Exposure of Prepubertal Beef Bulls to Cycling Females Affects Neither Age at Puberty Nor Ability to Pass an Initial Breeding Soundness Examination

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Introduction

Age at puberty is a crucial factor influencing a young bull's ability to pass a breeding soundness examination (BSE) at a year of age, and reducing that age may prove beneficial to beef producers. For beef females, exposure to mature bulls is known to hasten the onset of puberty and also can reduce the duration of postpartum anestrus. Relatively little research has evaluated the effects of female exposure on beef bull sexual development. Bulls are thought to use visualization rather than olfaction as their primary and preferred way to detect estrus in females. The purpose of this study was to determine whether continuous, long-term fence-line exposure of prepubertal beef bulls to estrous-cycling beef females influences a bull's age at puberty and subsequent ability to pass a BSE.

Experimental Procedures

Angus, Hereford, Simmental, and Simmental × Angus bulls (n = 77) developed from the Kansas State University Purebred Beef Unit were used in this study. Bulls were stratified by age and breed, then randomly assigned to receive continuous fence-line and visual contact with: (1) beef females exhibiting estrous cycles (Exposed; n = 41), or (2) no visual or fence-line contact with beef females (Control; n = 36) from an average age of 6.5 to 12 months. Bulls were housed in 4 dirt dry-lot pens with 2 pens per treatment. An 11-ft-high plywood wall served as a visual barrier between the exposed and control bulls, thus preventing the control bulls from observing the cycling beef females, with a minimum of 140 ft from control bulls to penned females. All bulls were fed a grower diet designed for bulls to achieve an approximate average daily gain of 3.5 lb per day.

Cycling beef females (n = 9) were maintained in a pen adjacent to the exposed bulls so the bulls had continuous visual and nose-to-nose contact with the females. Transrectal ultrasound for observing ovarian structures was performed on all females to ensure they were cycling prior to beginning the study. Beef female estrous cycles were synchronized so 4 to 5 females were in estrus each week of the study. Estrotect patches (Rockway, Inc., Spring Valley, WI) were utilized to aid in estrus detection each week to confirm that females were exhibiting estrous behavior.

When a bull averaged 196 ± 21.5 days of age, its initial body weight, scrotal circumference, and blood sample (to assess testosterone) was collected before enrollment in the study. A second body weight, scrotal circumference, and blood sample was collected on day 9 of the study and repeated every 28 days until the study concluded.

Beginning when bulls obtained a scrotal circumference ≥10.2 inches, a semen sample was obtained via electroejaculation using a SireMaster Professional electronic ejaculator (SireMaster, Manhattan, KS) with a 2.5-inch diameter probe (SireMaster, Manhattan, KS). All semen collections and evaluations were conducted at the Kansas Artificial Breeding Service Unit. Semen collection continued every 28 days until the bull achieved puberty. Bulls were considered pubertal if they achieved: (1) ≥10.2 inches scrotal circumference, (2) 5.0×10^6 sperm/mL, and (3) ≥10% progressive motility. A veterinarian conducted bull BSEs after approximately 5.5 months of treatment, when bulls averaged 363 ± 21.5 days of age. Semen samples were obtained from all bulls via electroejaculation, regardless of whether they had previously achieved puberty. Bulls passed the BSE if their semen sample had a minimum 30% progressive motility and 70% normal sperm morphology in addition to meeting all other BSE criteria, including an acceptable scrotal circumference for their age. Bulls that did not meet these minimum criteria at the initial examination were retested 20 days later.

Assessments of bull behavior were conducted twice monthly during the study, both when cycling females were in estrus and when they were not. Each day of assessment consisted of three 1-hour observation periods with a minimum of 1 observer per pen. The number of homosexual mounting attempts and flehmen responses were recorded for all bulls in each pen. In addition, exposed bulls were assessed for the number of times they entered a specified cycling female area (10 ft from each side of the cow pen) per hour of observation.

Results and Discussion

Treatment and day interacted ($P = 0.0003$) to affect bull body weight. Exposed bulls were heavier ($P = 0.02$) at day 149 of the study when bulls averaged 11.5 months of age compared with control bulls (1,122 ± 16 lb and 1,068 ± 16 lb, respectively). Scrotal circumference increased ($P < 0.001$) throughout the study but was unaffected by treatment ($P = 0.7$). Day of the study and treatment interacted ($P = 0.03$) to affect testosterone concentrations. Control bulls had greater ($P = 0.002$) testosterone concentrations than exposed bulls at day 93 of the study when bulls averaged 9.5 months of age (11.87 ± 0.78 ng/mL and 8.20 ± 0.77 ng/mL, respectively).

Bull age, weight, scrotal circumference, and semen characteristics at puberty were similar ($P > 0.10$) among exposed and control bulls (Table 1). The percentage of bulls that passed their first BSE was also similar ($P = 0.54$; Figure 1). A total of 14 bulls failed their BSE because of inadequate normal sperm morphology or percentage motile sperm. Eight bulls were retested 20 days after the first BSE. Of those 8, 4 bulls failed a second time, and the primary reason for failure of 3 bulls was sperm motility and normal morphology below the minimum passing standards. Age affected ($P = 0.03$) whether a bull passed or failed the BSE. Most research indicates that poor semen evaluations are the primary reason for failure of a BSE by yearling beef bulls, particularly inadequate percentage normal sperm morphology. Of the bulls that had achieved puberty during the study (n = 51), 47 passed the BSE (96.1%) and only 2 failed (3.9%). Pubertal exposed bulls had a BSE passing rate of 93.1%, and 100% of the control bulls that achieved puberty during the study passed their first BSE.

Bull sexual behavior assessments were conducted as potential indicators of female influence on developing bulls. A 3-way interaction ($P = 0.05$) between treatment, month of assessment, and stage of the estrous cycle (estrus or not in estrus) when the assessment was conducted was observed for the number of mounting attempts. Exposed bulls exhibited more homosexual mounting activity when females were in estrus than when they were not in estrus during months 1 ($P = 0.02$), 3 ($P < 0.001$), 4 ($P = 0.01$), and 5 ($P = 0.07$) of the study. Exposed bulls entered the designated cow area more often when females were in estrus and during the first month of the study; entrance level generally decreased with each subsequent estrus assessment. The bulls likely found the females a novel stimulus, but their interest generally waned over time. Bull homosexual mounting attempts and flehman responses were similar ($P > 0.10$) between exposed and control bulls when females were in estrus. Collectively, sexual behavior assessment results indicate no clear influence of bulls' exposure to cycling females on their display of sexual behaviors.

Implications

Continuous and long-term exposure of young, developing beef bulls to cycling beef females does not enhance their sexual development, nor does it influence the percentage of bulls passing their initial BSE at a year of age.

Table 1. Number of bulls reaching puberty by day 149 of study (average 11.5 months of age) and mean age, scrotal circumference, body weight, and semen characteristics at puberty for bulls with continuous fence-line exposure to cycling beef females (Exposed) and bulls not exposed to females (Control)

Item	Exposed	Control	*P*-value
Number of bulls pubertal, %	29 (56.9)	22 (43.1)	...
Age, days	320.3 ± 5.3	311.3 ± 5.9	0.28
Scrotal circumference, in.	13.6 ± 0.2	13.7 ± 0.2	0.65
Weight, lb	1026 ± 27	963 ± 30	0.25
Sperm concentration, 10^6/mL	85.53 ± 9.6	106.12 ± 10.8	0.35
Motility, %	45.2 ± 4.3	34.2 ± 4.5	0.23
Normal morphology, %	33.8 ± 4.3	24.8 ± 4.9	0.17

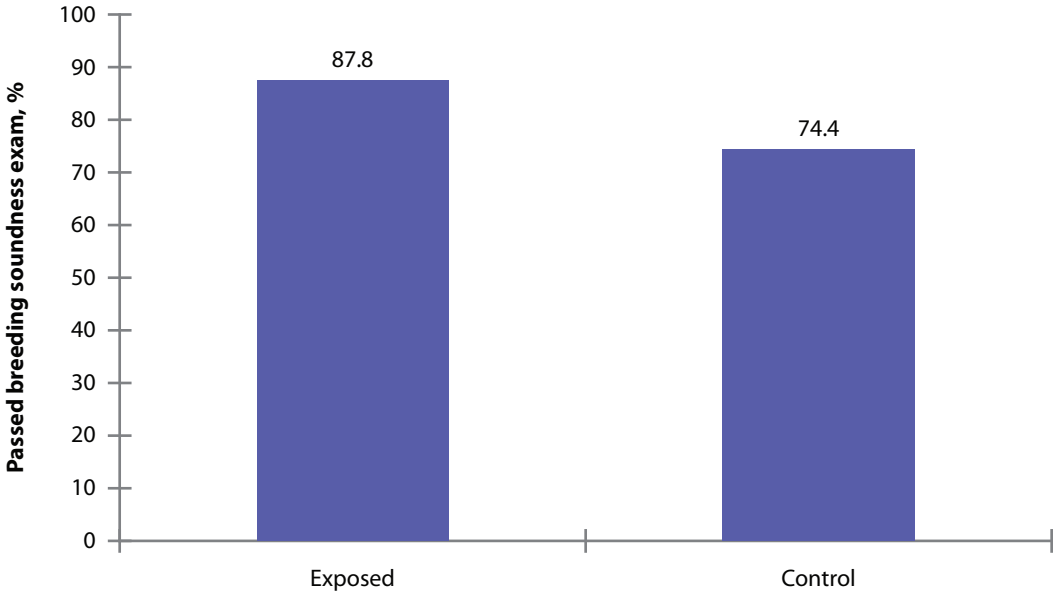

Figure 1. Percentage of developing beef bulls exposed (Exposed) or not exposed (Control) to cycling beef females that passed their initial breeding soundness examination (conducted at an average of 363 days of age).