2000 Animal Science Research Report

Pages 164-168

Effects of Body Condition of Beef Cows at Calving and Protein Supplementation on Estrous Behavior and Follicle Size

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Story in Brief

Spring calving, multiparous Angus x Hereford cows (n=45) were fed to calve with a body condition score (BCS; 1=emaciated, 9=obese) of thin (<5) or moderate (³5). Cows were blocked by BCS and calving date and randomly assigned to receive either low (1.2 kg/d) or high (2.5 kg/d) amounts of a 42% CP supplement. All cows grazed the same native grass pasture after calving and were fed native grass hay free choice. Cows were fed protein supplement in individual stalls for 49.2 ± 2.3 d. Beginning 20 d postpartum, blood samples were collected from each cow three times weekly, and estrous behavior was monitored continuously with the HeatWatch® system. Onset of estrus was defined as the first of two mounts within 4 h. Size of the dominant follicle at 4 to 14 h after the onset of estrus was determined by ultrasonography. Duration of luteal activity (LA) before and after the first estrus was characterized as short (plasma progesterone ³ .5 ng/mL for < 10 d) or normal (plasma progesterone ³ .5 ng/mL for ³ 10 d). Weight gains during treatment tended to be greater for cows on high than on low nutrition. Sixty-five percent of cows had short LA prior to their first estrus. The number of mounts and duration of the first estrus were not influenced by BCS at calving or postpartum nutrition. Size of the dominant follicle was greater for cows with moderate condition at calving compared with thin cows, and for cows on high vs low protein supplementation after calving. Cows in moderate condition returned to estrus earlier than thin cows. Postpartum nutrient intake and BCS at calving influence the size of the dominant follicle at the first estrus in multiparous beef cows.

Key Words: Beef Cattle, Nutrition, Estrus, Follicle, Supplementation

Introduction

Nutrient intake and body energy reserves are major regulators of reproductive performance of beef cows. Fewer cows become pregnant when they calve in thin body condition as compared with cows calving in moderate condition (Selk et al., 1988). Cows in moderate body condition resume ovarian activity earlier after calving than thin cows (Vizcarra et al., 1998). Chronic nutritional restriction inhibits the reproductive process in beef cows (Richards et al., 1989). Inadequate nutrition decreases growth rate and size of the dominant follicle (Bossis et al., 1999). When cows were fed inadequate protein, they had longer intervals to estrus and decreased conception rates (Sasser et al., 1988). Therefore, the objective of this study was to determine the effects of BCS at calving and postpartum protein supplementation on estrous behavior and follicle size.

Materials and Methods

Spring calving, multiparous Angus x Hereford cows (n=45) were fed to calve with a body condition score (BCS; 1=emaciated and 9=obese) of thin (<5) or moderate (³5). Cows grazed native tallgrass prairie at the Range Cow Research Center near Stillwater. At parturition cows were blocked by body condition score and calving date (March 22 ± 3.2 d) and randomly assigned to receive either low (1.2 kg/d) or high (2.5 kg/d) amounts of a 42% CP supplement. At feeding, calves were separated from cows, and cows were fed supplement in individual stalls. Cows were fed supplement for 49.2 ± 2.3 d. All cows grazed the same native grass pasture after calving with native grass hay free choice. Cow

and calf weights were determined monthly from calving to weaning.

Estrous behavior was monitored continuously with a radiotelemetry system [1], commencing at 20 d postpartum. Onset of estrus was defined as the first of two mounts within 4 h. The end of estrus was defined as the last mount that had a mount 2 h prior and no mounts in the following 12 h.

Blood samples were collected from each cow three times weekly, commencing 20 d postpartum. Blood plasma obtained and concentrations of progesterone were quantified by radioimmunoassay. Duration of luteal activity (LA) before and after estrus was characterized as short (plasma progesterone ³ .5 ng/mL for < 5 consecutive samples; < 10 d) or normal (plasma progesterone ³ .5 ng/mL for ³ 5 consecutive samples; ³ 10 d).

Size of the dominant follicle was determined by transrectal ultrasonography at 4 to 14 h after the onset of the first postpartum estrus. A blood sample was collected at this time, and plasma concentrations of estradiol were quantified by radioimmunoassay.

Least squares analyses of variance for a randomized complete block design were used to determine the effects of BCS at calving, postpartum protein supplementation, and the interaction on estrous behavior and size of the dominant follicle. Cow age and calving date were included as covariates where appropriate. Means were compared with Fishers-LSD when there was a significant interaction.

Results and Discussion

Increasing supplemental CP after calving decreases weight and BCS loss of grazing beef cows (Lusby and Wettemann, 1988). Body condition score of thin cows was less at calving (P<.01) than moderate cows (4.3 ± .1 vs 5.0 ± .1). Cows on high and low nutrition had similar BCS after treatment (4.5 ± .1). Total weight gain during treatment tended (P<.13) to be greater for cows on high vs low nutrition (25 ± 3 vs 17 ± 3 kg).

Interval to first postpartum estrus was shorter for cows with good BCS at calving compared with thin cows for both high and low protein nutrition (Table 1). Cows in good body condition initiate ovarian activity earlier than thin cows (Vizcarra et al., 1998). Duration of the first postpartum estrus was not influenced by BCS at calving or postpartum supplementation (Table 1). We previously observed no difference in duration of estrus of first calf heifers that were fed moderate or high energy diets after calving (Ciccioli and Wettemann, 2000). Average duration of estrus for cows in this experiment was 5.9 ± 1.9 h. This is less than our previous findings for mature, cyclic, nonsuckled beef cows monitored with the HeatWatch^{Ò} system (White et al., 1999). However, in the current experiment, cows were nursing calves. In addition, they were not cycling prior to the observed estrus. Results with these postpartum suckled cows are similar to reports for beef heifers monitored with the HeatWatch^{Ò} system (Stevenson et al., 1996). We previously observed that first calf heifers fed high energy diets after calving had increased mounting behavior (Ciccioli and Wettemann, 2000). In the current experiment, number of mounts at the first postpartum estrus was not influenced by BCS at calving or postpartum supplementation (Table 1).

Prior to the first estrus, 65% of cows had short LA for <10 d. Normal LA (³10 d) occurred in 27% of cows before the first estrus, and LA was not detected in 8% of cows prior to the first estrus. We previously reported that 72% of mature beef cows had a short (<5 d) increase in progesterone prior to the first normal LA (Looper et al., 1997). Eighty-seven percent of first calf heifers had short LA prior to the first estrus after calving (Ciccioli and

Wettemann, 2000). In this experiment, all but one cow had normal LA after estrus.

Cows with moderate BCS at calving had a larger (P<.01) dominant follicle compared with cows in thin BCS (Table 1). The size of the dominant follicle tended to be greater (P<.07) for cows receiving more supplemental protein compared with cows that received less protein. First calf heifers fed a high energy diet had larger follicles at estrus compared with heifers fed a moderate energy diet (Ciccioli and Wettemann, 2000). Feeding increased amounts of supplemental protein to cows consuming native forage increases organic matter intake (McCollum and Horn, 1991), which increases energy intake. In this experiment, cows fed more supplemental protein may have had increased intake of metabolizable energy. Increased energy intake increases IGF-I (Granger et al., 1989), which enhances follicular development (Spicer and Echternkamp, 1995). Although follicle size was altered by BCS and protein nutrition, plasma concentrations of estradiol were not affected (Table 1).

Cows in thin condition, or consuming diets deficient in CP have decreased reproductive performance (Selk et al., 1988). Body condition at calving and postpartum protein supplementation did not alter the duration of estrus, but may influence mounting behavior during estrus. Thin BCS at calving and low protein supplementation decreased the size of the dominant follicle at the first estrus after calving. Both nutrition and BCS at calving may alter follicular development at the first estrus as well as the duration of the interval from calving to the first ovulation.

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Acknowledgements

The authors thank Mark Anderson, Randy Jones, and Joe Steele for assistance with animal management and data collection, and LaRuth Mackey for laboratory assistance.

Table 1. Effects of body condition at calving and postpartum protein supplementation on estrous behavior.

Nutrition[1]	Low			High		
BCS[2]	Thin	Moderate		Thin	Moderate	SEM
Duration of estrus, h	5.0	6.8		6.6	5.1	1.9
Mounts, no.	6.7	15.8		11.4	10.8	3.6
Follicle size, mm [a,b]	13.2	14.2		13.6	16.3	.6
Estradiol, pg/mL	2.72	2.92		2.68	2.18	.67
Postpartum interval, d[a]	95.7	63.7		89.9	62.7	9.4

[1]Low=1.2 kg/d and high=2.5 kg/d of a 42% CP supplement.

[2]Thin (BCS<5), Moderate (BCS³5).

[a]Significant effect of BCS (P<.05).

[b]Significant effect of nutrition (P<.07).

[1] HeatWatch®, DDx Inc., Denver, CO

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