# Influence of Prepartum Nutrition on Reproductive Performance and Plasma Glucose, Protein and Esterified Fatty Acids in Range Cows

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## Story in Brief

Sixty-eight mature, pregnant Hereford Cows were used to determine blood constituents prior to calving when subjected to different prepartum nutritional regimes. Starting November 19, 1980, one group of cows was supplemented to maintain their November weight until calving. Three other groups were fed a low level of nutrition from November 19 to January 22, 1981; then the level of nutrition was increased for two of the three groups. One group was fed to return to their November weight by calving (low-high) and another group was fed to maintain their weight until calving (low-moderate). The third group was fed to continue to lose weight (low-low), so that approximately 10 percent of the November weight was lost by the time of calving. All animals were treated alike after calving.

Projected weight losses were probably not achieved because of a mild winter, but losses were in the desired directions. Total esterified fatty acids in plasma were not affected by treatment. However, plasma glucose and protein were affected by treatment. When nutrition was increased, the concentration of glucose and protein in plasma were increased. Pregnancy rates ranged from 74 to 95 percent for the various treatments.

## Introduction

Many factors dictate the interval from calving to first estrus and subsequent ovulation in beef cows. One factor, the level of winter nutrition, or energy intake during the final trimester of gestation, affects pregnancy rate the following breeding season.

The nutritional requirement of a cow increases tremendously during the last trimester of pregnancy to meet the needs of the rapidly growing fetus. In addition, changes are also taking place in the placenta. Many essential hormones that regulate reproductive functions are produced by the placenta and fetus. Fetal and placental hormones produced during late pregnancy may influence constituents found in the blood plasma of range cows, or plasma constituents may regulate reproductive processes. Glucose is the major source of energy at the cellular level and may influence secretion of hormones. Total plasma protein may indicate the health of the animal, or it may be related to protein metabolism. Esterified fatty acids in the plasma are related to fat absorption. Therefore, this experiment was designed to determine the changes in blood constituents that occur during late pregnancy and to relate these changes to subsequent rebreeding performance in range cows on different levels of winter nutrition.

## Materials and Methods

Sixty-eight pregnant, mature Hereford cows were maintained on native tallgrass range at the Range Cow Research Center, 12 miles west of Stillwater. Starting November 19, 1980, one-fourth of the cows were randomly assigned to a moderate level of nutrition so as to maintain their November body weight until calving. The remaining animals were assigned to a low level of nutrition so they would lose about 7.5 percent of their November weight by January 22, 1981 (approximately 45 days prepartum). At this time the nutritional levels of the cows were altered. One-third of the cows remained on the low level of nutrition (low-low group) so they would lose about 10 percent of their November weight prior to calving; another group (low-high) was changed to a high level of nutrition so they would gain back their November weight by the time of calving; and a third group (low-moderate) was fed the same level of nutrition as the moderate group to calving. It was anticipated that the moderate, low-low, low-high and low-moderate cows would lose about 0, 10, 0 and 7.5 percent, respectively, of their fall weights prior to calving. Therefore, during the 45 days before calving, moderate cows would be maintaining weight, low-high cows would be gaining weight, low-moderate cows would be gaining weight but at a lower rate than low-high cows, and low-low cows would be losing weight. Feed levels were adjusted on the basis of body weights taken every 2 weeks and are summarized in Table 1. All cows were managed in the same pasture after calving and supplemented at the same rate.

**Table 1. Feeding program**

| | Nutritional treatment | | |
|---|---|---|---|
| Date | Moderate | Low | High |
| Nov. 19, 1980 | 21 lb of 41% protein CSM[a] pellets/week | 5 lb of 41% protein CSM pellets/week | |
| Jan. 22, 1981 | 21 lb of 41% protein CSM pellets/week | 5 lb of 41% protein CSM pellets/week | 30 lb of 41% protein CSM pellets/week |
| Postpartum | 28 lb of 41% protein CSM pellets/week | | |

[a]41% protein cottonseed meal pellet.

Body condition scores of the cows, based on visual appraisal, were determined independently by at least two individuals at monthly intervals for the duration of the experiment. The scores were based on a scale from 1 = very thin, to 9 = very fat. Blood samples were collected at 2-week intervals starting January 22, 1981, until calving. Plasma protein was measured with a refractometer. Plasma glucose and total esterified fatty acids were quantified by colorimetric methods.

## Results and Discussion

Winter weight losses for the low treatments were not achieved even at the low supplemental level (Table 1), probably as a result of an unusually mild winter with no snow and warmer temperatures than normal. However, as indicated in Table 2, body weight losses were in the direction desired. Moderate cows lost 2.8

**Table 2. Percent weight change at 45 days prepartum[a] and at calving[b]**

| Nutritional treatment | 45 Days prepartum | Calving |
|---|---|---|
| Moderate | 1.5 ± .9 | −2.8 ± 1.8 |
| Low-Low | −1.8 ± 1.0 | −5.3 ± 1.3 |
| Low-Moderate | −1.2 ± .8 | −1.4 ± .8 |
| Low-High | 0 ± .8 | +2.0 ± 1.2 |

[a]Weight change from November.
[b] Weight change from November prior to calving, does not include calving loss.

percent of their fall weight prior to calving, low-low cows lost 5.3 percent of their fall weight, low-moderate cows lost 1.4 percent of their fall weight and low-high cows gained 2.0 percent of their fall weight.

Body condition scores were similar for all treatment groups on November 19 and did not differ significantly on January 22, although cows on the low-moderate and low-high treatments had slightly lower scores than the other two groups (Table 3). By March 19 (the average calving date for all cows), the moderate cows had decreased .5 units from November, low-low cows had decreased .8 units, low-moderate cows had decreased .5 units and low-high cows had decreased only .2 units from November. The low-high cows had a reduction in body condition although they gained weight because the gain was associated with an increase in weight of the calf and placental fluids.

The concentration of total esterified fatty acids (TEFA) was not affected by treatment at any time period prepartum (Table 4). Cows, regardless of the treatment, had a concentration of approximately 25 mg/100 ml TEFA in plasma.

**Table 3. Body condition score[a] for cows maintained on different prepartum nutritional treatments**

| | Nutritional treatment | | | |
|---|---|---|---|---|
| Date | Moderate | Low-Low | Low-Moderate | Low-High |
| Nov. 19, 1980 | 6.5 ± .2 | 6.5 ± .1 | 6.4 ± .1 | 6.5 ± .2 |
| Dec. 18, 1980 | 6.4 ± .1 | 6.3 ± .1 | 6.1 ± .1 | 6.3 ± .1 |
| Jan. 22, 1981 | 6.0 ± .1 | 6.1 ± .1 | 5.8 ± .1 | 5.6 ± .2 |
| Feb. 19, 1981 | 6.5 ± .1 | 6.0 ± .1 | 6.2 ± .1 | 6.4 ± .1 |
| Mar. 19, 1981 | 6.0 ± 0 | 5.7 ± .1 | 5.9 ± .1 | 6.3 ± .2 |

[a] 1 = very thin, 9 = very fat.

**Table 4. Influence of nutrition and stage of gestation on total esterified fatty acids (mg% on triacetin basis) in range cows**

| | | Nutritional treatment | | | |
|---|---|---|---|---|---|
| Period | Days prepartum | Moderate | Low-Low | Low-Moderate | Low-High |
| 1 | 0-11 | 25.3 ± 1.3 | 24.2 ± 1.6 | 23.9 ± 1.4 | 27.3 ± 1.4 |
| 2 | 12-25 | 26.7 ± 1.4 | 23.6 ± 1.5 | 24.9 ± 1.0 | 28.0 ± 1.2 |
| 3 | 26-39 | 27.8 ± 1.4 | 25.7 ± 1.4 | 25.8 ± 1.3 | 25.1 ± 1.0 |
| 4 | 40-53 | 25.5 ± 1.9 | 24.7 ± .7 | 24.6 ± 1.1 | 23.2 ± 1.4 |
| 5 | 54-67 | 25.7 ± 2.5 | 23.0 ± 1.2 | 22.7 ± 1.0 | 23.7 ± 1.2 |
| Average | | 26.3 ± .7 | 24.3 ± .6 | 24.5 ± .5 | 25.5 ± .6 |

Plasma glucose concentrations (Table 5) were affected by treatment at some time periods prepartum. The moderate cows at period 2 (between 12 and 25 days before calving) had lower glucose concentrations than did the low-low, low-moderate or low-high ($P<.1$). At periods 2 and 3 the glucose concentrations of low-low cows were less than those for low-moderate and low-high cows ($P<.1$ and $P<.025$ in periods 2 and 3, respectively). This indicates that as nutrition increased, the glucose concentration also increased.

Plasma proteins (Table 6) were influenced by treatment. Low-low cows had significantly lower concentrations of plasma protein at period 2 than did low-moderate and low-high cows ($P<.01$). Plasma protein concentrations were also reduced in low-low cows at period 4 ($P<.005$) compared to low-moderate and low-high cows. This period was about 45 days prepartum and was near the time the supplementation was increased for the low-moderate and low-high cows. A difference in the treatment groups at this specific period indicates that when cows are changed from a low level of nutrition to a higher level, plasma proteins also increase.

The reproductive data (Table 7) indicate that acceptable reproductive performance was obtained with moderate nutrition. Interpretation of the effects of these nutritional treatments on reproductive performance is difficult with the limited number of cows per treatment. This experiment will be replicated for 4 years to evaluate the effect of these treatments on the interval from calving to estrus and on conception and conception rate.

**Table 5. Influence of nutrition and stage of gestation on plasma glucose (mg%) in range cows**

| Period | Days prepartum | Nutritional treatment | | | |
|---|---|---|---|---|---|
| | | Moderate | Low-Low | Low-Moderate | Low-High |
| 1 | 0-11 | 61.3 ± 4.8 | 54.7 ± 1.3 | 59.6 ± .7 | 59.3 ± 2.2 |
| 2 | 12-25 | 52.6 ± 1.8 | 54.0 ± 1.6 | 58.5 ± 1.1 | 56.0 ± 1.5 |
| 3 | 26-39 | 53.9 ± 1.9$^{a,b}$ | 52.0 ± 1.3$^{a}$ | 58.7 ± 1.6$^{b}$ | 55.6 ± 1.9$^{b}$ |
| 4 | 40-53 | 54.7 ± .9 | 54.1 ± 1.2 | 54.7 ± 1.4 | 59.6 ± 2.1 |
| 5 | 54-67 | 55.9 ± 1.7 | 54.3 ± 1.7 | 61.2 ± 4.8 | 61.7 ± 2.0 |
| Average | | 55.5 ± 1.2 | 53.7 ± .6 | 58.4 ± .8 | 57.9 ± .9 |

$^{a,b}$Means in a row with different superscripts differ ($P<.025$).

**Table 6. Influence of nutrition and stage of gestation on plasma protein (%) in range cows**

| Period | Days prepartum | Nutritional treatment | | | |
|---|---|---|---|---|---|
| | | Moderate | Low-Low | Low-Moderate | Low-High |
| 1 | 0-11 | 7.5 ± .15 | 7.3 ± .13 | 7.5 ± .10 | 7.6 ± .12 |
| 2 | 12-25 | 7.3 ± .11$^{a,b}$ | 7.1 ± .01$^{a}$ | 7.5 ± .09$^{b}$ | 7.4 ± .10$^{b}$ |
| 3 | 26-39 | 7.1 ± .15 | 7.1 ± .09 | 7.3 ± .08 | 7.2 ± .13 |
| 4 | 40-53 | 7.1 ± .15$^{c,d}$ | 6.8 ± .09$^{c}$ | 7.2 ± .08$^{d}$ | 7.2 ± .11$^{d}$ |
| 5 | 54-67 | 7.1 ± .18 | 6.8 ± .07 | 7.0 ± .11 | 7.3 ± .09 |
| Average | | 7.2 ± .06 | 7.0 ± .05 | 7.3 ± .04 | 7.3 ± .05 |

$^{a,b}$Means in a row with different superscripts differ ($P<.01$).
$^{c,d}$Means in a row with different superscripts differ ($P<.005$).

Table 7. Influence of prepartum nutrition on pregnancy rate of range cows

| Level of nutrition | No. pregnant/No. exposed | (% pregnant) |
|---|---|---|
| Moderate | 11/12 | (92) |
| Low-Low | 13/17 | (76) |
| Low-Moderate | 18/19 | (95) |
| Low-High | 15/19 | (79) |

This study, when complete, will provide much information on the relationships between winter supplemental feeding programs, body weight loss, body condition score, blood metabolites and reproductive performance of range cows. These data should allow us to determine desirable winter feeding programs and assist in the elucidation of causes of extended intervals from calving to first estrus.

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# Effect of Dexamethasone on Gonadotropin Secretion in Postpartum Anestrous Range Cows

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## Story in Brief

An extended interval from calving to first estrus in beef cattle may be associated with environmental stress and, suckling which increase the secretion of adrenocorticotropic hormone (ACTH) by the pituitary gland. Increased secretion of ACTH causes greater amounts of corticoids to be secreted by the adrenal gland. This experiment was designed to determine if treatment of anestrous cows with dexamethasone, a synthetic corticoid, would inhibit the release of ACTH by the pituitary and, as a result, alter secretion of the luteinizing hormone (LH) and alter the interval from calving to estrus. Treatment with dexamethasone did not influence the percentage of cows in estrus by 85 days after calving, however, it tended to lengthen the interval from calving to first estrus in those cows that exhibited estrus. The pattern of LH secretion was altered for several days after treatment.

## Introduction

Studies with laboratory animals suggest that exposure to stressful conditions alters secretion of pituitary hormones. Stresses imposed before breeding have