BVD and challenged with a BRD pathogen (*Mannheimia haemolytica*). Rumen temperature boluses were successful in detecting a temperature increase due to a disease challenge and correlated to rectal temperature readings.

Key Words: Feedlot Cattle, Health Monitoring, Rumen Bolus, Temperature Monitoring

Introduction

Bovine respiratory disease (BRD) is the most significant health problem in stocker operations and feedlots in the United States (Duff and Galyean, 2007). Bovine respiratory disease continues to negatively affect the economics, animal wellbeing, performance and carcass quality of beef cattle. The organism found to most frequently cause BRD is *Mannheimia haemolytica*. One of the many precursors to respiratory tract disease in feedlot cattle is bovine viral diarrhea virus (BVD; Plummer et al., 2004). Cattle that are infected with BVD are a major concern in the beef industry as the virus leads to decreased performance, reproduction and economic return while increasing the susceptibility to other diseases like BRD.

Most illnesses in cattle are currently detected by visual symptoms and then verified by determining an animal's body temperature with a rectal thermometer. However, this requires the animal to be sorted from a pen, moved to a handling facility and restrained in a chute. Remote monitoring of temperature could eliminate the need for rectal temperature measurements, thereby, decreasing stress and labor associated with movement of the animal if they are not ill. Furthermore, with remote detection of body temperature, it is possible that the onset of a disease occurrence could be identified earlier than by observing visual symptoms. Early, low stress detection of disease has the potential to allow early intervention which may result in benefits such as reduced medications, increased performance and increased beef quality which will improve the economics of beef production.

The following study was performed to determine the potential of a new rumen temperature bolus technology to remotely determine changes in core body temperature of calves exposed to a common BRD related bacteria and a BVD virus.

Materials and Methods

Animals. This study was conducted at the Oklahoma State University Nutrition Physiology Research Center. Twenty-Four Angus crossbred steers (initial BW = 691 ± 69 lbs) were utilized in two 17 day blocks. Within each block, steers were allotted to one of the following treatments:

1) No challenge (Control)

2) Exposure for 72 h to persistently infected (PI) BVD steers (BVD)

3) Challenged with *M. haemolytica* (MH)

4) Exposure for 72 h to PI BVD steers followed by *M. haemolytica* challenge (BVD+MH)

Treatment 2 and 4 steers were exposed to a confirmed PI BVDV calf (type 1B) at the Willard Sparks Beef Research Unit. At time 0, all steers were intranasally dosed with 60 mL of phosphate buffer saline solution, with or without 6 x 10^{10} CFU of *M. haemolytica*.

Data Collection. Rumen temperature boluses (Figure 1; SmartStock, LLC, Pawnee, OK) were orally administered prior to exposure to PI BVD virus steers, using a custom made balling gun (Figure 2). Temperature was transmitted from the rumen bolus every minute to a remote data station located in a room near steers. For this study, rumen temperatures were evaluated for 3 d prior to and 14 d post MH challenge. Rectal temperatures were recorded using an electronic probe (GLA M-500; GLA Agricultural Electronics, San Luis Obispo, CA) at time 0 and 2, 4, 6, 12, 18, 24, 36, 48, 72 and 96 h post challenge.

Rumen temperature measures were averaged by hour and then by day with a day starting at 08:00. Rumen temperatures were analyzed using repeated measures analysis of the MIXED procedure of SAS with a first-order autoregressive covariance structure (SAS Institute, 2003). Rumen and rectal temperatures recorded at the same time points were compared using a best fit regression line.

Figure 1. Rumen temperature bolus measures approximately 3.25 inches long and 1.25 inches in diameter.

Figure 2. Balling gun used to administer rumen temperature boluses.

Results

Average daily rumen temperature resulted in a treatment x day interaction (P<.01). Steers challenged with MH had increased rumen temperatures on d 1 and 2 post MH challenge, whereas steers exposed to BVD virus had increased rumen temperatures on d 5 and 6 post MH challenge (Figure 3). Hourly rumen temperature peaked at approximately 8 h for MH challenged steers and 112 and 140 h for BVD exposed steers (Figure 4). The maximum rumen temperature measured for each calf during the experiment was highest for MH steers. There was no difference in maximum temperature for BVD and control steers (Table 1). Maximum rumen temperature was increased for the BVD (0.69°F), MH (2.15°F) and BVD+MH (2.32°F) over control steers. There were no treatment differences in the minimum, average or range of rumen temperatures (Table 1). Rectal temperatures averaged 0.24°F higher than rumen temperatures at the 11 time points compared with a R^2 of 0.80 (Figure 5).

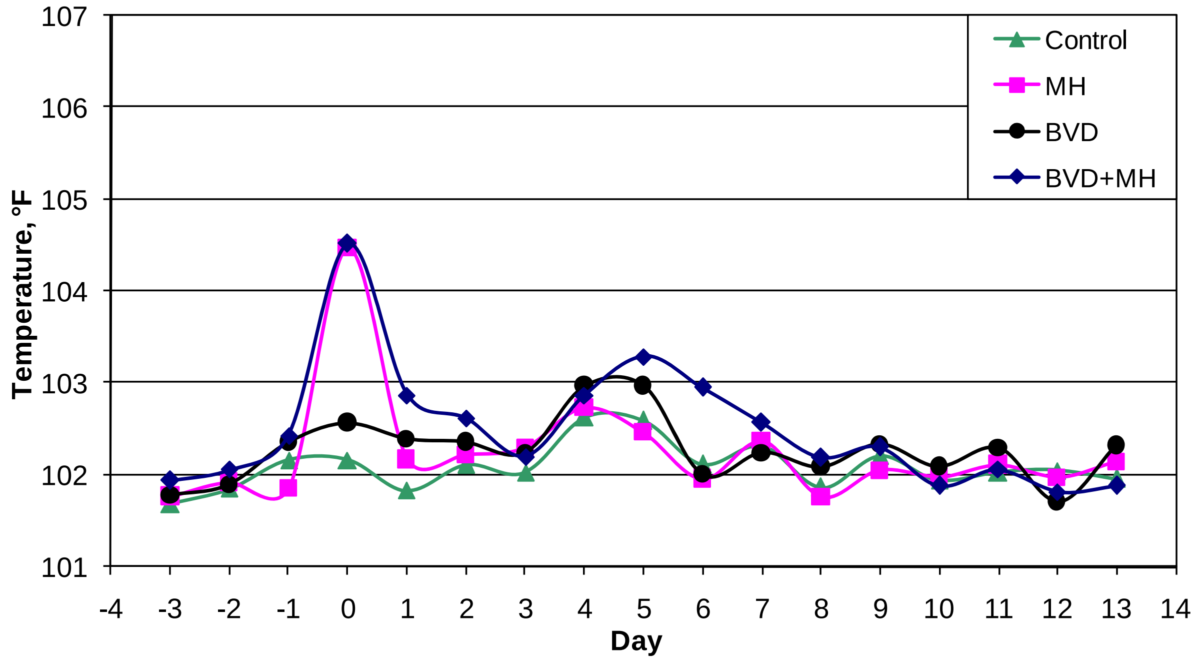

Figure 3. Average daily rumen temperature by treatment interaction (P<.01, SEM=.235) with day 0 equal to MH (*Mannheimia haemolytica*) challenge. BVD (Bovine Viral Diarrhea) exposure initiated 72 h prior to MH challenge.

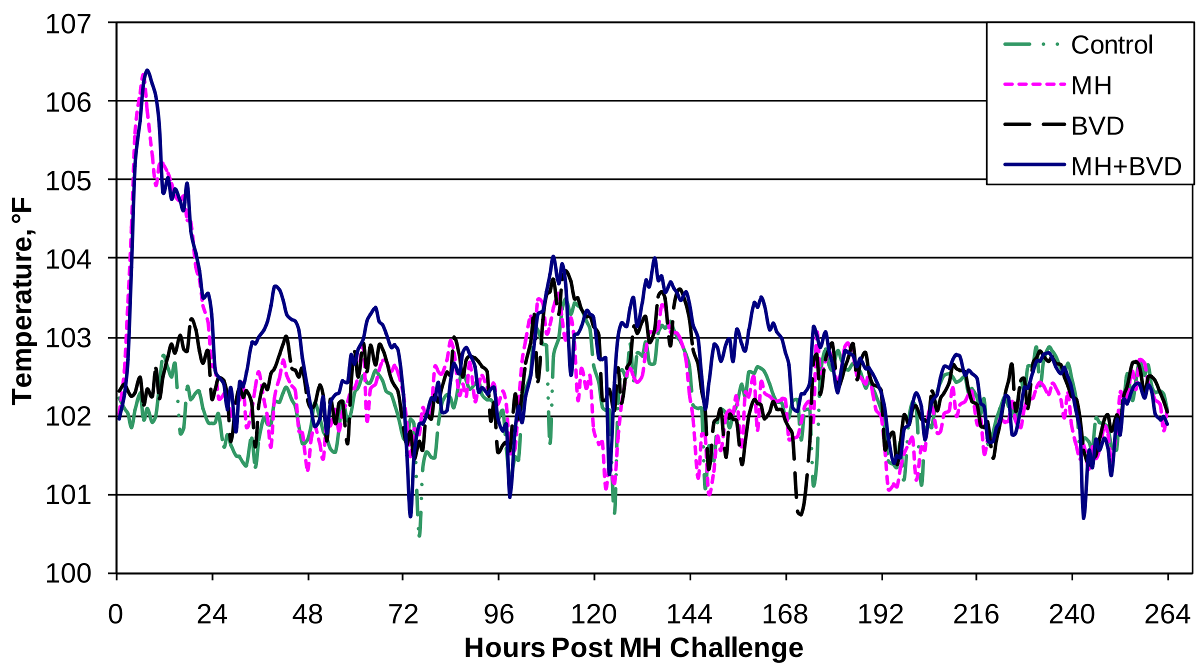

Figure 4. Average hourly rumen temperature by treatment interaction (P<.01, SEM=.528) with hour 0 equal to MH (*Mannheimia haemolytica*) challenge dosing. BVD (Bovine Viral Diarrhea) exposure initiated 72 h prior to MH challenge.

Table 1. Effect of treatment on rumen temperature average, minimum, maximum and range (°F) 0-264 h post challenge. Challenged with MH (*Mannheimia haemolytica*), BVD (Bovine Viral Diarrhea) or both.[1]

	Control	MH	BVD	BVD+MH	SEM
Mean	102.1	102.3	102.3	102.6	.2
Min	94.7	95.4	94.3	95.6	1
Max	104.6[a]	106.7[b]	105.3[a]	106.9[b]	.3
Range	9.9	11.4	11	11.3	1

[1]Within row, numbers with different superscripts differ (P<.01).

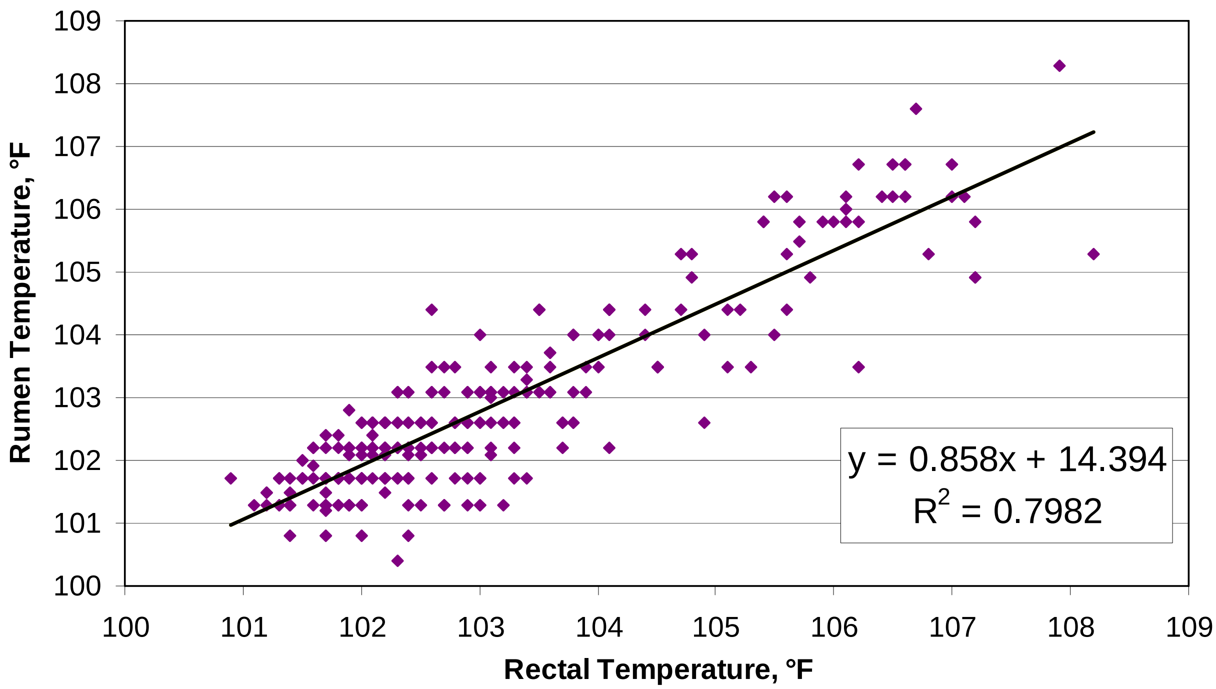

Figure 5. Correlation of rumen and rectal temperature as methods to obtain core body temperature. Measurements compared were taken at 11 different time points.

Discussion and Conclusion

This research has demonstrated that remote monitored rumen temperature boluses produce temperature results that are highly correlated with rectal temperatures and have potential to be a viable means of detecting adverse health events in cattle. Improved detection of adverse health events may result in decreased morbidity and mortality in the cattle receiving and feeding industry. The reliability of rumen boluses to remotely transmit core body temperature of an animal could also be coupled with highly tamper resistant identification. It has further been proposed by Mayer et al. (2007) that, while currently untested, rumen temperature bolus may be potentially useful in determining when and how much an animal drinks, extent of rumination resulting in measuring of feed intake, heat generation during fermentation and affects of water temperature on animal temperature. Additional research will be necessary to determine if use of rumen temperature monitoring will allow earlier or more accurate detection of illnesses in cattle in a production setting. Earlier detection will need to be coupled with effective management that results in decreased treatment cost or decreased severity of the disease that results in economic advantage to cattle producers.

Literature Cited

Duff, G.C. and M.L. Galyean. 2007. J. Anim. Sci. 85:823-840.

Mayer, K. et al. 2007. Available at
http://mobile.act.cmis.csiro.au/documentation/Instrumenting%20Cattle.pdf

Plummer, P.J. et al. 2004. J. Am. Vet. Med. Assoc. 225:726-731.

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