EFFECT OF PREPARTUM SUPPLEMENTATION ON PLASMA CONSTITUENTS AND REPRODUCTIVE PERFORMANCE OF RANGE BEEF COWS

J.C. Garmendia[1], R.P. Wettemann[2]
and K.S. Lusby[3]

Story in Brief

Seventy-six mature Hereford cows were used to determine the influence of amount of supplemental feed during late gestation on concentrations of glucose and non-esterified fatty acids in plasma and subsequent reproductive performance. On November 10, 1981, 18 of the cows were assigned to a moderate level of supplementation to maintain their fall weight until parturition; 58 cows were assigned to a low level of supplementation so that they would lose approximately 10% of their fall weight by calving. On January 20, 1982, one-third of the low cows continued on the low plane of nutrition (low-low group), one-third received moderate (low-moderate), and one-third was increased to a high level (166% of the moderate; low high). All cows received the moderate level of nutrition after calving.

Cows on the moderate treatment gained 1.5% of their fall weight before calving, and cows on the low-low, low-moderate and low-high treatments lost 13.3, 7.5 and 7.5%, respectively. Treatments did not significantly influence concentrations of non-esterified fatty acid (NEFA) and glucose in plasma. Plasma concentrations of NEFA before calving were positively related to body condition scores of the cows. More cows on the moderate treatment were cycling and were pregnant at the end of the breeding season. These results suggest that body condition of cows during pregnancy influences plasma concentrations of NEFA and supplemental feeding influences concentration of glucose in plasma.

Introduction

The main goals in a cow-calf enterprise are the production of a live calf by each cow and weaning a large calf every 12 months. A cow must conceive by 80 days-postpartum in order to have a 365-day calving interval. Parturition is followed by a variable period of time when the cow is reproductively inactive. During this time, uterine involution occurs and pituitary hormones are secreted which stimulate the ovaries and result in the initiation of estrous cycles.

The duration of the postpartum anestrous interval in cows is influenced by many factors, of which, nutrient intake is the most inportant. Dunn (1980) indicated that the most critical period of time in the productive life of the beef female is the last trimester of gestation plus the first 60 days of lactation. Malnutrition during the last trimester of gestation is important because fetal growth is greatest and severe deficiencies may cause neonatal mortality. In addition, cows which are not in good condition at calving, usually have an extended interval from calving to the first postpartum estrus. When energy was

[1]Graduate student Animal Science [2] Professor, Animal Science [3]Associate Professor,

limited during the prepartum period, the interval from parturition to first estrus was increased and weight and condition of the dam, birth weight of the calves, number of cows exhibiting estrus and pregnancy rate, were decreased (Bellows and Short, 1978).

Plasma concentrations of glucose and non-esterified fatty acids may be useful as a measure of energy status in cows. The purpose of this experiment was to determine the influence of different levels of nutrition in beef cows during late gestation on concentrations of plasma metabolites and subsequent reproductive performance.

Materials and Methods

Seventy-six mature Hereford cows were maintained on native tallgrass range and divided into 4 prepartum nutritional regimes based on size, age and whether or not they weaned a calf the previous year. On November 10, 1981, one-fourth of the cows were assigned to a moderate (M) level of nutrition. Cows were fed the amount of cotton seed meal (CSM; 3 lb/day) necessary to maintain their fall weight until parturition. The remaining cows were assigned to a low (L) nutrition supplementation (2 lb/day) so that they would lose approximately 5% of their fall weight (the November 10 weight) by January 19, 1982 (approximately 60-90 days prepartum). On January 20, 1982, one-third of the low cows continued on the low plane of nutrition (1.5 lb/day) so they would lose 10-15% of their fall weight by parturition (low-low; LL group). Another one-third of the low cows were fed the same amount of CSM as the M group until parturition (low-moderate; LM group). The remaining one-third of the L cows were fed 166% of the CSM fed to the M cows (low-high; LH group). After calving, all cows received the moderate level of nutrition. One-third of the weekly supplemental CSM was fed on each Monday, Wednesday and Friday. Native dormant tallgrass was replaced with prairie hay when the grass was covered with ice or snow. Cows were weighed and body condition scores were determined every 2 weeks from November 10, 1981 until calving. Body condition scores were based on a scale from 1 to 9 for which a condition score of 1 represented a very emaciated animal and a cow scoring 9 was considsered extremely obese. Blood plasma samples were collected every 2 weeks from February 2, 1982 until calving and concentrations of glucose and non-esterified fatty acids were quantified. Progesterone was analyzed by radioimmunoassay in weekly plasma samples taken between 15 and 85 days postpartum. Concentrations of progesterone greater than 1 ng/ml for 2 consecutive weeks indicated the onset of ovarian activity.

Results and Discussion

The proposed winter weight changes were achieved by the feeding programs used. By January 20 (about 60 days before calving), moderate cows had gained about 1.5% of their fall weight (Table 1); however, cows on the restricted supplementation had lost approximately 4.5 % of their fall body weight. Body weight of the cows in the moderate group was maintained until calving and the cows on the low level of nutrition had lost 13.3% of their fall weight at calving. Increasing the amount of supplement fed to cows on the restricted regime to moderate or high levels at 60 days before the expected calving date did not inhibit weight loss. Instead, cows continued to lose weight and at calving both low-moderate and low-high cows had lost -7.5% of the fall body weight. Unfavorable weather conditions during the time of the greatest prepartum nutritional requirements probably affected the ability of the cows to recover and gain weight before calving.

Table 1. Body weights and changes for cows on different prepartum nutritional treatments [a]

Nutritional Treatment	Fall Weight (Nov. 10)	About 60 days Precalving (Jan. 20)	Average Calving Date (March 18)
Moderate	973	988 (+1.5)	987 (+ 1.4)
Low-Low	973	927 (-4.7)	844 (-13.3)
Low-Moderate	952	914 (-4.0)	881 (- 7.5)
Low-High	978	932 (-4.7)	905 (- 7.5)

[a] Total body weight (lb) and percent weight change from November.

Changes in body condition score during late pregnancy were similar to the changes in body weight (Table 2). Sixty days before calving cows in the moderate group had conserved their fall body condition while the cows in the restricted supplementation group had lost between 15-21% of their fall body condition.

Table 2. Body condition score [a] and changes for cows on different prepartum nutritional treatments.

Nutritional Treatment	Fall Weight (Nov. 10)	About 60 days Precalving (Jan. 20)	Average Calving Date (March 18)
Moderate	5.9	5.8 (- 1.7) [b]	5.8 (- 1.7)
Low-Low	6.1	4.8 (-21.3)	4.8 (-21.3)
Low-Moderate	5.7	4.8 (-15.8)	5.3 (- 7.0)
Low-High	6.1	5.2 (-14.8)	5.8 (- 4.9)

[a] 1 = very thin, 9 = very fat
[b] Percentage change from November in parenthesis.

At calving, cows which were maintained on the low-low treatment had lost 21.3% of their fall condition score and the cows that were on the low treatment and were switched to extra supplementation 60 days before calving, had partially recovered their body condition. Changes in the body weight of the cows were generally smaller than the changes in body condition. Increases in weight of the calf and placental fluids before parturition, probably were compensating for the reduction in body weights of the cows. For instance, changes in body condition may represent actual loss of nutrient reserves more accurately than weight loss during late gestation.

Plasma glucose concentrations (Table 3) were greatest (57 mg%) in the cows on the moderate treatment and least (52.9 mg%) in the cows on the restricted supplementation at 45 days before the average calving date. However, these differences were not significant.

Table 3. Influence of nutrition on plasma glucose (mg%) in range cows

Period	Nutritional Treatment			
	Moderate	Low-Low	Low-Moderate	Low-High
February 2	57.0	52.9	53.1	55.7
February 18	57.1	56.6	54.6	53.0
March 4	57.6	56.1	54.2	53.5
Calving	51.7	56.0	51.5	55.1

At calving, blood glucose concentrations were greatest (56 mg%) in the cows on the restricted feeding and least (51.7 mg%) in the cows on the moderate level of supplementation. But the differences were not significant.

Treatments did not significantly influence concentration of NEFA in plasma. Non-esterified fatty acids in plasma were relatively constant within each treatment group of cows throughout the experiment (Table 4). Cows on the moderate treatment had the lowest concentration of NEFA, while the greatest concentrations of NEFA were in the group of cows with the restricted supplementation. Concentrations of NEFA in plasma before calving were related with body condition score of the cows. Cows with higher body condition scores had greater concentrations of NEFA.

Table 4. Influence of nutrition on plasma non-esterified fatty acids[a] in range cows

Period	Nutritional Treatment			
	Moderate	Low-Low	Low-Moderate	Low-High
February 2	991	1235	1061	1123
February 18	954	1130	1064	1172
March 4	951	1198	1057	1178
Calving	863	1227	1162	1089

[a]Microequivalents/liter

Increased concentrations of NEFA in plasma reflect the extent of body fat utilization. During fasting conditions, energy must be utilized from stored fat. In addition, cows in the best body condition at 45 days prepartum had the ability to mobilize depot fat when the energy requirements were maximum. At calving, there was a difference between plasma concentrations of NEFA for cows fed the moderate and restricted supplementations; the moderate group of cows, which maintained their fall body weight, had the lowest NEFA concentrations, indicating reduced mobilization of stored fat.

Cows with restricted supplementation (low-low treatment) throughout the experimental period, had the thinnest body condition scores after calving and the greatest plasma NEFA concentrations, indicating an increased mobilization of energy sources to meet the high energy requirements associated with lactation.

The percentage of cows cycling by 85 days postpartum and the proportion of pregnant cows were used as indicators of reproductive performance (Table 5). More cows on the moderate regime of feeding were cycling (68.4%) by 85 days postpartum and were pregnant (84.2%) at the end of the breeding season. Restriction of feeding (low-low supplementation) drastically affected reproduction and only 11.8% of the cows were cycling and conceived during the breeding season. Increasing the amount of supplementation at 60 days before the average date of calving increased the percentage of cows cycling and the pregnancy rate compared to cows on the low-low treatment. However reduced supplementation during mid pregnancy resulted in reduced reproductive performance even if nutrient intake was increased during the last 60 days of pregnancy.

Table 5. Percentage of cows cycling by 85 days after calving and cows pregnant at the end of breeding season

Nutritional Treatment	Cows Cycling (%)	Cows Pregnant (%)
Moderate	68.4 (13/19) [a]	84.2 (16/19)
Low-Low	11.8 (2/17)	11.8 (2/17)
Low-Moderate	23.3 (4/17)	41.2 (7/17)
Low-High	30.7 (4/13)	61.5 (8/13)

[a]Number of cows responding compared to the total number of cows.

Literature Cited

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