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Effect of copulation on estrus duration and ovulation time in goats

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ABSTRACT

The objective of the present study was to evaluate the effect of copulation on estrus duration and ovulation in goats. During the fall season, 14 multiparous Boer does were estrous synchronized with controlled internal drug release (300 mg), maintained in the vagina for 7 days, and received 50 μg of intramuscular GnRH device insertion and 5 mg of natural intramuscular PGF2α at device removal. The does were randomly divided into two equal groups: a treatment group (TRE; n = 7) and a control group (CON; n = 7). The TRE group received two copulas by fertile bucks within the first 4 hours of estrus onset, and the CON group received only mounts by the same males equipped with canvas aprons. Estrus detection was performed every 12 hours after controlled internal drug release removal within the first 24 hours and then every 4 hours for 5 days. Estrus was defined when a doe accepted mounting by the bucks equipped with canvas aprons. Each doe in estrus got the first transrectal ultrasonography at 24 hours after estrus onset and then every 4 hours until all the preovulatory follicles ovulated. Estrus onset for the TRE and CON groups was 40.3 ± 17.4 (mean ± standard deviation) and 43.3 ± 12.2 hours (P = 0.72), respectively. Estrus duration for the same groups was 28.6 ± 5.4 and 36.7 ± 5.3 hours (P = 0.02), respectively. The mean ovulation time for the TRE and CON groups was 31.4 ± 2.2 and 35.7 ± 3.7 hours (P = 0.04), respectively. The proportion of ovulations that occurred after the end of estrus in the TRE group was higher than in the CON group (86% vs. 33%, respectively; P = 0.05). The number of ovulations for the TRE group was 2.1 ± 0.7; for the CON group, there were 2.2 ± 0.5 ovulations (P = 0.92). It was concluded that copulation by a buck at the beginning of estrus reduced estrus duration and hastened the ovulation time in Boer goats.

1. Introduction

Caprine estrus length exhibits great variations [1–4]. Estrus duration is essential to artificial insemination (AI) technology [5,6]. It has been traditionally recommended that goats be inseminated 12 hours after the onset of estrus and inseminated again the following day if they are still in estrus [6] or immediately after estrus detection and 12 hours later [7]. Previous studies have shown decreased estrus duration between 9.3 and 19.2 hours (26%–44% reduction compared with the control group) after copulations during the first 12 hours of estrus [4,8–12]. This effect was independent of the number of copulas at the same estrus [8]. It was also found that the decline in estrus duration was due to the mechanical effect of the penis-like device against the vaginal fornix [9]. When the mechanical effect of the penis was eliminated by local and regional

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anesthesia of vagina and cervix of the does, after which the male was permitted to copulate the females, no reduction in estrus duration was observed [10]. It was also noticed that the accessory sexual fluid did not show any effect on estrus duration [10]. Interestingly, when a copula was permitted by a vasectomized teaser before the AI, an increase in fertility rate was noticed compared with a control group of noncopulated females that were inseminated with the same semen [12]. However, no differences between control (CON) and treatment (TRE) groups either in the number of ovulations or ovulation times were detected when assessed at 8-hour intervals by laparoscopy [11]. Because of the 8-hour interval used among examinations, the likelihood of overlooking some real differences in ovulation times between groups cannot be ruled out. Therefore, if the periods between assessments are reduced, a more accurate estimation of plausible differences between groups in the ovulation time could be recognized.

The objective of the present experiment was to evaluate the effect of copulation on estrus duration and ovulation in Boer goats.

2. Materials and methods

2.1. Animals and experimental design

All procedures used in this experiment were in compliance with the Guide for the Care and Use of Agriculture Animals in Research and Teaching and were approved by the Texas A&M University Institutional Animal Care and Use Committee. The Teaching and Research Goat Herd from the Department of Large Animal Clinical Sciences was used. A controlled randomized design with two groups, CON (n = 7) and TRE (n = 7), was performed. The TRE group was permitted to receive two copulas within the first 4 hours after estrus onset. The CON group did not receive any copula during estrus, only mounts. During the fall season, 14 multiparous Boer does with mean age (±standard deviation [SD]) of 3.1 ± 0.7 years (range: 1.5–4), mean weight of 52.2 ± 10.0 kg (range: 38.6–68.2), and mean body condition scores of 3.2 ± 0.4 (range: 2.5–3.75) were used. The does were estrous synchronized with controlled internal drug release (CIDR; 300-mg progesterone) maintained in the vagina for 7 days and received 50 μg of intramuscular GnRH at device insertion and 5 mg of natural intramuscular PGF2α at device removal. Estrus was detected twice a day during the first 24 hours after pessary removal and then every 4 hours by using three fertile proven bucks from 1 to 4 years old with high serving capacity as teasers with canvas apron for 120 hours led by a leash as in previous investigations [4,8–12]. The same males were also used for copulation. In the TRE group, the male (without canvas) was permitted two copulations, the first at estrus onset and the second 4 hours later. Females were considered to be in behavioral estrus when accepted to be mounted by the buck with canvas aprons. Estrus response was defined as the proportion of females in estrus within the first 5 days of CIDR removal. Estrus onset was defined as the interval from CIDR removal to the first accepted mount. Estrus duration was the interval from the first accepted mount to the last accepted mount. Copula was defined as penile intromission into the vagina with thrusting. Ovulation time was defined as the interval between estrus onset and the first ovulation (first ovulation time), or the last ovulation (last ovulation time), or as the mean time between the first and last ovulations (mean ovulation time). The ovulation time was also related to behavioral estrus (inside or outside of estrus). The ovulation time and the number of ovulations were assessed by transrectal ultrasonography starting 24 hours after estrus onset and repeated every 4 hours until complete ovulation. The does were restrained in a special chute, in standing position, without receiving any tranquilization with the abdomen lifted up by means of a wide strap, and the ovaries were assessed by per rectum examination using a 7.5-MHz linear prostatic probe as previously reported [13]. The first, last, and mean ovulation times, and the number of ovulations were calculated. All bucks were housed together in close proximity to the females' pens after the teasing process in an adjacent corral in constant visual, olfactory, and auditory communication with the females. The does were housed in groups of no more than four does per cover pen, with free coastal hay available and supplemented with a commercial mixed concentrate ration (16% crude protein, 3.0% crude fat, 16% crude fiber, 0.9% Ca, 0.55% P) and fed individually twice daily with 450 g per doe per meal. All does had free access to water and trace mineral salt. The weight and body condition score were evaluated at the time of CIDR removal [14].

2.2. Statistical analysis

The sample size required to detect a difference between groups of 10 hours in estrus duration, with an SD of 6 hours, using an alpha error of 5% and a power of 80% for an independent continuous variable was estimated. The sample size needed for each group was seven does [15]. The continuous variables (estrus onset, estrus duration, and interval between estrus onset and ovulation) were analyzed by a Student *t* test for independent samples. The categorical variables (estrus response, number of ovulations, and ovulations inside or outside of behavioral estrus) were analyzed by a chi-square or Fisher Exact Test as appropriate [16]. All data were expressed as mean ± 1 SD. Differences were considered statistically significant when $P \leq 0.05$. Statistical software was used to perform all statistical analyses [15].

3. Results

A summary of all the results from this investigation can be seen in Table 1. All the females in this study presented estrus after CIDR removal but one doe from the CON group. The estrus onset for the TRE and CON groups was 40.3 ± 17.4 and 43.3 ± 12.2 hours (P = 0.72), respectively. The estrus duration for the same groups was 28.6 ± 5.4 and 36.7 ± 5.3 hours (P = 0.02), respectively. All the females in estrus ovulated (n = 13). The first ovulation was earlier for the TRE group compared with the CON group (29.1 ± 3.2 vs. 33.7 ± 3.9 hours, respectively; P = 0.05). The last ovulation was 32.6 ± 2.5 and 37.7 ± 3.9 hours for the same groups, respectively (P = 0.02). The mean ovulation time for the