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Evaluation of the endocrine response of cattle during the relocation process ☆, ☆ ☆

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ABSTRACT

To evaluate the endocrine responses associated with the relocation process, 22 Holstein heifers (326.4 ± 46.8 kg BW) were randomly assigned to control (CON) or relocation (RELOC) treatment groups. On d 0, heifers were weighed and fitted with indwelling rectal temperature (RT) monitoring devices and jugular catheters. On d 1, baseline blood samples were collected from all heifers for 2 h prior to the transportation event, then weighed. Controls were returned to tie stalls and RELOC were loaded into a modified stock trailer (12 individual stanchions) for a 4 h transportation event. Simultaneous blood samples were obtained at 30-min intervals from both groups throughout the 4 h transport event (TE-I). After transport, RELOC were unloaded at an unfamiliar location, weighed, and placed in tie stalls for a 2 h post-transportation period. All heifers were then placed into two separate holding paddocks with access to water and hay for 4 h. After 4 h, hay and water was withdrawn for 20 h. On d 2 RELOC heifers were exposed to a second transport event (TE-II); the timeline and procedures of TE-II were identical to those of TE-I (except for the starting point for RELOC heifers). All serum samples were analyzed for concentrations of cortisol, growth hormone (GH), and insulin-like growth factor-I (IGF-I). A 6% reduction in BW for the RELOC as compared to 2.5% reduction in BW for CON ($P < 0.001$) was observed during TE-I. Overall BW loss was 2% greater ($P < 0.02$) for RELOC heifers compared to CON heifers. During TE-I, RELOC heifers had greater RT ($P < 0.05$) compared to CON heifers. There was treatment × time interaction observed for cortisol ($P < 0.003$); RELOC had greater cortisol concentrations at multiple time points throughout TE-I and -II. No differences

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($P > 0.05$) in area under the curve (AUC) for cortisol were observed during TE-I. However, AUC for total cortisol during TE-II was greater ($P < 0.01$) in the RELOC group compared to CON. There were no differences in AUC for GH between treatment groups for TE-I or -II, but a transient decline ($P < 0.05$) within each group was observed from d 1 to d 2. There were no differences ($P > 0.05$) in IGF-I concentrations or in AUC between the treatment groups during TE-I and -II or from d 1 to d 2. Results provide evidence that the actual processes surrounding the transportation of cattle, can elicit a stress response, as defined by increased concentrations of cortisol, RT, and BW losses.

1. Introduction

One stressor that most, if not all, cattle encounter in a typical management system is stress associated with the relocation process (handling, loading, transporting, and unloading of cattle). The relocation process has been implicated as one of the major stresses to recently received cattle (Grandin, 1997). The biological impact of the animal's response to stress is also one of the factors associated with the multi-factorial etiology of the bovine respiratory disease complex (Loerch and Fluharty, 1999) as it most often is observed in recently transported cattle upon arrival at a new facility. The stress associated with transportation and arrival at a new facility can contribute to physiological changes including elevated rectal temperature (RT), transient changes in endocrine hormones, altered metabolic enzymes and metabolites associated with energy and protein metabolism (NEFA, glucose, blood urea nitrogen, creatine phosphokinase, and lactate dehydrogenase), and changes in growth characteristics of newly received cattle (Loerch and Fluharty, 1999).

Burdick et al. (2010) reported an increase in RT of bulls within 30 min of the onset of a transport event, which then declined during transport to a nadir approximately 400 min after initiation of transportation. Of particular interest in that previous study was a lack of change in serum concentrations of cortisol between pre- vs. 9 h post-transport. The results of the Burdick et al. (2010) study were similar to those reported by Blecha et al. (1984) who utilized an 8–9 h transport event and reported no change in cortisol concentrations pre- vs. post-transport. However, in a more recent transportation trial, Burdick et al. (2011) collected blood samples during the actual transportation event and again reported an increase in RT, but they also reported that bulls classified as temperamentally calm had elevated concentrations of cortisol as a result of transportation. Other researchers have reported an increase in circulating glucocorticoids with transport (Crookshank et al., 1979; Locatelli et al., 1987). The ambiguity in endocrine responses which exists across these studies highlights the importance of timing associated with sample collection in defining the actual changes in physiological and endocrine variables during the relocation process.

Although changes in physiological function have been reported pre- vs. post-transport, there are limited reports detailing the physiological and endocrine response during the actual transportation process. Therefore, given that the relocation process remains a concern within the cattle industry, and since it is generally recognized as a stressful event, the objective of this study was to more accurately characterize several physiological and endocrine parameters in cattle throughout the relocation process.

2. Material and methods

2.1. Experimental design

The use of animals and all animal procedures conducted during this study were reviewed and approved by the IACUC committee at Mississippi State University (IACUC #08-041). This project was conducted in 2008 on 21 October (d 0), 22 October (d 1) and 23 October (d 2) at the Bearden Dairy facilities at Mississippi State University (33.46N, 88.82W, 119.79 m altitude) with the average temperature being 16.11 °C for all three days of the study with lows reaching 8 °C and highs 23.3 °C.

Twenty-two Holstein heifers (326.4 ± 46.8 kg BW) were maintained on pasture at the Bearden Heifer Development Unit for a period of 10 week prior to the start of the study. During this 10-week period, heifers were acclimated to human contact and halter restraint in tie stalls. Seven days prior to initiation of the relocation process, heifers were weighed and randomly assigned to one of two treatment groups: (1) control heifers (CON) that were not relocated, and (2) relocation heifers (RELOC), which experienced two transport events within a period of 23.5 h (Table 1). Control heifers remained at the Heifer Development unit location for the duration of the study. A modified tie stall area was constructed in the same area where the heifers were fed through the headstalls each day prior to the start of the study. This area was in a covered barn open on all sides to allow natural airflow without the use of any fans. The tie stall space allocated for each heifer was similar space to that allowed for the heifers in the RELOC stanchions on the trailer. Heifers in the RELOC group were transported in modified open-air stock trailer with 12 individual stanchions (1.5 m × 0.7 m). The trailer was constructed so that 6 individual stanchions were along each side wall of the trailer with a middle isle between the 2 row of 6 stanchions to allow individuals the ability to traverse the length of the trailer and access the animals for sample collection. The RELOC heifers were transported approximately 402.34 km totaling 4 h (240 min) on a 4-lane highway reaching driving speeds of 112.65 kph and only slowing down to drop off samples or turn.

The first transportation event occurred from 0330 to 0745 h on d 1, followed by a second transport event from 0300 to 0730 h on d 2. During the interval between the two transport events, CON and RELOC were allowed access to