Effects of Acclimation to Handling on Performance, Reproductive, and Physiological Responses of Brahman-crossbred Heifers

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Acclimation to human handling after weaning hastened the onset of puberty in Brahman-crossbred heifers.

Summary

The objective of this experiment was to evaluate the effects of acclimation to human handling on growth, plasma concentrations of cortisol, and puberty attainment of Brahman-crossbred heifers. Over two consecutive yr, 37 Braford and 43 Brahman × Angus heifers were assigned randomly to receive or not the acclimation treatment within 30 d after weaning. The acclimation process consisted of bringing heifers to the cowpens three times weekly during four consecutive wk, where heifers were exposed to common handling practices and returned to pastures within 2 h. Heifers were maintained in bahiagrass (Paspalum notatum) pastures and received a blend of soybean hulls and cottonseed meal at a daily rate of 6.0 lbs of DM per heifer during the experiment (d 0 to 130). Blood samples were collected prior to and at the end of the acclimation process for determination of cortisol concentrations. Puberty status was assessed monthly during the experiment. Acclimated heifers had decreased (P<0.05) average daily gain (ADG) compared to control heifers (1.1 vs. 1.3 lbs/d, respectively). Attainment of puberty, however, was hastened (P<0.01) for acclimated heifers. Further, acclimated heifers had reduced cortisol concentrations compared to control heifers after the acclimation period (3.8 vs. 5.1 μg/dL, respectively). Results from this experiment indicated that although acclimation decreased body weight gain, it enhanced the attainment of puberty in Brahman-crossbred heifers.

Introduction

Age at puberty is influenced by breed type, and heifers containing Brahman breeding typically reach puberty after 15 mo of age (Plasse et al., 1968; Rodrigues et al., 2002). In addition to this genetic effect, Brahman-crossbred heifers are often described as temperamental, and this trait is expected to further negatively influence their reproductive function (Plasse et al., 1970). Cattle with excitable temperament experience stimulated secretion and circulating concentrations of ACTH and cortisol (Curley et al., 2008). These hormones directly impair the mechanisms responsible for puberty establishment of heifers, such as synthesis and release of gonadotropins (Li and Wagner, 1983; Dobson et al., 2000). However, acclimation of beef females to handling has been reported to alleviate these negative physiological effects of temperament on reproduction (Echternkamp, 1984). Based on these previous observations, we hypothesized that Brahman-crossbred heifers exposed to handling acclimation procedures after weaning would experience improved temperament, alleviated adrenal steroidogenesis, and enhanced reproductive performance. The objectives of the present experiment were to compare growth, temperament, plasma

measurements, puberty attainment and pregnancy rates of Brahman × Angus and Braford heifers exposed or not to acclimation procedures.

Materials and Methods

Over two consecutive yr, 37 Braford (37.5% Brahman + 62.5% Hereford) and 43 Brahman × Angus (approximately 25% Brahman) heifers were initially evaluated for puberty status via trans-rectal ultrasonography (d 0 and 10) and for temperament by measurements of chute score, pen score, and exit velocity (d 10) within 30 d after weaning. On d 10, heifers were stratified by puberty status, temperament and body weight (BW), and randomly assigned to control or acclimation treatment. Heifers were maintained in bahiagrass (*Paspalum notatum*) pastures and received a blend of soybean hulls and cottonseed meal at a daily rate of 6.0 lbs of DM per heifer throughout the experimental period (d 0 to 130). The acclimation process (d 11 to 39) consisted of bringing heifers to the cowpens three times weekly, where heifers were exposed to common handling practices and returned to pastures within two h. Heifer shrunk (after 16 h of feed and water restriction) BW was collected on d 1 and 192 for calculation of heifer ADG during the experiment. Heifer puberty status, evaluated via plasma progesterone concentrations and trans-rectal ultrasonography, was assessed on d 40 and 50, d 80 and 90, and d 120 and 130. Heifers were considered pubertal once a corpus luteum and plasma progesterone concentrations greater than 1.5 ng/mL (Cooke et al., 2007) were concurrently detected in one or both evaluations performed on a 10-d interval.

Blood samples collected prior to (d 10) and at the end of the acclimation process (d 40) were also evaluated for plasma cortisol concentrations. Blood samples were collected via jugular venipuncture into commercial blood collection tubes (Vacutainer, 10 mL; Becton Dickinson, Franklin Lakes, NJ) containing sodium heparin, placed on ice immediately, and centrifuged at 2,400 × g for 30 min for plasma collection. Plasma was frozen at -20°C on the same d of collection. Concentrations of progesterone and cortisol were determined using Coat-A-Count solid phase ^{125}I RIA kits (DPC Diagnostic Products Inc., Los Angeles, CA). All samples were analyzed in duplicates.

Heifer temperament scores were also obtained on d 40, following blood collection and ultrasonography exam, to evaluate treatment effects. Heifer temperament was assessed by pen score, chute score, and chute exit velocity. Chute score was assessed by a single technician based on a 5-point scale, where 1 = calm, no movement, and 5 = violent and continuous struggling. For pen score assessment, heifers exited the chute and entered a pen containing a single technician, and were assigned a score on a 5-point scale, where 1 = unalarmed and unexcited, and 5 = very excited and aggressive toward the technician in a manner that requires evasive action to avoid contact between the technician and heifer. Exit velocity was assessed by determining the speed of the heifer exiting the squeeze chute by measuring rate of travel over a 1.5-m distance with an infrared sensor (FarmTek Inc., North Wylie, TX). Further, within each assessment d (d 10 and 40), heifers were divided in quintiles according to their exit velocity, and assigned a score from 1 to 5 (exit score; 1 = slowest heifers; 5 = fastest heifers). Individual temperament scores were calculated by averaging heifer chute score, pen score, and exit score.

Growth, temperament, and physiological data were analyzed using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). The model statement contained the effects of treatment, breed, time variables (when appropriate), and consequent interactions. Data were analyzed using heifer(breed × treatment × yr) as random variable. Results are reported as LS means and were separated using LSD. Puberty data were analyzed with the GLM and LOGISTIC procedure of SAS. The model statement contained the effects of treatment, breed, time of estimated puberty establishment, year, and the appropriate interactions. Significance was set at $P \leq 0.05$ and tendencies were determined if $P > 0.05$ and ≤ 0.10.

Results

Acclimated heifers had reduced ($P<0.01$) ADG compared with control heifers (1.1 vs. 1.3 lbs/d

respectively; SEM=0.04). Given that both treatment groups were provided similar pastures and supplements during the experiment, treatment effects on ADG can be attributed to the additional exercise that acclimated heifers were exposed to during the acclimation period. During each acclimation event, heifers had to walk nearly 1.3 miles in addition to the activity inside the handling facility, whereas control heifers remained on their pasture. A treatment effect was also detected ($P<0.05$) for puberty attainment. Although age at puberty in cattle is highly determined by BW and growth rate (Schillo et al., 1992), heifers exposed to acclimation procedures reached puberty sooner than control heifers despite their reduced ADG (Figure 1).

Acclimated heifers had reduced ($P<0.01$) cortisol concentrations compared with control heifers after the acclimation period (3.8 vs. 5.1 μg/dL; SEM=0.17; Figure 2). Supporting our results, previous research indicated that acclimation of cattle to handling procedures was an alternative to prevent elevated concentrations of cortisol in response to handling stress (Crookshank et al., 1979; Andrade et al., 2001; Curley et al., 2006). However, no treatment effects were detected for temperament scores (Table 1), although acclimated heifers had reduced chute score ($P<0.01$) compared with control heifers after the acclimation period (Table 1). Further, all measurements of temperament were positively correlated to each other, and also to cortisol concentrations ($P<0.01$; Table 2). The positive correlations detected among measurements of temperament and cortisol concentrations reported herein were also described by others (Stahringer et al. 1990; Fell et a., 1999; Curley et al., 2006), suggesting that these three measurements of cattle behavior during handling can be used as indicators of temperament and also denote the amount of stress that the animal is experiencing (Thun et al., 1998; Sapolsky et al., 2000).

Supporting our main hypothesis and rationale, acclimated heifers in the present experiment had reduced cortisol concentrations, decreased chute score, and hastened onset of puberty compared with non-acclimated cohorts. Nevertheless, the mechanisms by which acclimation procedures hastened puberty attainment regardless of decreased ADG remain unclear. Based on our hypothesis, it can be speculated that reduced cortisol concentrations in acclimated heifers facilitated the initiation of the physiological events required for puberty attainment, particularly the first ovulatory LH surge (Smith and Dobson, 2002). Although concentrations of cortisol were only evaluated when heifers were handled and restrained for blood collection, one can speculate that acclimated heifers also had reduced cortisol concentrations compared to control heifers on a daily basis given that heifers from both groups were often exposed to brief human interaction, particularly because of feeding and traffic of personnel/vehicles within the research station. Still, additional research should be conducted to further address these assumptions.

In conclusion, results from this experiment indicate that acclimation of Brahman-crossbred heifers to handling procedures and human interaction reduced ADG because of the additional exercise that heifers were exposed to, but alleviated adrenal steroidogenesis and hastened onset of puberty. Therefore, acclimation of Brahman × Angus and Braford replacement heifers to human handling after weaning may be an alternative to enhance their reproductive development, and increase the efficiency of heifer development programs in cow-calf operations containing Brahman-influenced cattle.

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Table 1. Temperament measurements, obtained after the acclimation period, of heifers exposed or not (control) to handling acclimation procedures. [1]

Item	Acclimated	Control	SEM	*P*-Value
Temperament score	2.46	2.48	0.096	0.93
Chute score	1.37	1.84	0.091	< 0.01
Pen score	2.85	2.72	0.137	0.51
Exit velocity, m/s	2.91	2.74	0.148	0.43

[1] Values reported are covariately adjusted means.

Table 2. Pearson correlation coefficients among measurements of temperament and plasma cortisol concentrations of heifers. [1]

Item	Cortisol	Chute score	Exit velocity
Chute score	0.44 < 0.01		
Exit velocity	0.55 < 0.01	0.46 < 0.01	
Pen score	0.48 < 0.01	0.40 < 0.01	0.69 < 0.01

[1] Upper row = correlation coefficients. Lower row = *P*–values.

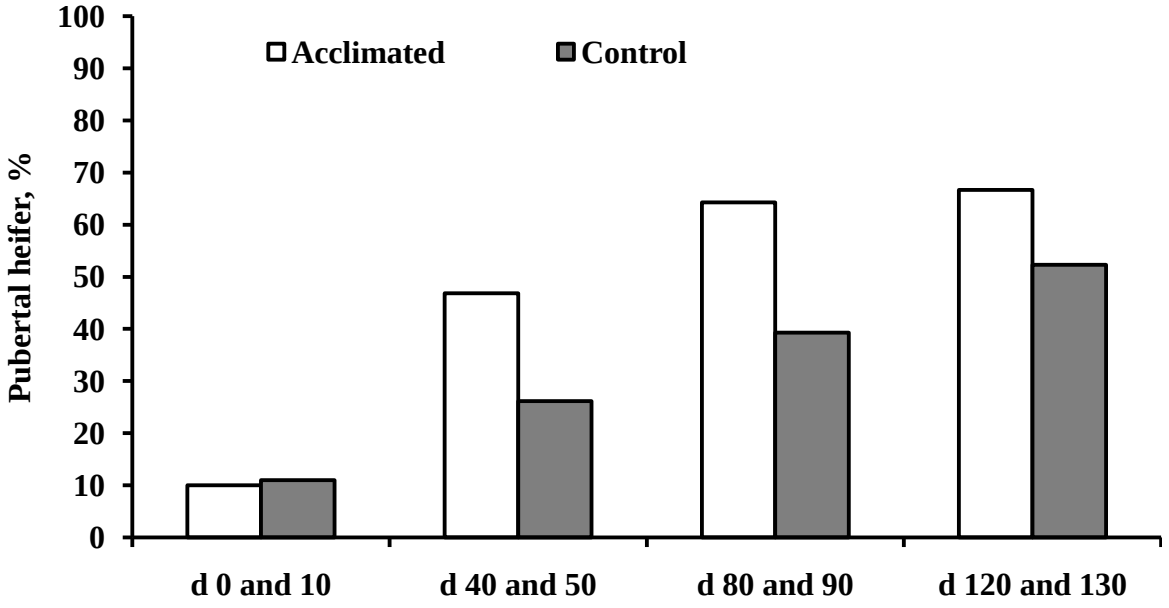

Figure 1. Puberty attainment of heifers exposed or not (control) to handling acclimation procedures (d 11 to 39). Heifers were considered pubertal once a corpus luteum and plasma P4 concentrations greater than 1.5 ng/mL were concurrently detected in one or both evaluations performed on a 10-d interval. A treatment effect was detected (*P*=0.02; SEM=6.5).

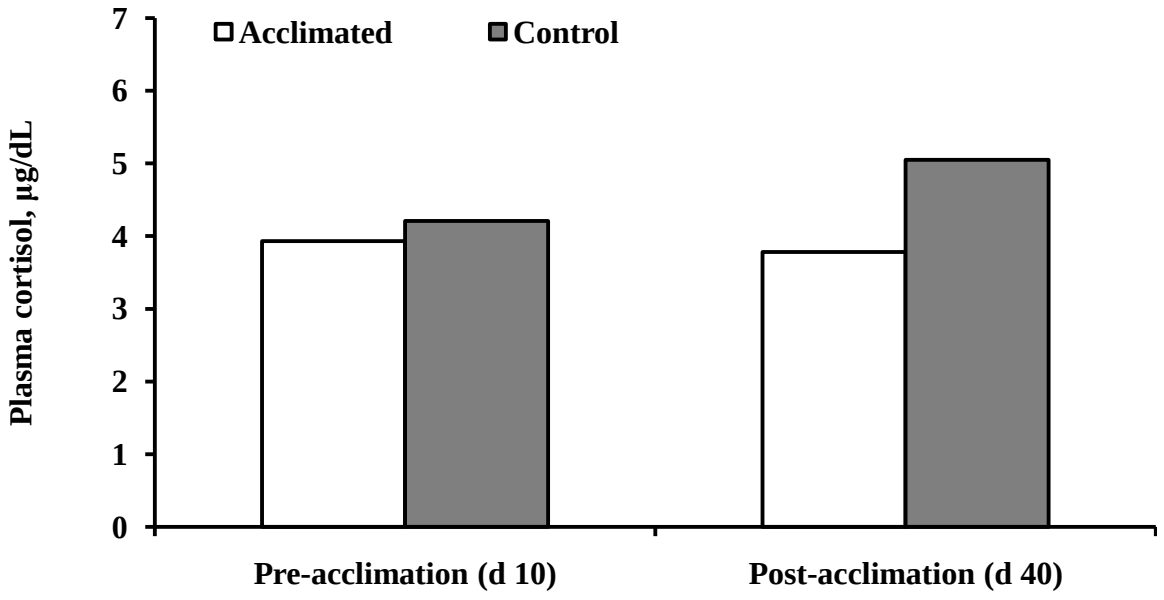

Figure 2. Plasma cortisol concentrations of heifers exposed or not (control) to handling acclimation procedures (d 11 to 39). Samples collected on d 10 served as covariate, therefore results reported for d 40 are covariately adjusted least square means. Acclimated heifers had reduced (*P*<0.01; SEM=0.17) concentrations of cortisol compared to control heifers on d 40.