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Influence of Post-AI Nutrition on Blood Urea Nitrogen, Progesterone, and Pregnancy

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Influence of post-AI nutrition on blood urea nitrogen, progesterone, and pregnancy[1]

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Summary

Research has shown that changes in nutrition can have an effect on reproductive performance. Our objective was to determine the effect of post-AI nutrition on BCS, blood urea nitrogen (BUN), progesterone, and pregnancy rates. Forage-developed Angus-cross bred heifers (n = 336) were synchronized with the Select Synch+ Controlled Internal Drug Releasing device (CIDR) protocol (d -7 100 μg GnRH and CIDR; d 0 25 mg PG and removal of CIDR). Estrus was detected for 72 h and heifers bred by AI 12 h after being detected in estrus; heifers not in detected in estrus were bred by AI and given an injection of GnRH at 72 h. Each breeding period was equally divided into three treatments: 1) heifers returned to feedlot (LOT), 2) heifers were moved to pasture (PASTURE), or 3) heifers were moved to pasture and supplemented with 5 lb/hd/d of dried distillers grains plus solubles (SUPP). Blood samples were collected on d -7, 0, 2, 14 and 42 (pregnancy determination; d 0 = AI). Body condition scores were determined on d -7 and 42. All heifers were in similar BCS (5.4 ± 0.05) on d -7, but on d 42 SUPP (5.9 ± 0.04) were in better condition than LOT (5.8 ± 0.04) which were in better condition than PASTURE (5.4 ± 0.04). All treatments had similar BUN concentrations on d -7 (129 ± 1), but on d 2, 14, and 42 SUPP had greater BUN concentrations compared to both LOT and PASTURE. There was no difference in BUN concentrations between pregnant and open heifers. Progesterone concentrations were similar among all heifers on d 0 and 2. On d 14, SUPP had greater progesterone concentrations compared to LOT, and on d 14 and 42 PASTURE had greater progesterone concentrations compared to LOT. Progesterone was similar for open and pregnant heifers on d 0 and 2, but greater in pregnant heifers on d 14 and 42. There was no difference among treatments in pregnancy rates (57, 56, and 59% for SUPP, LOT, and PASTURE; analyzed by chi-square). In summary, supplementing forage-developed heifers after insemination increased BCS and BUN concentrations but had no effect on pregnancy rates.

Introduction

Embryonic development is a complex process involving genome activation, compaction, blastocyst formation, elongation, maternal recognition of pregnancy, and attachment. A disruption in any of the preceding processes may result in embryonic mortality. Data on the incidence of embryonic mortality in cattle is limited, but the majority of embryonic loss in cattle is reported to occur before day 42 of pregnancy (Ayalon, 1978; Maurer and Chenault, 1983; Peters, 1996). Nutrition can influence embryonic survival through many mechanisms, but the most likely possibilities include direct or indirect regulation of the uterine environment. Nutritionally mediated changes to the uterine environment can occur by changing components of uterine secretions or by influencing the circulating concentrations of progesterone that regulate uterine environment (Foxcroft, 1997). Nutrition can directly influence the uterine environment through protein intake. Heifers fed 85% of their energy and protein maintenance requirements had reduced numbers of cleaved ova on day 3 and morula on day 8 compared to heifers fed 100% maintenance (Hill et al., 1970) indicating decreased embryonic growth. Heifers fed excess protein (25% excess of UIP or DIP) had altered the pH of the uterus on day 7 (Elrod et al., 1993). Cool season grasses grazed throughout the upper Midwest can vary greatly in crude protein throughout the summer months, and the majority of this variability occurs in degradable intake protein (Patterson, 2000).

[1] This project was funded by the South Dakota Corn Utilization Council.
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Therefore, the objective of this experiment was to determine if supplementing energy and protein post-AI influences BCS, blood urea nitrogen (BUN), progesterone, and pregnancy rates.

Materials and Methods

Experimental Design

This experiment was conducted on 336 foraged-developed heifers at one location. Over the previous winter, heifers were developed on range and supplemented as conditions required. Seven days prior to the start of the breeding season all heifers were brought into a feedlot and synchronized with the Select Synch + Controlled Internal Drug Releasing device (CIDR) protocol (d -7 100 μg GnRH and CIDR; d 0 25 mg PG and removal of CIDR). Estrus was detected for 72 h and heifers bred 12 h by AI after detection in estrus; heifers not detected in estrus were bred by AI and given an injection of GnRH at 72 h. Estrus was detected by visual observation with the aid of EstroTech (Rockway Inc., WI) patches. Approximately 12 h following the initiation of standing estrus animals were AIed by a single technician to a single sire.

Following insemination, heifers were immediately placed in one of three treatment groups (Figure 1): 1) heifers were returned to the feedlot (LOT), 2) heifers were moved to pasture (PASTURE), or 3) heifers were moved to pasture and supplemented with 5 lb/hd/d of dried distillers grains plus solubles (DDGS; SUPP). Heifers remained in treatment groups for 42 days until pregnancy was determined by transrectal ultrasonography. Bulls were placed with heifers 11 days following the final AI for a 28-d breeding season. Pregnancy rates were determined by transrectal ultrasonography on day 42 and 60 days following bull removal.

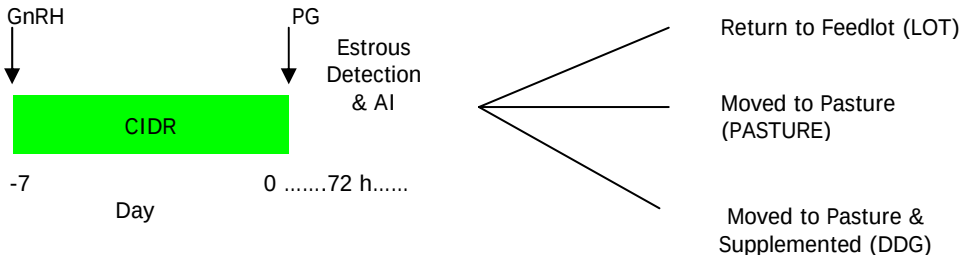

Figure 1. Animals were randomly allotted to one of three post-AI dietary treatments following synchronization with the Select-Synch plus CIDR protocol and detection in standing estrus.

Blood Collection and Radioimmunoassays

Blood samples were collected by venipucture into 10 mL vacutainer tubes (Fisher Scientific, Pittsburgh, PA) on day -7, 0, 2, 14 and 42. Blood was allowed to clot for 1 h at room temperature, stored at 4°C for 24 hours, and centrifuged at 1200xg for 30 minutes to harvest serum. Serum was stored at –20°C until assayed for progesterone and blood urea nitrogen (BUN). Intra- and interassay coefficients of variation for progesterone assays were 9.6% and 4.7% respectively, and assay sensitivity was 0.4 ng/mL of serum. Intra- and interassay coefficients of variation for BUN assays were 5.0% and 2.5% respectively, and assay sensitivity was 5 mg/dL of serum.

Statistical Analysis

Differences between treatments in BUN and circulating concentrations of progesterone were determined by analysis of repeated measures. Differences in BCS and pregnancy rates were determined by chi-square analysis.

Results and Discussion

At the initiation of the trial all heifers were in similar BCS ($P = 0.78$; 5.4 ± 0.05), and all treatments had similar BUN concentrations ($P > 0.14$; 12.9 ± 1 mg/dL). Following the treatment period (day 42 after AI)

SUPP heifers (5.9 ± 0.04) were in better BCS ($P < 0.01$) than LOT (5.8 ± 0.04) which were in better BCS ($P < 0.01$) than PASTURE (5.4 ± 0.04; Table 1). On day 2, 14 and 42 after AI supplemented heifers had greater ($P < 0.01$) BUN concentrations compared to both LOT and PASTURE heifers (Figure 2). However, there were no differences in BUN concentrations between pregnant and open heifers ($P = 0.37$; Figure 3). The increased protein being supplemented with the DDGS likely caused the increase in BUN. However, the increase in BUN was not to the level that has been reported to change uterine environment and decrease pregnancy rates (Elrod and Butler, 1993).

Table 1. Influence of treatment on body condition score

	Feedlot	Pasture	Pasture & Supplement
Day -7	5.4 ± 0.05	5.4 ± 0.05	5.4 ± 0.05
Day 42	5.8 ± 0.04[a]	5.4 ± 0.04[b]	5.9 ± 0.04[c]

Columns with different superscripts are different ([abc]$P < 0.01$). Data reported as mean ± SE

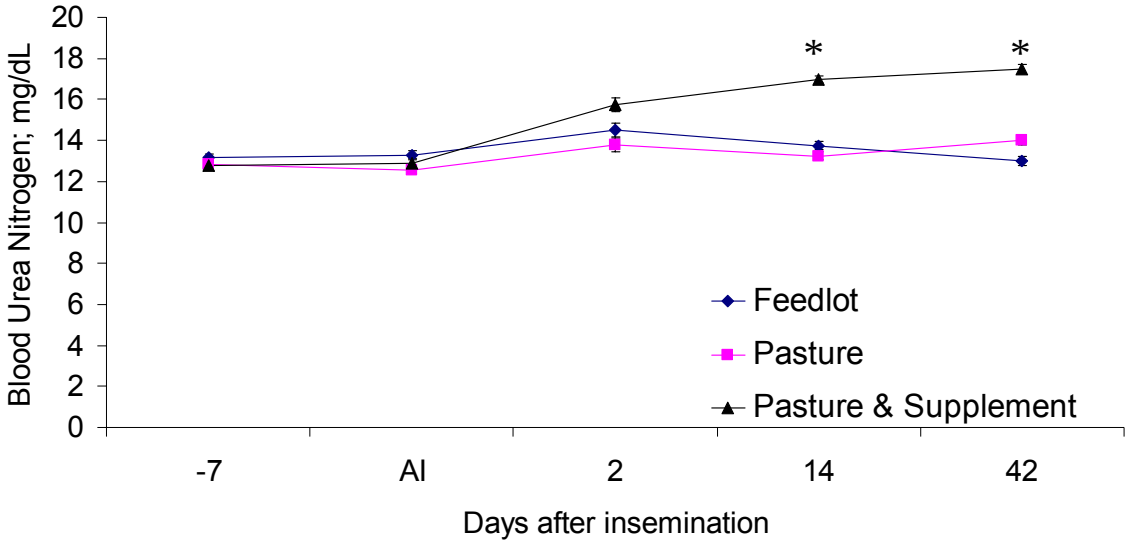

Figure 2. Influence of treatment on circulating concentrations of blood urea nitrogen. * indicates $P < 0.01$. Day -7 is day of CIDR insertion.

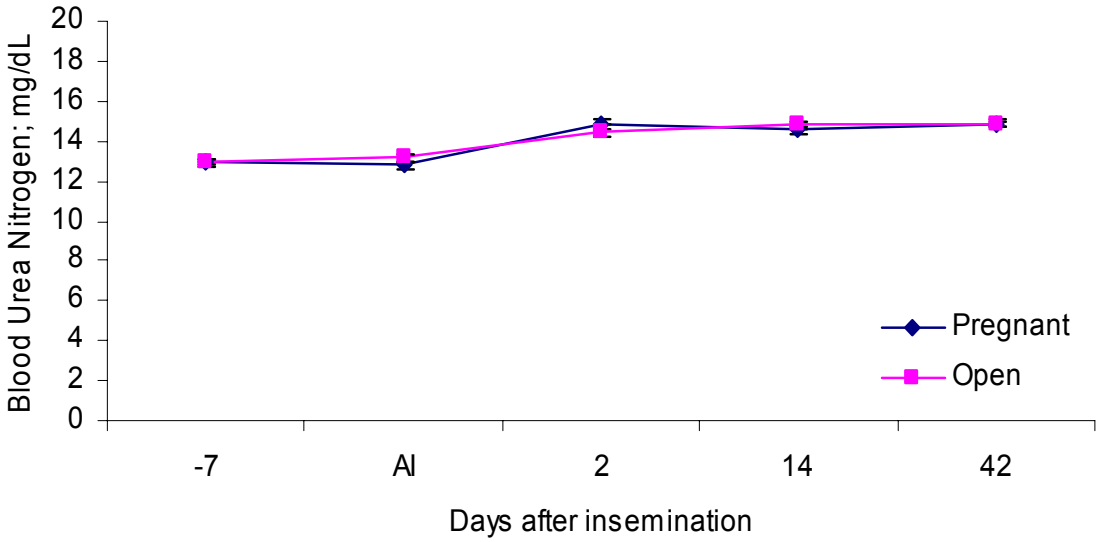

Figure 3. Influence of pregnancy on circulating concentrations of blood urea nitrogen. Day -7 is day of CIDR insertion.

Progesterone concentrations were similar among all heifers ($P \geq 0.05$) on d 0 (day of AI) and 2. However, the supplemented heifers had greater progesterone on d 14 ($P = 0.02$) compared to LOT, and on day 14 and 42 PASTURE had greater progesterone ($P < 0.02$) compared to LOT (Figure 4). Progesterone was similar ($P > 0.16$) for open and pregnant heifers on d 0 and 2, but greater ($P < 0.04$) in pregnant heifers on d 14 and 42 (Figure 5) as expected. There were no differences among treatments in pregnancy rates (Table 2). This confirms that the increased BUN from supplementing extra protein was not to the level to effect pregnancy rates.

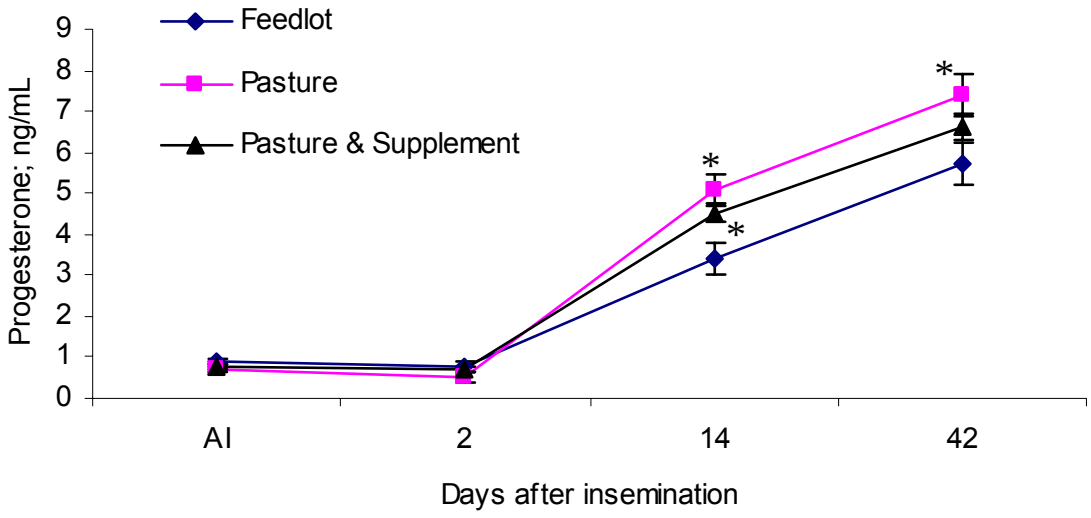

Figure 4. Influence of treatment on circulating concentrations of progesterone. * indicates $P < 0.01$. Day -7 is day of CIDR insertion.

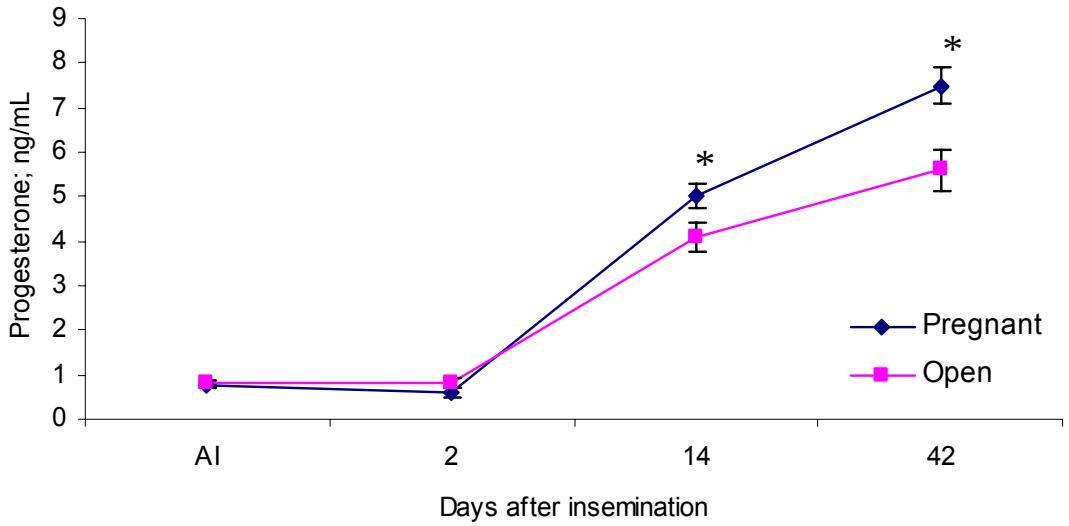

Figure 5. Influence of pregnancy on circulating concentrations of progesterone. * indicates $P < 0.01$. Day -7 is day of CIDR insertion.

Table 2. Influence of treatment on pregnancy rates

	Feedlot	Pasture	Pasture & Supplement
Day 42	56%	59%	57%
Final	86%	89%	88%

Bulls introduced 11 days after AI for a 28 day period.

In conclusion, heifers that were developed on pasture throughout the winter prior to breeding had increased BCS and increased BUN when supplemented after AI, but supplementation had no benefit on pregnancy rates. Results may differ if heifers had been developed in a feedlot from weaning to breeding.

Acknowledgements

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