

Influence of Prepartum Nutrition on Concentrations of Estrone, Estradiol, Estrone Sulfate and Progesterone in the Plasma of Range Cows

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Story in Brief

Seventy-nine mature, pregnant Hereford cows were used to examine the influence of prepartum nutritional intake on plasma concentrations of reproductive hormones. Starting November 19, 1979, 60 cows were assigned to a low level of supplemental feed, so as to lose about 10% of their November weight by calving; 19 cows were fed a moderate level of supplement to maintain body weight during pregnancy. Low cows were further divided into 3 groups on January 21, 1980; one-third remained on low (low-low), one-third received moderate (low-moderate) and one-third was increased to a high level (160% of moderate; low-high). All animals were treated the same following calving. Blood samples were taken every two weeks from 45 days before calving until parturition. Cows on the moderate treatment gained about 1% of their fall weight before calving, and cows on the low-low, low-moderate and low-high treatment lost 11, 4 and 6%, respectively, of their fall weights. Plasma concentrations of estrone, estradiol, estrone sulfate and progesterone were affected by treatment. Moderate cows had greater concentrations of progesterone and estrone while cows in the low-low group had higher plasma concentrations of estradiol and estrone sulfate. The changes in hormone concentrations may influence the hypothalamus or pituitary and alter the synthesis and secretion of gonadotropic hormones. The results suggest a possible mechanism by which prepartum nutrition may regulate the interval from calving until the first estrus.

Introduction

Level of nutrition during the wintering period has been repeatedly demonstrated to influence the interval from calving to first estrus and subsequent ovulation in beef cows. Cows losing weight and body condition have longer intervals from calving to first estrus. During the last trimester of pregnancy, the fetus and placenta are growing rapidly. Since many of the hormones regulating reproductive functions are produced by the placenta and fetus, it seems likely that the influence of prepartum nutrition on subsequent postpartum reproductive performance may be mediated by changes in endocrine function. Estrone, estradiol, estrone sulfate and progesterone are hormones pro-

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duced during late gestation that are involved in regulation of reproductive function in cows. This experiment was designed to determine if reduced nutrition, as reflected by changes in body weight and body condition, influences the pattern of secretion of these hormones by beef cows during late gestation.

Materials and Methods

Seventy-nine pregnant, mature Hereford cows were grazed on native tallgrass range at the Lake Carl Blackwell Range Cow Research Center. Beginning November 19, 1979, one-fourth of the cows were randomly assigned to a moderate level of nutrition so as to maintain their November body weight until calving (moderate group). The remaining cows were assigned to a low level of nutrition so that they would lose about 10% of their November weight by calving. On January 21, 1980 (approximately 45 days before calving) nutritional intake for some of the cows was altered. One-third of the cows on the low level remained on low (low-low group); one-third were fed the same amount of supplement as the cows on the moderate treatment (low-moderate group); another one-third were supplemented with 160% of the amount fed to the moderate group so as to gain weight (low-high group). Feed levels are summarized in Table 1.

Body condition scores of the cows, based on visual appraisal, were determined by at least two individuals every two months during the experiment. The scores were based on a scale from 1 = very thin, to 9 = very fat. Blood samples were collected every two weeks beginning February 7, 1980. Plasma concentrations of estrone, estradiol, estrone sulfate and progesterone were quantified by radioimmunoassay. Hormone concentrations were analyzed by polynomial regression equations.

Results and Discussion

Winter weight changes are summarized in Table 2. Moderate cows gained 1 percent of their fall weight prior to calving, low-low cows lost 11 percent of their fall weight, low-moderate cows lost 5 percent of their fall weight and low-high cows lost 6 percent of their fall weight.

Table 1. Feeding program

Date	Nutritional Treatment		
	Moderate	Low	High
Nov. 19, 1979	21 lb of 41% protein CSM ^a pellets/week	6 lb of 41% protein CSM pellets/week	
Jan. 24, 1980	21 lb of 41% protein CSM pellets/week	6 lb of 41% protein CSM pellets/week	35 lb of 41% protein CSM pellets/week
Postpartum	----- 28 lb of 41% protein CSM pellets/week -----		

^a41% protein cottonseed meal pellet.

Table 2. Percent weight change at 45 days prepartum^a and at calving^b

Nutritional treatment	45 Days prepartum	Calving
Moderate	+ 1.2 ± .7	+ .8 ± .5
Low-low	-11.0 ± .5	-11.0 ± 1.1
Low-moderate	-12.4 ± .4	- 4.6 ± .9
Low-high	-11.3 ± .4	- 5.7 ± 1.0

^aWeight change from November

^bWeight change from November prior to calving, does not include calving loss.

Table 3. Body condition score^a for cows on different nutritional treatments

Date	Nutritional Treatment			
	Moderate	Low-low	Low-moderate	Low-high
Nov. 19, 1979	6.5 ± .7	6.3 ± .2	6.4 ± .2	6.4 ± .1
Jan. 24, 1980	6.0 ± .2	4.9 ± .1	4.9 ± .1	5.1 ± .1
Mar. 13, 1980	5.3 ± .2	3.9 ± .2	4.3 ± .2	5.0 ± .2

^a1 = very thin, 9 = very fat

Body condition score changes closely paralleled body weight changes (Table 3). Body condition scores were similar for all groups on November 19. By March 13 (the average calving date for all cows was March 6) the moderate cows had decreased by approximately 1 unit, low-low cows had decreased by 2.4 units, low-moderate cows had decreased by 2.1 units and the low-high cows had decreased by 1.4 units.

Response curves for plasma progesterone concentrations were significantly different for cows on moderate vs. low-low, low-moderate and low-high treatments ($P < .05$). Plasma progesterone concentrations were greater in moderate cows from day 30 prepartum to about day 8 prepartum. At day 15 before calving, progesterone in the plasma of moderate cows averaged 9 ng/ml compared to 8 ng/ml for low-low, low-moderate and low-high cows (Figure 1).

Concentrations of estrone in the plasma of cows on the moderate treatment were not significantly different from cows on low-low, low-moderate and low-high treatments. However, cows on the low-low treatment had a significantly different response curve than cows on low-moderate and low-high ($P < .05$). Plasma estrone concentrations were less for low-low cows from about day 16 prepartum till the day of calving (Figure 2).

Cows on the moderate treatment had reduced concentrations of estradiol from about day 18 prepartum until calving (Figure 3). Plasma concentrations of estradiol were similar for cows on low-low, low-moderate and low-high treatments. In addition, cows in the moderate group had reduced concentrations of estrone sulfate compared to cows in the low-low, or low-high groups ($P < .05$; Figure 4).

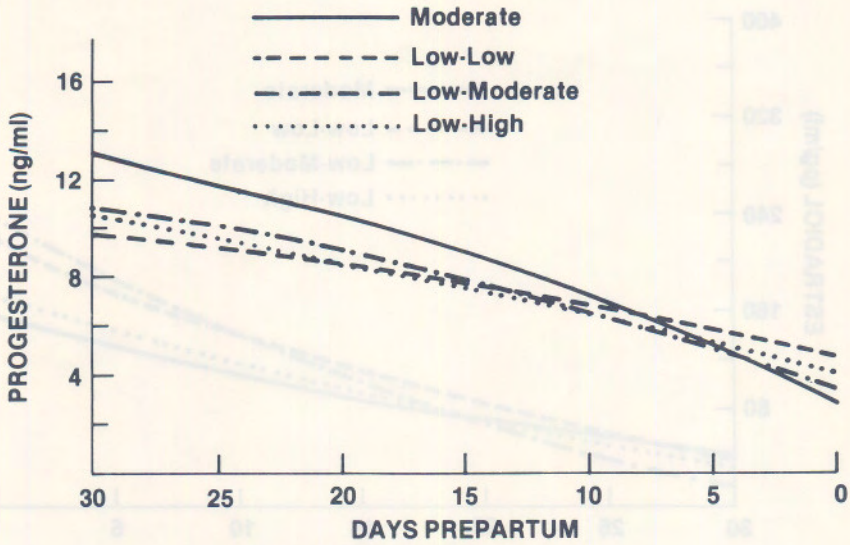


Figure 1. Least Squares Regressions of Progesterone Response to Four Nutritional Treatments

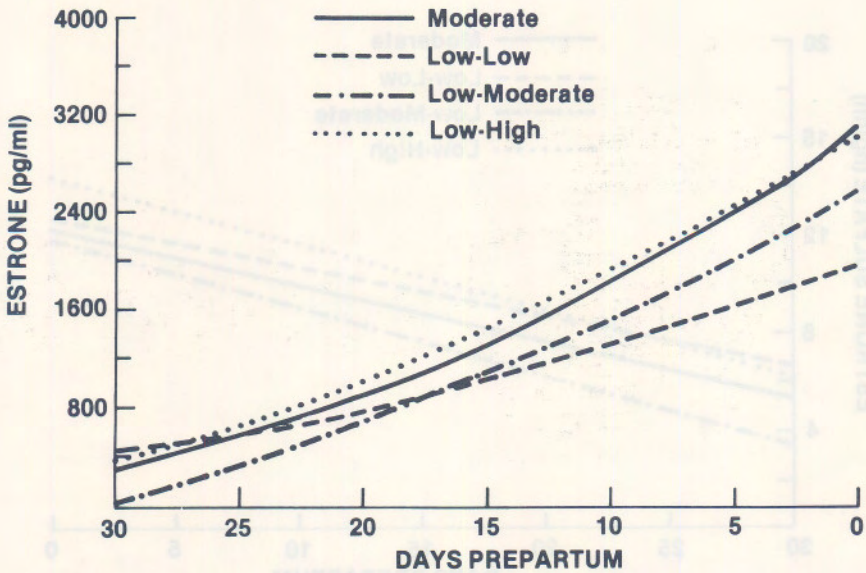


Figure 2. Least Squares Regressions of Estrone Response to Four Nutritional Treatments

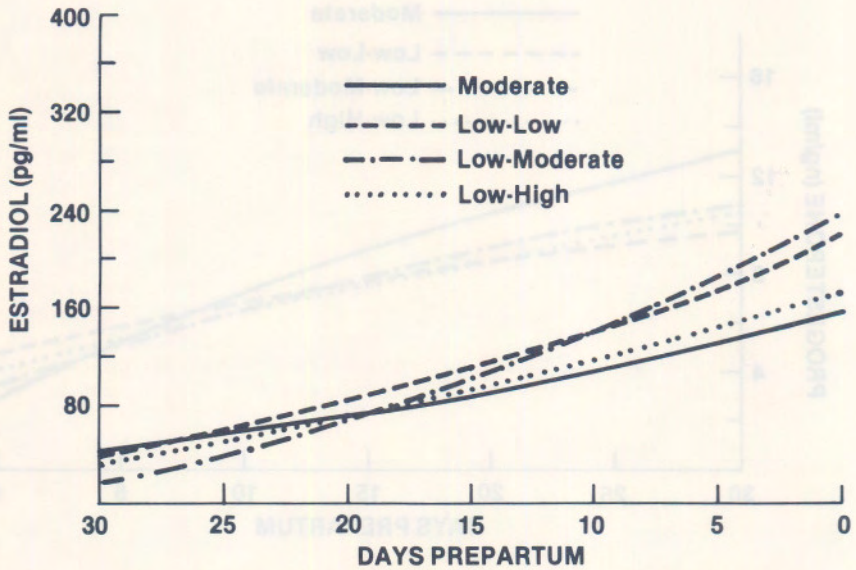


Figure 3. Least Squares Regressions of Estradiol Response to Four Nutritional Treatments

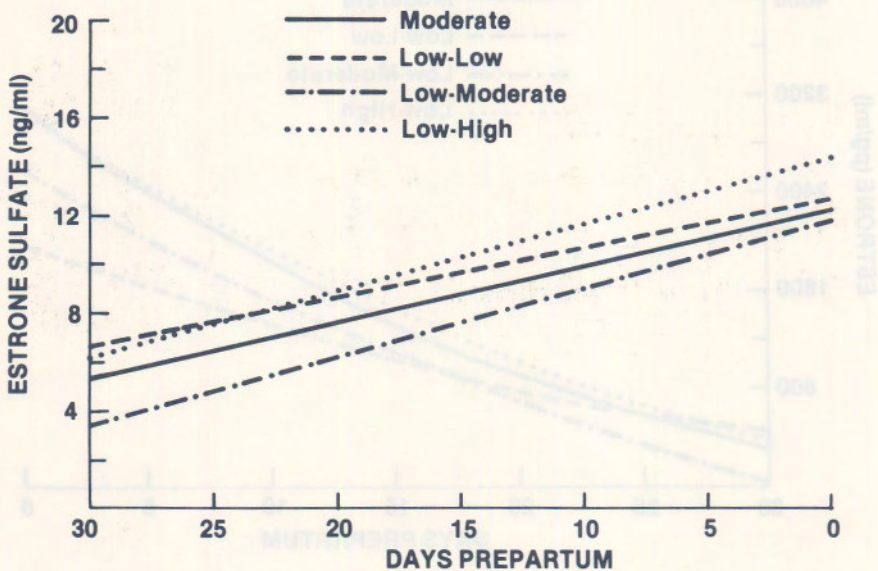


Figure 4. Least Squares Regressions of Estrone Sulfate Response to Four Nutritional Treatments

Conception rates during a 75 day breeding period, commencing May 15, were 58, 21, 40 and 39%, respectively, for the moderate, low-low, low-moderate and low-high treatments. This reproductive performance is less than desirable and is probably related to poorer than optimum body condition of the cows at calving. For instance, in a subsequent year, cows on the moderate treatment calved with a body condition score of 6.2, compared to 5.3 for the moderate cows in this experiment, and 92% of the cows conceived during the breeding period.

The differences in hormone concentrations indicate that nutrition of the cow alters the synthesis or metabolism of steroid hormones during the last 30 days of gestation. The changes in steroid hormone concentrations produced by the placenta and ovary may influence the hypothalamus or pituitary and alter the synthesis and secretion of gonadotropic hormones. These results suggest a possible mechanism by which prepartum nutrition, as reflected in body weight change, may regulate the interval from calving until the onset of ovarian activity and first estrus.

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Introduction

Much interest exists in the feeding of young bulls. Gil et al. (1967) reviewed the variable responses observed in growth and feed efficiency when young bulls are fed with growth stimulants. Impregnating bull calves with Ralgro will improve physical development (Moore et al., 1968) but impregnating prepartum bulls may not affect the function of the testis (Jankovic et al., 1967). Testicular function of bulls impregnated when puberty was 25 weeks of age is not affected. The objectives of this experiment were to evaluate the influence of prepartum and postpartum treatments on the function of bulls.

Materials and Methods

One bull of each breed and highest treatment that were used in a study described by Gil et al. (1967) were evaluated in this experiment. Bulls estimated to be slightly over one year of age were selected for uniformity in weight from a large group of common to animals. The bulls weighed about 500 pounds at the start of the 118 day feeding period and about 1075 pounds at slaughter. The highest treatment was (1) no implant, (2) a single Com-pubec implant at the start of the trial, (3) Ralgro implant at the start and on day 75 of the trial and (4) Synovex at the start and on day 75 of the trial. Four bulls of each of the breeds (Charolais, Fleischschaff, Fleischschaff x Angus)