BREEDTYPE INFLUENCES HYPOTHALAMIC-PITUITARY-ADRENAL AXIS ACTIVITY AND RESPONSIVENESS TO EXOGENOUS BOVINE CORTICOTROPIN-RELEASING HORMONE (bCRH) IN BEEF STEERS

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Background. Stress occurs when the hypothalamus of an animal perceives a stressor and releases corticotrophin releasing hormone (CRH). CRH elicits the pituitary to secrete adrenocorticotrophic hormone (ACTH) which in turn causes the adrenal gland to produce and secrete cortisol. This overall stress response of an animal is often translated into an inability to reach full genetic potential due to a change in environment, either internal or external, that the animal cannot cope with immediately. The inability to reach full genetic potential often is seen as reduced function of the reproductive and immune systems and the growth of the animal. The quantity and duration of exposure to the stress response may impact the productivity of the animal.

The objective of this study was to determine if breedtype influences the responsiveness of the hypothalamic-pituitary-adrenal (HPA) axis when stimulated by exogenous bovine CRH.

Research Findings. Steers of four different beef breedtypes, Angus (n = 8), Angus X Bonsmara (n = 8), Brahman (n=8), and Bonsmara (n=8), were fitted with jugular cannulas prior to the experiment and placed into individual stanchions. For two hours prior and two hours following an I.V. bolus of bovine CRH blood samples were taken to determine concentration of ACTH and cortisol in circulation. Parameters used for evaluation of the pituitary and adrenal responsiveness included pre-CRH concentration, Time 0 concentration, peak plasma concentration, amplitude of response, and area under the response curve. Pre-CRH concentrations of ACTH, when the steers were adapting to handling stress, showed the only differences among the breedtypes for pituitary responsiveness. During this time period Bonsmara-influenced steers had lower ACTH concentrations. The only parameters in which there were not breedtype differences in adrenal responsiveness were at Time 0 when the CRH bolus was administered and in the amplitude of the response. All other parameters displayed breedtype differences and among these, the Bonsmara-influenced steers had lower circulating cortisol concentrations. It was concluded that breedtype did not influence the pituitary responsiveness to exogenous CRH in beef steers; however, breedtype did influence adrenal responsiveness. Specifically, the Bonsmara-influenced steers exhibited a lesser response to stressors and a lower adrenal response to CRH suggesting that they have a less active HPA axis.

Application. Knowledge of breedtype differences in HPA axis activity can be beneficial in stress management of cattle. Crossbreeding programs may be developed to optimize HPA axis activity which can alter the herd's overall responsiveness to stressors. Additionally, management practices can be tailored to the specific breedtype's HPA axis responsiveness to help minimize any potential negative impact of stressors on immunity, reproduction, growth, and carcass traits.

Table 1. ACTH plasma concentration prior to and after CRH administration

Breedtype	Pre-CRH (pg/ml)	Time 0 (pg/ml)	Peak (pg/ml)	Amplitude (pg/ml)	Post-CRH AUC (pg/ml * time)
Angus	66.9 ± 15.4^{a}	24.6 ± 5.2	80.4 ± 12.9	55.8 ± 14.0	3765.5 ± 435.8
Brahman	88.0 ± 15.4^{a}	23.6 ± 5.2	65.0 ± 12.9	41.4 ± 14.0	3714.2 ± 435.8
Bonsmara X Angus	$47.5 \pm 15.4^{a,b}$	12.0 ± 5.2	44.2 ± 12.9	32.2 ± 14.0	2514.5 ± 435.8
Bonsmara	13.3 ± 15.4^{b}	11.1 ± 5.2	57.8 ± 12.9	46.6 ± 14.0	2908.0 ± 435.8

Means within columns bearing a, b superscripts differ ($P < 0.05$).

Table 2. Cortisol plasma concentration prior to and after CRH administration

Breedtype	Pre-CRH (ng/ml)	Time 0 (ng/ml)	Peak (ng/ml)	Amplitude (ng/ml)	Post-CRH AUC (ng/ml * time)
Angus	$19.0 \pm 3.7^{a,b}$	14.3 ± 4.1	34.1 ± 3.1^{a}	19.8 ± 3.4	1794.5 ± 198.5
Brahman	25.4 ± 3.7^{a}	17.7 ± 4.1	$32.5 \pm 3.1^{a,b}$	14.8 ± 3.4	2331.3 ± 198.5
Bonsmara X Angus	$13.6 \pm 3.7^{b,c}$	5.3 ± 4.1	18.8 ± 3.1^{c}	13.5 ± 3.4	1095.7 ± 198.5
Bonsmara	7.8 ± 3.7^{c}	6.6 ± 4.1	$23.7 \pm 3.1^{b,c}$	17.1 ± 3.4	1521.9 ± 198.5

Means within columns bearing a, b, c superscripts differ ($P < 0.05$).