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Relationships between temperament and transportation with rectal temperature and serum concentrations of cortisol and epinephrine in bulls ☆

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ABSTRACT

This study investigated whether temperament influences rectal temperature and serum concentrations of cortisol and epinephrine in response to transportation. Brahman bulls were selected based on temperament score (average of exit velocity, EV, and pen score, PS) measured 28 days prior to weaning with the 8 most Calm (0.89 ± 0.15 EV and 1.00 ± 0.00 PS), 8 most Temperamental (3.70 ± 0.29 EV and 4.88 ± 0.13 PS), and the 8 Intermediate (1.59 ± 0.12 EV and 2.25 ± 0.16 PS) selected from a pool of 60 bulls. Whole blood was collected pre- and post-transport, and rectal temperature recording devices were inserted pre-transport for continual collection of rectal temperature during transport. Bulls were transported in a trailer 770 km from Overton, TX (32.27 N, −94.98 W, 153 m altitude) to New Deal, TX (33.74 N, −101.84 W, 1006 m altitude). Serum cortisol and plasma epinephrine concentrations were determined. Prior to transportation (0 min) Temperamental bulls had greater rectal temperature than Calm or Intermediate bulls ($P<0.05$). Rectal temperature peaked within 30 min after the onset of transportation with Temperamental bulls having greater peak rectal temperatures than Calm or Intermediate bulls ($P<0.05$). The lowest mean rectal temperature was reached 400 min after the onset of transportation with Calm bulls having lower mean rectal temperatures than Intermediate or Temperamental bulls ($P<0.05$). Prior to transportation Temperamental bulls had greater cortisol concentrations than Calm bulls ($P<0.05$). Temperamental bulls had greater concentrations of epinephrine prior to transportation than Calm or Intermediate bulls ($P<0.05$). Temperamental bulls also had greater concentrations of cortisol and epinephrine post-transportation than Calm bulls ($P<0.05$). Maximum and minimum rectal temperature were positively correlated ($r=0.73$; $P<0.01$). There was a positive correlation between EV and maximum rectal temperature ($r=0.62$; $P=0.01$), and a trend for EV to be positively correlated with minimum rectal temperature ($r=0.43$; $P=0.10$). Epinephrine tended to be positively correlated with maximum rectal temperature ($r=0.46$; $P=0.06$). Both cortisol (pre-transportation $r=0.55$; $P=0.02$) and epinephrine (pre- and post-transportation ($r=0.64$; $P<0.01$ and $r=0.59$; $P<0.01$, respectively) were positively correlated with EV. In summary, temperament was predictive of 1) changes in rectal temperature due to transportation and 2) circulating concentrations of cortisol and epinephrine before and after transportation.

☆ Mention of trade names or commercial products in this article is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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1. Introduction

Livestock production practices (e.g., ear tagging, branding, castration, and vaccination), social mixing, and transportation have been reported to be stressful and induce secretion of the stress hormones cortisol, epinephrine, and norepinephrine (Crookshank et al., 1979; Rulofson et al., 1988; Lay et al., 1992; Carrasco and Van de Kar, 2003; Charmandari et al., 2005; Buckham Sporer et al., 2008). Acute stress is not necessarily detrimental to the health of an animal, and may even be beneficial (Galyean et al., 1999; Dhabhar, 2002; Duff and Galyean, 2007; Sorrells and Sapolsky, 2007). However, chronic stress can negatively impact growth, reproductive function, and immune function (Moberg, 1987; Dobson et al., 2001; Shi et al., 2003; Silberman et al., 2003; Compas et al., 2004; Zhao et al., 2008). Therefore, minimizing multiple stressful incidents may be beneficial to health and growth of livestock.

The effect of animal temperament on health and performance is an area of increasing research interest. In cattle temperament is defined as the reactivity, or fear response, to humans (Fordyce et al., 1988). Temperament has been correlated with concentrations of stress hormones in cattle, in that more temperamental, or excitable, cattle have greater concentrations of cortisol and epinephrine (Schuehle et al., 2005; King et al., 2006; Curley et al., 2006a,b, 2008). Analogous to stress, temperament can have negative impacts on growth (average daily gain), carcass traits and immune function in cattle with poor temperaments (Voisinet et al., 1997; Fell et al., 1999; Mondal et al., 2006; Oliphint et al., 2006).

Transportation has been purported as a stressor in the livestock industry, yet interestingly there have been limited studies in cattle that have demonstrated increases in rectal temperature. Tarrant et al. (1992) did not find a change in rectal temperature measured before and after a 24-h transport of Friesian steers. In addition, a shorter 9-h transport of young beef bulls did not find a transport-induced difference in rectal temperature, measured by using a hand-held digital thermometer (Buckham Sporer et al., 2008). Yet, rectal temperature of their bulls was lower 48 h after the initiation of transportation. In contrast, rectal temperature increased in heifers that were transported for 4 h on two consecutive days compared to non-transported controls (Behrends et al., 2009). However, limited information is available on the effect of transportation on changes in rectal temperature in cattle which do not have the influence of human presence during the data collection.

Therefore, our study was designed to determine the influence of temperament on rectal temperature recorded without human presence and secretion of cortisol and epinephrine in bulls in response to transportation.

2. Materials and methods

2.1. Experimental design

Bulls (10 months of age) from the Texas AgriLife Research Center's purebred Brahman herd in Overton, TX were selected for use in this study based on their temperament score measured 28 days prior to weaning (133 ± 3 days of age). Temperament score (Curley et al., 2006a; King et al., 2006) was an average of exit velocity (EV) and pen score (PS). Exit velocity is an objective measurement that records the rate (m/s) at which cattle exit a working chute (Burrow et al., 1988; Curley et al., 2006a). Pen score (Hammond et al., 1996) is a subjective measurement in which cattle are separated into small groups of three to five and their reactivity to a human observer scored on a scale of 1 (calm, docile, and approachable) to 5 (aggressive, volatile, and crazy). Based on temperament score the 8 most Calm (0.89 ± 0.15 EV and 1.00 ± 0.00 PS), 8 most Temperamental (3.70 ± 0.29 EV and 4.88 ± 0.13 PS), and the 8 Intermediate bulls (1.59 ± 0.12 EV and 2.25 ± 0.16 PS) were selected from a pool of 60 bulls (Fig. 1). Prior to transportation bulls were fitted with rectal temperature recording devices (A HOBO Pro v2 Temp data logger probe; Part # U23-004, Onset Corp., Pocasset, MA) that measured rectal temperature continuously at 1-min intervals in the absence of a human operator. The factory-calibrated rectal temperature recording devices were tested for accuracy upon receipt from the manufacturer. However, several rectal temperature recorders became displaced during transportation. Specifically, temperature data presented includes only those bulls that yielded a complete data set ($n = 5$, 8, and 4 for Calm, Intermediate and Temperamental, respectively). Once all bulls were loaded on the trailer continuous recording of the data from the rectal temperature devices commenced (i.e., time 0, initiation of transportation). Prior to and after transportation, while bulls were restrained in a working chute, whole blood samples (2×10 mL) were collected via jugular venipuncture in uncoated or EDTA coated tubes (BD, Franklin Lakes, NJ) and serum and plasma isolated for determination of cortisol and epinephrine concentrations, respectively. Bulls were loaded into an 11-m open-sided livestock trailer and transported approximately 770 km (9 h) from Overton, TX (32.27 N, −94.98 W, 153 m altitude) in East Texas to New Deal, TX (33.74 N, −101.84 W, 1006 m altitude) in the South Plains of West Texas. This study took place on November 11th, 2007 when the average ambient temperatures were 15 °C and 10 °C for Overton and New Deal, respectively. All experimental procedures were in compliance with the Guide for the Care and Use of Agriculture Animals in Research and Teaching and approved by the Institutional Animal Care and Use Committees of Texas A&M University and the USDA.

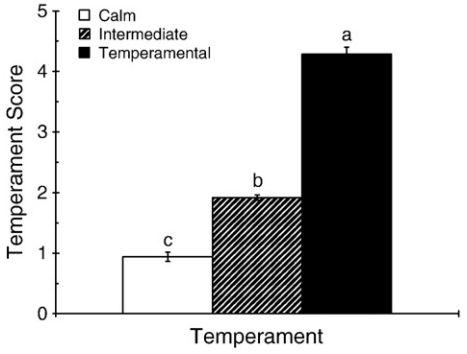

Fig. 1. Temperament score of bulls. Purebred Brahman bulls (10 months of age) were selected based on temperament score measured 28 days prior to weaning. Temperament score was an average of exit velocity (EV) and pen score (PS). Means with unlike letters differ by $P < 0.05$.