Postpartum Nutrition Affects Performance of Spring-Calving First-Calf Heifers Grazing Native Range

N.H. Ciccioli, C.A. Lents, F.J. White, and R.P. Wettemann

Story in Brief

An experiment was replicated over 2 yr to investigate the influence of body condition score at calving and postpartum nutrient intake on reproductive performance of Hereford x Angus heifers. Spring calving heifers were fed to calve at 24 mo of age with a body condition score of 4 to 5. Heifers were blocked by body condition score and calving date and randomly allotted to gain .45 kg/d (M) or .90 kg/d (H) for about 71 d postpartum. Commencing at 30 d postpartum, blood samples were collected weekly and estrous behavior was continuously monitored by radiotelemetry. Size of the dominant follicle was measured at 4 to 14 h after the onset of the first postpartum estrus. All cows were artificially inseminated between 12 and 20 h after onset of the first estrus. Heifers calving with a body condition score of 4 or 5 had similar reproductive performance. Cows fed the H diet postpartum had a greater body condition score at 90 d after calving and had heavier calves (205-d) than cows fed the M diet. The interval from calving to first estrus and ovulation was 31 d shorter in H than M cows. Maximum diameter of the ovulatory follicles and pregnancy rates at the first estrus were greater for cows receiving a H diet compared with those receiving M diet. We conclude that increased weight gain of first-calf heifers after calving results in a shorter postpartum anestrus interval, larger ovulatory follicles and a greater pregnancy rate at the first estrus. In addition, cows fed high energy diets postpartum produce heavier calves at weaning.

Key Words: Postpartum, Nutrition, Ovary, Pregnancy Rate, Beef Cow

Introduction

Reproduction has been suggested to be at least five times more important economically than growth rate and product quality for beef cow-calf enterprises (Trenkle and Willham, 1977). Improvement of reproductive performance is often limited by prolonged periods after calving when cows do not display estrous behavior or ovulation and/or have low pregnancy rate at the first service.

Failure to conceive early after calving is the main cause of reproductive inefficiency in first-calf heifers. Calving at 2 yr of age imposes high nutritional demands that are often difficult to supply under grazing conditions. Consequently, low nutrient intake before or after calving has a greater negative effect on reproduction in young than in mature cows. Nutritional management has an important influence on the reproductive activity of postpartum cows. Feed restriction during the prepartum period of mature cows results in thin cows at calving that have reduced pregnancy rates in the breeding season (Selk et al., 1988). Supplementation during the postpartum period increases the cumulative percentage of cows in estrus and pregnant during a 60-d breeding season (Spitzer et al., 1995). The objectives of this study were to determine the effects of body condition score (BCS) of first-calf cows at calving, and two levels of nutrient intake post-calving, on performance and reproductive function at the first estrus.

Materials and Methods

During 2 yr, Hereford and Hereford x Angus heifers (1998, n = 34; 2000, n = 42) maintained on pasture were fed a protein supplement (40% CP either 0.9 or 1.8 kg/cow/d), during the last 90 d of gestation, so that they would calve with a BCS of 4 to 5. At calving, in February and March, cows were blocked by calving date and BCS and within block randomly allotted to one of two nutritional treatments for 71 ± 17d. Cows were group-fed and targeted to gain 0.45 (Moderate=M) or 0.90 kg/d (High=H). During treatment all cows were fed prairie hay free choice. M cows were supplemented with 2 kg/cow/d of 38% CP cubes whereas H cows had free access to a high-energy diet (12% CP and 2.25 Mcal ME/kg of DM). The diet was composed of rolled corn (40%), ground alfalfa pellets (35%), cottonseed hulls (22%), cane molasses (3%) and salt (.25%). Shrunk (16 h of feed deprivation) body weights and BCS were recorded monthly between 30 d before and 150 d after parturition. Calves were weighed within 24 h of birth and at 30-d intervals until weaning.

Commencing at 30 d after calving, cows were bled weekly and concentrations of progesterone in plasma were quantified using a radioimmunoassay. Estrous behavior was continuously monitored with a radiotelimetric system (HeatWatch®, DDx, Inc., Denver, CO). Onset of estrus was defined as the first of two mounts detected within 4 h, and the end of estrus was identified as the last mount, with a mount within 4 h before, without a subsequent mount for 12 h. The dominant follicle (DF) was defined as the follicle that was at least 10 mm in diameter and it was the largest follicle present in either ovary at first estrus. Size of the dominant follicle was determined at 4 to 14 h after onset of estrus by transrectal ultrasonography. Ovulation with the first estrus was confirmed by at least two consecutive plasma samples with concentrations of progesterone >1 ng/ml. Postpartum anestrous interval (PPI) was the number of days from calving to first estrus and ovulation. Cows that had not ovulated (H=1 vs M=9) by the end of a 23-wk period were assigned a PPI equal to 168 d (1wk after estrus and ovulation were last determined) and were included in the analysis. All cows were artificially inseminated between 12 and 20 h after onset of the first estrus by a single technician using semen from one bull in each year. Pregnancy was determined at 35 to 55 d post-insemination by ultrasonography and confirmed by calving date.

Data for BCS, body weights and reproductive characteristics were analyzed as a randomized complete block design with a 2 x 2 factorial treatment structure using a mixed model with year as a random effect and days on feed as a covariant (PROC MIXED; SAS Inst. Inc., Cary, NC). Logistic regression analysis was used to test the effects of year, BCS at calving, postpartum nutrition and all first order interactions on pregnancy rates (PROC GENMOD, SAS).

Results and Discussion

The effect of BCS at calving and the interaction between BCS at calving and postpartum nutrient intake were not significant for any response variable, therefore results are presented for the effect of postpartum nutrition on various traits.

It was not expected that first-calf cows that calved with thin (BCS 4) or moderate (BCS 5) condition would have similar performance and reproductive function. Reproductive function is usually reduced in thin cows. However, if cows were bred for a shorter time period than the one used in this study, an effect of BCS on reproduction might have been observed. Spring calving first-calf cows should calve at a BCS of 6 to have efficient rebreeding (Spitzer et al., 1995).

Body weights for H and M gain cows were similar prepartum (423 ± 11 kg) and during the 2 wk postpartum (376 ± 11 kg). Cows in H gain were 23, 43, and 63 kg heavier (P<.01) than cows in M gain at 5, 9 and 13 wk postpartum, respectively. Postpartum weight gain during the feeding period averaged .34 and 1.13 kg/d for M and H gain cows, respectively. Body condition score was similar for M and H cows at calving but a greater postpartum nutrient intake increased (P<.01) BCS at the end of feeding (Table 1). Cows on the H nutrition gained .46 BCS whereas M cows lost .19 of a BCS. Calves born from H or M cows had similar weights at birth. However, calves suckling H cows were heavier (P<.01) than those suckling M cows at the end of the feeding period. Average daily gain was .25 kg/d greater (P<.01) for calves suckling H compared with those suckling M cows. When weaning weights were adjusted to 205 d of age, calves reared by H cows weighed 10 kg more (P<.05) than those reared by M cows. Postpartum nutrient intake can influence the amount of subcutaneous fat, milk production and calf weight gain at 70 d of age and the last two variables were highly correlated (r=0.89; Perry et al., 1991). First-calf cows fed high energy diets had increased milk production from 30 to 60 d postpartum but then it decreased (Lalman et al., 2000) indicating that calves may require less milk after 60 d and thus a greater proportion of energy consumed might be available to gain maternal tissue. H cows and their calves weighed more at the end of feeding.

Table 1. Effects of postpartum nutrition on BCS of cows and calf growth rate

	Postpartum nutrition		
Item	Moderate	High	SE
No. of cows	42	39	
BCS			
at calving	4.69[a]	4.74[a]	.18
at end of feeding	4.5[a]	5.2[b]	.13
Calf body weight, kg			
at calving	33.1	33.5	1.5
at end of feeding	81[a]	98[b]	10
adj. at 205-d	174[c]	184[d]	16

[a,b]Means within a row differ (P<.01).

[c,d]Means within a row differ (P<.05).

Behavioral and ovarian characteristics and reproductive performance at the first estrus are summarized in Table 2. Duration and number of mounts received at the first postpartum estrus were not affected by postpartum nutrient intake, which is consistent with our previous observations in mature cows fed different levels of crude protein after calving (Lents et al., 2000). In the present study, average duration of the first estrus was 5.5 h and number of mounts received per cow was 16. In contrast, we observed that non-lactating cyclic cows have a longer estrous period (16 h) and receive more mounts (42) per estrus (White et al., 2000). Reduced receptive behavior at the first postpartum estrus may be due to reduced secretion of estradiol by the follicle (Lyimo et al., 2000) and/or to a small number of cows in estrus simultaneously

(Floyd et al., 2001). Ovarian function was affected by postpartum nutrition and H cows had a preovulatory follicle larger (P<.01) in diameter than M cows. Reduced nutrient intake also decreased the size of the dominant follicle in postpartum beef cows (Lents et al., 2000). Changes in cow nutritional status are reflected by changes in the availability of metabolites and metabolic hormones that increase follicular growth. Reproductive performance of first-calf cows was greatly improved by feeding a high-concentrate diet postpartum. Greater nutrient intake after calving not only shortened (P<.01) the average PPI to estrus for more than the normal length of one estrous cycle but also it increased (P<.02) pregnancy rate at the first service by 18 percentage points. Cows fed a high postpartum nutrient intake resumed luteal activity earlier after calving (Vizcarra et al., 1998). Our experiment is the first to demonstrate that postpartum nutrition increases pregnancy rate at the first estrus of first-calf cows. The size of the preovulatory follicles was greater in H than M cows at the first estrus indicating that it might alter ova development and/or uterine function to improve pregnancy rate at the first ovulation.

Table 2. Effects of postpartum nutrition on estrous behavior, ovarian function and reproductive performance of first-calf cows at the first estrus

	Postpartum nutrition		
Item	Moderate	High	SE
No. of cows	33	38	
Duration of estrus, h	5.5[a]	5.7[a]	1.1
No. of mounts	15.1[a]	17.8[a]	5.3
Diameter of DF, mm	13.5[a]	14.7[b]	.3
Duration of PPI, d	133[a]	102[b]	16
Pregnancy rate, %	58[a]	76[b]	

[a,b]Means within row differ (P<.02).

Implications

A successful breeding program depends not only on cows showing and being detected in estrus, but also on pregnancy rate. Lactating first-calf cows have a prolonged postpartum interval followed by a first estrus period of short duration. Therefore, two 30-min visual observation periods per day may be insufficient to identify cows for AI. Increasing the frequency of visual observation to 6-h intervals and using devices to assist in cow identification may improve estrous detection rate. Feeding a high-concentrate diet free choice after calving consistently reduces the PPI, increases calf weaning weight and enhances pregnancy rate at the first service. Postpartum nutritional management can be used to improve reproductive performance of beef cows. Additional research is necessary to determine the amount of supplement required to increase production and minimize cost.

Literature Cited

Floyd, L.N. et al. 2001. J. Anim. Sci. 79(Suppl. 1):(In press).

Lalman, D.L. et al. 2000. J. Anim. Sci. 78:530.

Lents, C.A. et al. 2000. Okla. Agr. Exp. Sta. Res. Rep. P-980:164.

Lyimo, Z.C. et al. 2000. Theriogenology 53:1783.

Perry, R.C. et al. 1991. J. Anim. Sci. 69:3762.

Selk, G.E. et al. 1988. J. Anim. Sci. 66:3153.

Spitzer, J.C. et al. 1995. J. Anim. Sci. 73:1251.

Trenkle, A. and R.L. Willham. 1977. Science. 108:1009.

Vizcarra, J.A. et al. 1998. J. Anim. Sci. 76:927.

White, F.J. et al. 2000. Okla. Agr. Exp. Sta. Res. Rep. P-980:176.
