Reproductive Performance, Blood Urea Nitrogen, and Blood Glucose Concentration in Beef Heifers Grazing Annual Ryegrass in the Spring and Supplemented at Different Intervals Prior to Timed AI

D.L. Kreider1, K.P. Coffey2, J.D. Caldwell3, W.A. Whitworth4, T.G. Montgomery5, R. Rorie6, R.W. McNew7, W. Coblentz8, and R.K. Ogden9

Story in Brief

In successive years, 76 Gelbvieh x Angus heifers [n = 36 (year 1) and n = 40 (year 2)] at 12 to 14 months of age were stratified by weight and randomly allocated to one of three treatments to determine the impact of rumen degradable carbohydrates at different intervals prior to breeding on conception rate (CR) to timed artificial insemination (TAI), overall pregnancy rate (PR), serum urea nitrogen (SUN), and serum glucose (GLU). Heifers grazed bermudagrass pastures interseeded with annual ryegrass pastures during March, April, and May. Two replicates were provided no supplement (C); 3 replicates each were provided 3 lb/hd of supplement (32.5% ground corn, 32.5% cracked corn, 30% wheat middlings, and 5% liquid molasses), beginning either 60 (60S) or 30 (30S) d prior to TAI. Supplement for 60S was discontinued at the time 30S was initiated. Heifers were weighed unshrunk at the initiation of the study and at 28-d intervals. Serum was collected at 1230 h and 1530 h on d 7 after the start of supplementation and 1 d prior to TAI. Conception rate to TAI did not differ between treatments (P = 0.31; 42, 62, and 48% for C, 30S, and 60S, respectively). Overall PR was 92, 86, and 78% for C, 30S, and 60S, respectively, and did not differ among treatments (P = 0.42). Mean SUN was not altered by treatment (P = 0.95), or time of day (P = 0.68), but was affected by month (P < 0.001). Mean SUN was 24.1 ± 2.5, 15.5 ± 2.4, and 10.5 ± 2.4 mg/dl for March, April, and May respectively. Serum GLU differed among months, averaging 90.8 ± 3.8, 90.5 ± 3.2 and 101.6 ± 3.3 mg/dl for March, April, and May, respectively. Supplementation and supplement timing in this study did not affect CR to TAI or overall PR.

Introduction

Arkansas producers frequently take advantage of the ability of cattle to obtain a high percentage of their protein and energy needs from both grazed and harvested forages. Studies of forages in Arkansas by Davis et al. (1999) indicated that 59% of harvested forage samples tested contained adequate protein for a lactating beef cow, while only 29% contained adequate TDN. This suggests that the majority of Arkansas hay would have a high ratio of protein relative to the energy based on animal requirements. Furthermore, in Arkansas and the southeastern United States, beef cows and heifers frequently graze high-quality cool-season forages and small grains that have very high protein content, particularly relative to available energy in the rumen; thereby, creating a situation in which rumen ammonia concentration and thus serum ammonia and serum urea nitrogen concentration may become elevated. Previous work has shown that the ratio of protein to fermentable carbohydrates in forages consumed by ruminants has important effects on blood and milk urea nitrogen. Low concentrations of readily fermentable carbohydrates contribute to the release of ammonia in the rumen and increased serum urea nitrogen. Forage from well-managed cool-season pastures often contains more than 25% CP and 20% rumen degradable protein. Numerous studies have shown that high concentrations of serum urea nitrogen may affect reproductive function and cause decreased pregnancy rates (Chapa et al., 2001). Therefore, our objective was to determine the effects of energy provided by supplementation of heifers grazing high protein cool-season forages prior to breeding on serum urea nitrogen concentration and reproductive performance. This paper summarizes the first- and second-year data for this ongoing study.

Experimental Procedures

This study was conducted at the University of Arkansas Division of Agriculture Southeast Research and Extension Center at Monticello.

Animals. In successive years, 76 Gelbvieh x Angus heifers [n = 36 (year 1) and n = 40 (year 2)] at 12 to 14 months of age were stratified by weight (686 ± 12 lb initial BW); randomly allocated to one of 3 treatment groups; and then randomly assigned to one of 8 replicate pastures. Pastures consisted of bermudagrass (Cynodon dactylon) interseeded with annual ryegrass (Lolium multiformum). Grazing began when adequate forage (1,700 to 2,000 lb/acre) was available. Available forage was measured on or immediately following each weigh day. Forage samples were clipped from each pasture and composited into one large (400 g DM) sample for analysis of rumen degradable nitrogen in situ.

Treatments. In each year, 2 replicates comprised a control treatment (C) and were provided no supplemental feed during the entire grazing period (C), 3 replicates were provided 3.0 lb/hd of a corn-based supplement feed (32.5% ground corn, 32.5% cracked corn, 30% wheat middlings, and 5% liquid molasses) for 30 d starting 60 days prior to timed artificial insemination (60S); and 3 replicates were provided 3.0 lb/hd/d of the identical corn-based supplement for 30 d starting at 30 d prior to timed insemination (30S). Supplement for the 60S treatment was discontinued at the time 30S supplementation was initiated. Supplement was fed 7 d per week each morning at approximately 1000 h daily to avoid disruption of the morning grazing period.

Weighing and Sampling Procedures. Heifers were weighed unshrunk at the initiation of the study and at approximately 28-d

---

1 Department of Animal Science, Fayetteville
2 Southeast Research and Extension Center, Monticello
3 Department of Agricultural Statistics, Fayetteville
4 USDA/ARS, Marshfield, Wis.
intervals thereafter. Blood samples for serum urea nitrogen (SUN) and glucose (GLU) determination were obtained from all animals in all treatment groups via venipuncture at 1230 h and 1530 h 7 d following the start of each supplement feeding period and on 1 d prior to timed insemination (TAI). Heifers were returned to their respective pasture following each blood sample collection.

**Blood Assays.** Serum urea nitrogen and serum glucose were determined on a Ciba-Corning 550 Express clinical analyzer (Global Medical Instrumentation, Minn.).

**Breeding.** A 6-day CIDR protocol followed by TAI similar to that described by Martinez et al. (2000) was utilized. The CIDRs (Eazibreed, Pfizer, New York, N.Y.) were inserted and GnRH (gonadotrophin releasing hormone; 100 ug/hd, IM.; Cystorelin; Merial; Duluth, Ga.) were given to all heifers. Six d later, CIDRs were removed and prostaglandin shots (25 mg/hd IM; Lutalyse, Pfizer, New York, N.Y.) were given. On the day before TAI, heifers were bled at 1230 h and 1530 h. The regularly scheduled supplement was given to the 30S group following the first bleeding. A second GnRH injection (100 ug/hd) was given at approximately 48 h after the prostaglandin injection and all heifers were bred by TAI 16 to 18 h later. The TAI protocol is depicted in Fig. 1. At 10 d after TIA, heifers were transported to the Livestock and Forestry Branch Experiment Station at Batesville, and were exposed to a bull of proven fertility for an additional 50 d. Conception rate to TAI was determined by ultrasound at approximately 30 d post TAI, and overall pregnancy rate was determined by rectal palpation at approximately 45 d after bull removal.

**Statistical analysis.** The MIXED procedure of SAS (SAS Institute Inc., Cary, N.C.) was used to evaluate all continuous response variables. Year was included as a random effect. Data for repeated blood samplings were analyzed as repeated measurements. Differences in conception rate to TAI and overall pregnancy rates were tested by Chi Square test.

### Results and Discussion

The average weight of heifers at the start of the study was 686 ± 12 lb. Total gain during the treatment period averaged 104 ± 4 lb and did not differ among treatments (P > 0.65). Average forage availability is depicted in Fig. 2. Available forage reached a maximum in April, and then declined in May. Available forage was higher in April than in March (P < 0.0001) or May (P < 0.0001). Further, forage availability was higher in May, than in March (P < 0.04).

Serum urea nitrogen by treatment and month is shown in Fig. 3. Average SUN was above 20 mg/dl in all treatment groups in March but declined to lower concentrations in April and May. Previously, SUN concentrations above 20 mg/dl at the time of breeding have been shown to cause a reduction in pregnancy rates in dairy cattle. Serum urea nitrogen was not affected by treatment (P = 0.95) or by time of day of sample collection (P = 0.68), but was different for all sampling dates (P < 0.0001).

Serum glucose concentration by treatment and by month of sampling is shown in Fig. 4. The GLU concentration did not differ among treatments (P = 0.85) but was different among sampling dates (P < 0.0001). Concentration of GLU did not differ between the March and April sampling dates (P = 0.92) but the GLU concentration was greater in May than in either March or April (P < 0.0001).

Conception rates (CR) to TAI and overall pregnancy rates (PR) are depicted in Fig. 5. First-service CR to TAI were 42, 62, and 48% for C, 30S, and 60S treatments, respectively, but were not different (P = 0.31). Overall PR (TAI and natural service combined) were 92, 86, and 78% for C, 30S and 60S, respectively, but were not different among treatments (P = 0.42).

In summary, SUN concentrations were elevated above the concentrations that are reported to cause reduced reproductive performance for the month of March, but had declined well below those concentrations at the actual time of breeding in May. The supplementation and the timing of supplementation used in this study did not significantly alter pregnancy rate to TAI or overall CR during the first two years of this study.

### Implications

The elevated serum urea nitrogen concentrations in all heifer groups grazing ryegrass in March were greater than concentrations that have been shown to cause a decrease in pregnancy rates in other studies. However, the elevated concentrations had declined at the time of breeding, and pregnancy rates in this study were not affected by the supplementation used in this study. The elevated urea nitrogen observed during the early portion of the grazing period in this study might be of concern to producers if breeding occurred during the time when elevated urea concentrations existed.

### Literature Cited

Timed AI Protocol

![Diagram of the protocol used for timed artificial insemination.](image)

Fig. 1. Diagram of the protocol used for timed artificial insemination.

![Available forage for March, April, and May (average of yr 1 and yr 2).](image)

Fig. 2. Available forage for March, April, and May (average of yr 1 and yr 2).

![Serum Urea Nitrogen (SUN) concentrations heifers in March, April, and May (average of year 1 and year 2) for C (no supplement), 30S (30 d supplement starting 30 d prior to TAI), and 60S (30 d of supplement starting at 60 d prior to timed AI).](image)

Fig. 3. Serum Urea Nitrogen (SUN) concentrations heifers in March, April, and May (average of year 1 and year 2) for C (no supplement), 30S (30 d supplement starting 30 d prior to TAI), and 60S (30 d of supplement starting at 60 d prior to timed AI).
Fig. 4. Serum Glucose (GLU) concentration of heifers in March, April, and May (average of yr 1 and yr 2) for C (no supplement), 30S (30 d supplement starting 30 d prior to TAI), and 60S (30 d of supplement starting at 60 d prior to AI).

Fig. 5. Two-year summary of pregnancy rate to timed AI (TAI) and overall pregnancy rate for C (no supplement), 30S (30 d supplement starting 30 d prior to TAI), and 60S (30 d of supplement starting at 60 d prior to TAI).