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EFFECT OF PRENATAL STRESS ON CALVES' CORTISOL CLEARANCE RATES, BEHAVIORAL AND PHYSIOLOGICAL RESPONSES TO BRANDING, AND IMMUNOLOGICAL RESPONSES TO WEANING

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Background. Common livestock production practices, such as handling and transportation, are considered stressful to cattle and are known to activate the hypothalamic-pituitary-adrenal (HPA) axis. Research with rodents has found the activation of the HPA axis during pregnancy results in offspring that are better able to cope with stress in maturity. If this same response occurs in cattle, then production methods could be modified to enhance the ability of calves to cope with later stressors. It is well established that when livestock are stressed, their immune function is impaired and they are, therefore, more apt to succumb to disease. In the following study, cows were stressed during pregnancy to determine what effects prenatal stress may have on their calves' physiological and immunological response to normal production stressors such as branding and weaning.

Experiment. Seventy-seven pregnant Brahman cows were randomly assigned to one of three treatments: 1) transported in a stock trailer for 24.2 km, unloaded at a second farm and penned for 1 h, and then returned to the original farm (TR); 2) i.v. injections of 1 IU/kg BW ACTH (ACTH); or 3) sham cows who merely walked through the facilities (SHAM). Treatments were repeated at 60, 80, 100, 120, and 140 d of gestation. The ACTH treatment was included to create concentrations of plasma cortisol that were comparable with TR cows to determine if plasma cortisol may be responsible for changing the developing fetus. The calves were allowed to be delivered naturally. To determine the rate at which cortisol was cleared from the plasma during restraint stress, 180 d-old calves ($n = 7$ for TR, SHAM, and ACTH) were restrained for 3.5 h after injecting a bolus dose of cortisol (6.7 ng/kg BW). Blood samples were collected during the 3.5 hours of restraint. A second group of 180 d-old calves ($n = 7$ for TR, SHAM, and ACTH) were branded and restrained for 3.5 hours. Blood samples were collected for cortisol determination. A third group of 200 d-old calves ($n = 5$ for TR and ACTH, $n = 7$ for SHAM) were vaccinated with Brucellosis on the morning of weaning. Blood samples were collected from these calves every other day for 14 days to monitor differential leukocyte counts and antibody titers to the vaccination.

The TR calves cleared cortisol at a slower rate than did the SHAM calves ($P = .01$), but not the ACTH calves ($P = .2, 261, 473, 374 \pm 50$ mL/min, respectively). This indicates that the

concentration of cortisol that is being produced by TR and ACTH calves is greater than what is actually being measured. Mean plasma cortisol concentrations increase in response to branding ($P = .0001$) similarly in all three treatments ($P = .6$). The overall mean cortisol concentration during branding for the TR, ACTH, and SHAM calves were: $52, 51,$ and 43 ± 3 ng/mL, respectively. No differences between treatments were found for kicking during branding or the number of times the brander had to be applied due to excessive movement of the calf. However, more ACTH calves vocalized during branding than TR or SHAM calves ($P = .02$). Antibody titers to Brucellosis did not differ between treatments during the two weeks following weaning ($P = .4$). However, TR calves had a greater number of lymphocytes than either the SHAM or the ACTH calves during a majority of sampling time ($P < .04$; Figure 1).

Implications. Cattle exposed to prenatal stress were found to clear cortisol from their plasma more quickly to increase lymphocyte numbers when exposed to the stress of weaning and antigenic challenge. Prenatal stress did not effect the calves' response to branding. Because prenatal stress affects important factors such as hormone kinetics and immunology, it is likely to have a major influence on the stress response and health of the calf. The observation that no treatment differences were detected during branding suggests that prenatal stress has a more complex effect on the calf than merely altering the stress response in all situations. Possibly, mild and severe stress are differentially effected by prenatal stress.

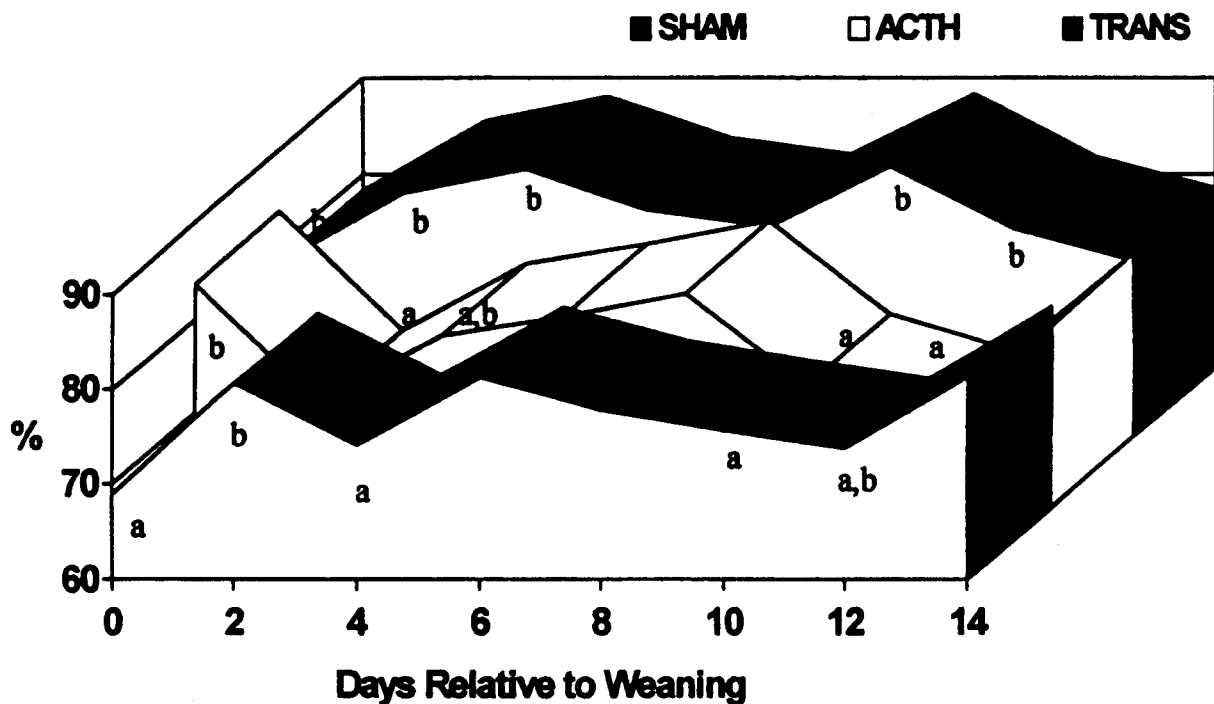


Figure 1. Percent lymphocytes in blood smears collected from calves every other day after weaning. Different superscripts on the same day indicate treatment differences ($P < .04$).