THE RELATIONSHIP BETWEEN PREPARTUM NUTRITION AND POSTPARTUM PLASMA GLUCOSE, BODY WEIGHT CHANGES, BODY CONDITION SCORE CHANGES AND REPRODUCTIVE PERFORMANCE IN BEEF COWS

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Story in Brief

Seventy-two Hereford range cows (3-6 years of age) were used in 1983 and 45 Hereford cows (2-3 years of age) were used in 1984 to determine the effect of prepartum nutrition on postpartum plasma glucose, body weight and condition score changes and the subsequent reproductive performance. Four nutritional treatment groups before calving were used each year of the study. Blood samples were obtained weekly after calving, whereas weights and condition scores were recorded biweekly.

Nutritional treatments, body weight change and condition score change were not related to postpartum concentrations of glucose in the plasma. However, those cows that became pregnant in 1983 had greater concentrations of plasma glucose than those that failed to conceive. In the second year (1984), the differences in plasma glucose concentrations between cows conceiving and those that did not were not significant but cows that conceived tended to have greater concentrations of glucose in the plasma than those that did not conceive. This study suggests that postpartum concentrations of plasma glucose may be related to the potential for conception during the breeding season.

(Key Words: Body condition score, cow, glucose, nutrition, postpartum, reproduction)

Introduction

Prepartum nutrition is an important factor that regulates reproductive performance of beef cows. The physiological links between the nutritional status of the beef cow and the onset of postpartum estrus and eventual conception have not been elucidated. Plasma glucose is a primary source of energy of most mammalian cells. Previous research indicates that concentrations of plasma glucose prepartum could be altered by changing amounts of supplemental feed to gestating beef cows. The purpose of this study was to investigate the response of plasma glucose in beef cows postpartum to prepartum nutrition and to evaluate the relationships between plasma glucose, changes in body weight, body condition score and reproductive performance.

Materials and Methods

Pregnant Hereford cows grazing native range near Stillwater, Oklahoma were assigned to one of four nutritional treatment groups. In November, 1982 (72 cows), and in November, 1983 (45 cows), cows were blocked by age and body condition score and assigned to treatments.

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Group 1 cows were supplemented to maintain their November weights until calving in March and April. Groups 2, 3 and 4 were restricted in supplementation, so as to lose 5 percent of their November weights by January 20 (approximately 45 days prior to calving). After January 20, Group 2 was continued on the restricted diet so they would lose another 5% of their weight before calving. Group 3 cows were supplemented the same as Group 1 cows from January 20 to calving. Cows in Group 4 were given 140 percent the supplemental feed given to Group 1 cows during the last 45 days of gestation. In 1982-83 cows were 3 to 6 years old, and in 1983-84 all first or second-calf heifers were used. Supplement consisted of differing amounts of soybean meal. During the first year, cows were group fed their supplement and during the second year cows were individually fed 3 days per week. Cows were maintained on range pasture with supplemental hay and approximately 4 pounds of 40% protein cubes were fed daily postpartum. In 1983 the severity and length of the winter season depleted hay supplies by May and forage quality and quantity was limited. In the early spring of 1984, standing forage and hay were both more available. Table 1 summarizes the treatments.

Table 1. Supplementation scheme used in 1983 and 1984 calving cows.

	Fall-Jan. 20	Jan. 20-Calving	Postpartum
Group 1	Maintain Fall weight	Maintain Fall weight	NRC for lactating cow
Group 2	Lose 5% of Fall weight	Lose 5% of Fall weight	Same as Group 1
Group 3	Lose 5% of Fall weight	Same as Group 1	Same as Group 1
Group 4	Lose 5% of Fall weight	Fed 140% of Group 1	Same as Group 1

Cows were weighed and body condition scores were assigned biweekly from the beginning of the trial until 85 days postpartum. Body condition scores were determined by at least two individuals and utilized a scale of 1 = emaciated, to 9 = obese. Tail vein blood samples (20 ml) were obtained weekly after calving until 85 days postpartum. An anticoagulant (oxalic acid) was added to each sample and the samples were cooled in an ice bath. Samples were centrifuged and the plasma was decanted and stored at -20 C until assayed for glucose, via an enzymatic, colorimetric procedure.

Weight and condition scores were evaluated by analyses of variance. Treatment effects on plasma glucose were analyzed by split-plot analysis of variance over time. Glucose means for cows that became pregnant were compared with those that failed to conceive by Hotelling's test of multivariate regression coefficients.

Results and Discussion

Body weights of the cows that calved in 1983 are depicted in Figure 1. Body weights and scores were similar for cows on all treatment groups

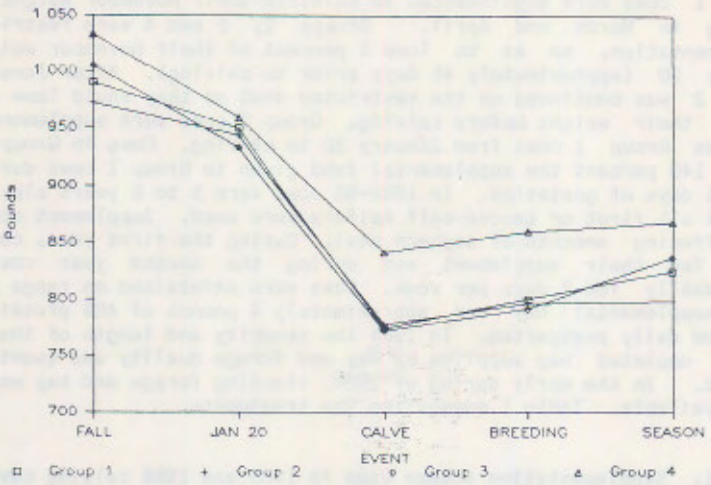

Figure 1. Mean body weights in fall, at Jan. 20, after calving, at the start of the breeding season, and 30 days into the breeding season for cows calving in 1983.

in November. Cows on all treatments lost weight by January 20. Group 1 lost 2.7% of the fall weight whereas Groups 2, 3, and 4 (fed together) lost 5% of their November weight. Group 4 had lost 18% of the fall weight after parturition and Groups 1 and 2 had lost 20% of the fall weight. Group 3 had lost 22% of the fall weight after calving. Body condition scores indicated that the 1983 cows were in a negative nutritional state until calving. Initial body scores (November) were similar for all groups (mean = 5.6). However, the Group 4 cows had a slightly greater body condition after calving and at the start of the breeding season. All Groups had average condition scores less than 5.0 after calving. Only slight improvement in mean body condition scores was observed by the start of the breeding season (May 1). A particularly long, late winter season delayed the availability of summer grasses until late May, and prematurely depleted the hay supplies. The slow recovery of body weights and body condition scores after calving are evidence of the weather-related nutritional stresses. The undesirable reproductive performance of the cows in 1983 reflects the weight and condition losses incurred by all groups of cows before calving and slow gains after calving (Table 2). There was no effect of prepartum treatment on concentrations of glucose in plasma postpartum or on reproductive performance. Weight change or condition score change (from fall) was unrelated to plasma glucose after calving. Postcalving weight change and condition score change were correlated ($r = .52$, $P<.01$). Multivariate regression curves for plasma glucose concentrations, by week postpartum, for cows that became pregnant or failed to conceive during a 90 day breeding season are shown in Figure 2. Plasma glucose concentrations in cows that became pregnant were greater ($P<.05$) during the first 12 weeks after calving compared to concentrations in cows that did not conceive. The shapes of the regression curves were similar ($P>.5$).

Table 2. Mean conception rates and days to conception by treatment group for cows calving in 1983.

	Group 1	Group 2	Group 3	Group 4
Total cows	18	17	18	19
Cows pregnant (no.)	7	2	4	8
Cows pregnant (%)	39	12	22	42
Mean days to conception	103 ± 11	98 ± 35	102 ± 11	85 ± 3

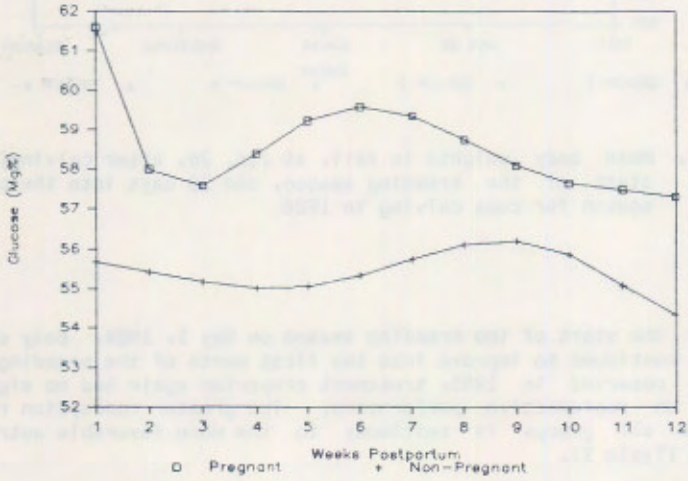

Figure 2. Multivariate predictions of plasma glucose by week postpartum for cows that became pregnant versus cows that failed to conceive in 1983.

For cows on the 1984 trial, weight losses were similar from November until the time of nutrition change in January to those in the previous year. Group 1 cows maintained their body weight from November until January 26. Groups 2, 3 and 4 lost 5% of the fall weight by January 26. Weight losses were quite similar for all four Groups from January until after calving. Contrary to the postpartum weight changes in 1983, all cows calving in 1984 consistently gained weight after calving and continued to gain during the breeding season. The condition scores of the cows in 1984 further indicate less nutritional stress after calving than in 1983. Mean body condition scores for all four Groups were above

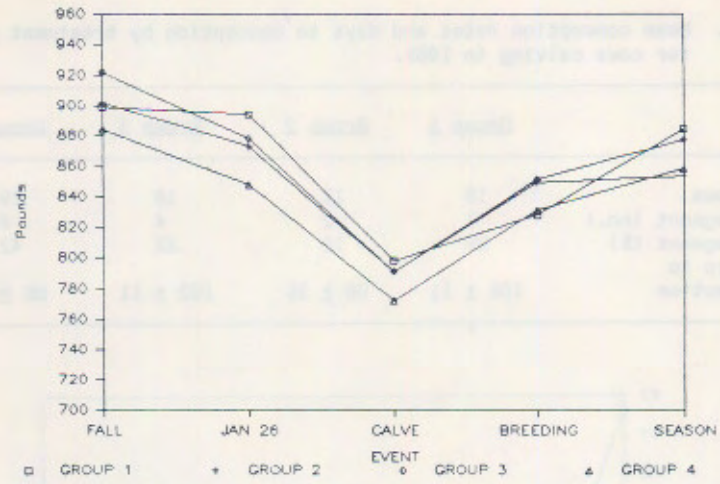

Figure 3. Mean body weights in fall, at Jan. 26, after calving, at the start of the breeding season, and 30 days into the breeding season for cows calving in 1984.

5.0 by the start of the breeding season on May 1, 1984. Body condition scores continued to improve into the first month of the breeding season. As was observed in 1983, treatment prepartum again had no significant effect on reproductive performance. The greater conception rates for cows in all groups is testimony to the more favorable nutrition in 1983-84 (Table 3).

Table 3. Mean conception rates by treatment group for cows calving in 1984.

	Group 1	Group 2	Group 3	Group 4
Total cows	12	10	10	13
Cows pregnant (no.)	11	8	6	9
Cows pregnant (%)	92	80	60	69

Similar to the results in 1983, treatment had no effect on postpartum concentrations of plasma glucose, and body weight change, body condition score change and plasma glucose were unrelated. The correlation between body weight change and condition score change from fall to post-calving was similar to that in 1983 ($r = .52$, $P<.01$). Multivariate regression curves of plasma glucose for cows that became pregnant and those that failed to conceive are plotted in Figure 4.

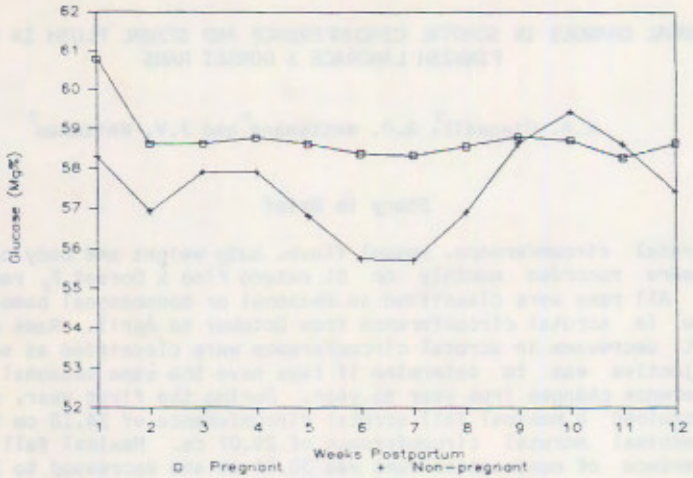

Figure 4. Multivariate predictions of plasma glucose by week postpartum for cows that became pregnant versus cows that failed to conceive in 1984.

Although glucose concentration was slightly higher in cows that conceived, the curves were not significantly different. There was a tendency for the shapes of the curves to be different (P = .09). Similar to data from 1983, glucose in plasma of cows that eventually conceived was consistently greater than for cows that failed to conceive. The alterations in the magnitude of the differences in plasma glucose for cows that became pregnant and those that did not could be attributed to the difference in the severity of nutritional stress endured by the cows in their respective years.

Plasma glucose concentrations are quite variable within a single cow or between different cows due to the many physiological factors regulating glucose. One blood sample will not give an accurate indication of the long-term glucose status of a cow. The results of this study indicate that plasma concentrations of glucose may be related to the potential of beef cows to become pregnant, especially in those that have been under nutritional stress.