Use of bull exposure in a Gonadotropin-releasing hormone-based estrous synchronization protocol that included fixed-time artificial insemination in first-calf suckled beef cows

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Abstract

The objective was to evaluate whether exposing primiparous suckled beef cows to the biostimulatory effect of bulls alters breeding performance associated with an estrous synchronization (ES) protocol that included GnRH, $PGF_{2\alpha}$ (PG), and fixed-time AI. This is a composite analysis of 3 experiments that evaluated: 1) effects of bull exposure at different d after calving (Yr 1); 2) biostimulatory effects of bull excretory products (Yr 2); and, 3) biostimulatory effects of familiar and unfamiliar bulls (Yr 3) on resumption of cycling activity. In all studies cows were exposed (BE; n = 84) or not exposed (NE; n = 70) to bulls or excretory products of bulls for at least 55 d before the start of the ES protocol. Average calving date did not differ among yr and was 52 ± 5 d (± SE). Start of the ES protocol was the same date each yr. Year did not affect the proportions of BE and NE cows that were cycling at the start of the ES protocol. However, a greater ($P < 0.01$) proportion of BE than NE cows were cycling at this time. Each cow was given GnRH, followed by PG 7 d later. Cows were observed for estrus twice daily (am:pm) after PG. Cows that showed estrus before 54, 60, and 64 h after PG were inseminated by AI 12 h later in each yr, respectively. Cows that failed to show estrus were given GnRH and TAI at 62, 72, and 72 h after PG in each yr, respectively. Pregnancy rates (PR) were determined ultrasonically 35 d after TAI. Proportions of BE and NE cows that showed estrus after PG and before TAI did not differ. Artificial insemination PR did not differ between BE and NE cows; however, TAI PR tended to be greater ($P = 0.07$) for BE cows than for NE cows. We conclude that TAI but not overall AI pregnancy rates in an ES protocol that includes GnRH, PGF2a, and TAI may be improved by the biostimulatory effect of bulls.

Introduction

Extended postpartum anestrus is the major cause of primiparous suckled cows failing to rebreed or breeding late in their next breeding season (Short et al., 1994). This problem can create a challenge to successfully synchronizing estrus or ovulation and artificial insemination (AI) in primiparous suckled beef cows. The presence of bulls accelerates resumption of postpartum ovarian activity in primiparous suckled beef cows (Custer et al.. 1990; Fernandez et al., 1993). Using estrous synchronization (ES) protocols that incorporate AI allows for a majority of cows to be inseminated artificially in a very short period of time. Jordan et al. (2002) indicated that gonadotropin releasing hormone (GnRH)-based ES protocols are more successful if postpartum cows have resumed cycling activity. Thus, the biostimulatory effect of bulls may be used as a management strategy to improve the breeding performance of primiparous cows using this type of ES protocol.

The objective of this study was to evaluate whether exposing primiparous suckled beef cows to the biostimulatory effect of bulls alters breeding performance associated with an estrous synchronization (ES) protocol that included GnRH, PGF2a (PG), and fixed-time AI. The hypotheses tested were that: 1) proportions of cows that exhibit estrus after PG; and 2) AI pregnancy rates do not differ between primiparous cows exposed or not exposed to the biostimulatory effect of bulls before the breeding season.

Materials and Methods

Animals, Years, and Treatments

One-hundred sixty-one, spring-calving, 2-yr-old Angus X Hereford crossbred, primiparous beef cows were used in this longitudinal study conducted over a 3-yr-period at the Montana State University Livestock Teaching and Research Center, Bozeman, Montana. Animal care, handling, and protocols were approved by the Montana State University Institutional Animal Care and Use Committee. In each experiment (Year), cows were stratified by calving date, calf birth weight, sex of calf, and body condition score before they were assigned to treatments. Average calving date among years was 52 ± 5 d (± SE). For the purposes of this study, cows that were exposed to the physical presence of bulls or exposed to excretory products of bulls are designated “BE” treatment; whereas, cows not exposed to bulls or excretory products of bulls are designated “NE” treatments.

Year 1. Fifty-six cows were assigned randomly to one of six treatments in a completely randomized design using a 2 x 3 factorial arrangement. Factors were exposure type (BE or NE) and day exposed postpartum (15, 35, or 55). Day 15, 35, or 55 after calving represented d 0 for each treatment, respectively. Four 2-yr-old, epididymectomized Angus bulls were used in this experiment. Bull to cow ratio for each was approximately 1:9. Cows were in their respective treatments for 62 ± 2 d at the start of the estrous synchronization (ES) protocol.

Year 2. Sixty-one cows were assigned randomly to one of four treatments: exposed continuously to presence of a bull (BE) or excretory products of bulls (BE), and not exposed to a bull (NE) or exposed to excretory products of cows (NE) beginning on d 35 ± 2 d after calving. Five, 3-yr-old, epididymectomized Angus bulls were used in this experiment. Bull to cow ratio for each was approximately 1:15. Cows exposed to excretory products of bulls or cows were placed into an enclosure that was approximately one-third (~245 sq. m) of the area of the pen and was used to alternately house bulls and cows. Bulls (n = 4) were place into this enclosure at approximately 0800 h and removed at 1830. Cows were then moved into the enclosure overnight between 1830 and 0800 h. Cows had been in their respective treatments for 63 ± 2 d at the start of the estrous synchronization (ES) protocol.

Year 3. Fifty cows were assigned randomly to one of two treatments; exposure to bulls (BEF) or exposure to mature OVX cows (NEF) from 5 to 35 d after calving. On d 30, 12 BEF cows were assigned randomly to be exposed to a different bull (BEU); likewise, 12 NEF cows were assigned to be exposed to unfamiliar OVX cows (NEU). The cow to bull and cow to OVX cow ratio was approximately 1:12, respectively, during the first 35 d after calving, and then 1:6, respectively, for the remainder of the experiment. Cows in the BEF and BEU treatments are designated BE cows, while cows in the CEF and CEU treatments are designated NE cows for this evaluation. Cows were in their treatments for either 95 d (BEF and NEF) or 60 d (BEU and CEU) before the start of the ES protocol

Lots Used for Exposure Type

Year 1, 2, and 3. Two lots were used in each experiment, designated north and south by their geographic location. Each lot contained four 41 m x 18 m (L x W) pens that were identical in east-west configuration, bunk space, aspect, slope, and connection to open-shed shelters. Lots were approximately 0.35 km apart. Animals housed in one lot were not able to see or smell animals housed in the other lot; however, there was a possibility that sounds made by animals in one area could be heard by animals in the other area. Pens within each lot were isolated from each other by draping and securing tarpaulins over the 3 m fences that separated pens. Cows exposed to bulls had had no contact with bulls throughout pregnancy and after calving until they were placed into pens with bulls (Years 1, 2, and 3) or excretory products of bulls (Year 2). Cows not exposed to bulls had no contact with bulls throughout pregnancy and the experiments.

Nutrition

Year 1, 2, and 3. Cows and calves had free access to good quality mixed-grass alfalfa hay and any pasture grasses that were available before they were moved into their respective pens. Once cows were moved into pens they were given free access to the same hay (chopped), 0.25 kg cracked barley per animal daily, water, and a mineralized-salt supplement until the end of the experiment in each year. The TDN of these diets exceeded the NRC requirement for lactating beef cows with a mature weight of 545 kg by approximately 18% (NRC, 1996). Bulls were fed the same diet as cows within each year.

Estrous Synchronization and AI

Year 1, 2, and 3. On May 18th of each year, each cow was injected i.m. with GnRH (100 μg/hd) on d –7, followed by an i.m. injection of $PGF_{2\alpha}$ (25mg/hd; d 0) 7 d later. Cows were then observed for estrus twice daily (0700 and 1900 h) until fixed time AI (TAI). Cows that exhibited estrus before 54 (Year 1), 60 (Year 2), and 64 (Year 3) h after $PGF_{2\alpha}$ were inseminated artificially 12 h later by one of two experienced AI technicians; each assigned randomly to breed a cow. Within each year, cows were inseminated with frozen semen from a single sire of proven fertility. Cows that failed to show estrus were given a second injection of GnRH (100 μg/hd) and TAI at 62, 72, and 72 h after $PGF_{2\alpha}$ for Years 1, 2, and 3, respectively. In Year 1, bulls were removed from cows at TAI; in Year 2, cows remained in their treatments for 5 d after TAI; and in Year 3, cows remained in their treatments for 7 d after TAI. Pregnancy rates were determined by transrectally ultrasonography 35 d after TAI.

Statistical Analyses

Calving date, calf BW, calf sex ratio, cow BW and BCS, and change in cow BW and BCS over the experimental period were analyzed by separate by analyses of variance for a completely random design using PROC GLM of SAS (SAS Inst. Inc., Cary, NC). The model included treatment (BE and NE), Year, and their interaction. Means were evaluated with the PDIFF option of SAS (SAS Inst. Inc., Cary, NC).

Proportions of cows among treatments that exhibited resumption of ovarian cycling activity at the start of the ES protocol, estrous response after $PGF_{2\alpha}$, pregnancy rates for AI at 12 h after estrus and TAI, and overall AI pregnancy rates among years were analyzed separately with the CATMOD PROC of SAS. The model for each analysis included year, treatment, and the year by treatment interaction. If a factor was not statistically important ($P > 0.10$) then data for the variables were pooled and re-analyzed. Data for cows that showed estrus before injection of $PGF_{2\alpha}$ were excluded from the analyses.

Results

Calving date, calf BW, calf sex ratio, cow BW and BCS, and change in cow BW and BCS did not differ among treatments or years. Two, 1, and 3 cows (5 of 161; 3.1%) exhibited estrus before injection of $PGF_{2\alpha}$.

There was no interaction between treatment (BE and NE) and Year (1, 2, and 3) for percentages of cows cycling at the start of the ES protocol, percentages of cows exhibiting estrus after $PGF_{2\alpha}$, pregnancy rates for AI at 12 h after estrus, TAI pregnancy rates, and overall AI pregnancy rates. Therefore, data these variables were pooled over Years and re-analyzed.

Table 1. Number of cows per treatment, percentages of cows cycling at the start of the modified Co-Synch protocol, percentages that showed estrus after $PGF_{2\alpha}$, and pregnancy rates for cows bred by AI 12 h after estrus, bred at fixed time AI (TAI), and overall AI for primiparous cows exposed to bulls or their excretory products (BE) or not exposed to bulls or their excretory products (NE)

	Treatment			
Variable	BE	NE	X^2	P value
n	84	70		
% cycling before the start of ES protocol	86.3^{b}	31.3^{c}	42.0	< 0.001
% showing estrus after $PGF_{2\alpha}$	50.0^{b}	50.0^{b}	0.00	= 0.96
AI pregnancy rate (%) [d]	72.6^{b}	62.9^{b}	2.70	= 0.11
Pregnancy rate for AI 12 h after estrus	84.6^{b}	81.8^{b}	0.07	= 0.80
Pregnancy rate for TAI	59.5^{b}	37.1^{c}	3.20	= 0.07

[a,b]Percentages within rows that lack a common superscript differ.

[b]Pregnancy rates determined ultrasonographically 35 d after TAI

A greater ($P < 0.001$) proportion of BE than NE cows were cycling at the start of the ES protocol. Proportions of BE and NE cows that showed estrus after $PGF_{2\alpha}$ and before TAI did not differ (Table 1). Artificial insemination pregnancy rates did not differ between BE and NE cows; however, TAI pregnancy rate tended to be greater ($P = 0.07$) for BE cows than for NE cows (Table 1).

Discussion

Berardinelli (1987) reported that 33% more primiparous cows exposed to bulls before the start of the breeding season were bred by artificial insemination (AI) during the first 21 d of a 55-d breeding season than cows not exposed to bulls. Subsequently, Fernandez et al. (1993) found that AI pregnancy rate, over a 21-d breeding season, for cows exposed to bulls before the breeding season was 40% greater than that for cows not exposed to bulls. Estrous synchronization was not incorporated into the breeding season of these two experiments. Subsequently, Jordan et al. (2002) suggested that gonadotropin releasing hormone (GnRH)-based ES protocols are more successful if postpartum cows have resumed cycling activity. We hypothesized that the biostimulatory effect of bulls would improve breeding performance of primiparous beef cows using an estrous synchronization (ES) protocol that included GnRH, $PGF_{2\alpha}$, and fixed-time AI.

This present study represents a compilation of breeding performance data collected over a 3-yr period from individual experiments that evaluated factors related to the biostimulatory effect of bulls. Cows in these experiments were exposed to the physical presence of bulls or the excretory products of bulls for longer than 60 d by the start of the ES protocol. The ES protocol began on the same calendar date for each year of these experiments, and the same ES protocol was employed in each experiment, except for minor differences in the timing of the second GnRH and TAI injection after $PGF_{2\alpha}$. The AI technicians used for these experiments were the same individuals for all 3 yr, and semen was from the same bull within years. Thus, it would be reasonable to evaluate the biostimulatory effect of bulls on breeding performance of the primiparous cows over these experiments. This idea is supported by the fact that there was interaction between treatment and year for any of the variables evaluated in this study.

We found that the percentage of cows that exhibited estrus after injection of $PGF_{2\alpha}$ did not differ between BE and NE cows, even though there were more BE cows cycling before the start of the ES protocol than NE cows. This indicated that the first injection of GnRH may have induced cycling activity in more anestrous NE cows than in anestrous BE cows. Furthermore, AI pregnancy rates for cows bred 12 h after estrus did not differ between BE and NE cows. This result indicates that the biostimulatory effect of bulls does not improve AI pregnancy rates of when cows are bred 12 h after a synchronized estrus.

Overall AI pregnancy rate was numerical greater for BE cows than for NE cows. This result appears to be consistent with those obtained by Anderson et al. (2002) and Berardinelli et al. (2004) in individual experiments with these cows. This advantage is reflected in the difference in TAI pregnancy rates between BE and NE cows. Exposing cows to bulls before the start of and during the ES protocol appeared to increase TAI pregnancy relative to cows not exposed to bulls. Again, this is similar to the result reported by Anderson et al. (2002) and indicates that exposure to bulls may affect TAI pregnancy rates.

In conclusion, results of the analyses of this 3-yr longitudinal study indicated that timed AI pregnancy rates, but not overall AI pregnancy rates, may be improved by exposing primiparous beef to bulls before and during an estrous synchronization protocol that included GnRH, $PGF_{2\alpha}$, and fixed time AI.

Acknowledgments

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