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Fifteen minutes of daily contact with sexually active male induces ovulation but delays its timing in seasonally anestrous goats



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ABSTRACT

The present experiment was conducted to determine (1) whether the sexually active bucks are able to stimulate the ovulatory activity of seasonal anestrous goats when the daily contact is reduced to 15 min/day during 15 days and (2) the exact ovulatory activity in anestrous goats exposed to bucks for 2 hours or less per day during 15 days. One group of goats ($n = 15$) was isolated from bucks. The other six groups ($n = 15$ each) were exposed to sexually active bucks ($n = 1$ each) for 15 minutes, 30 minutes, 1 hour, 2 hours, 4 hours, or 24 hours during 15 days. Goats with plasma concentrations of progesterone greater than 0.5 ng/mL were considered to have ovulated. More than 93% of females exposed to bucks ovulated throughout the experiment regardless of the duration of contact with males, whereas none of them ovulated in the isolated group ($P < 0.0001$). The proportions of females that ovulated at least once did not differ among groups as well as the proportions of goats that displayed normal or short ovulatory cycles. The interval between the introduction of males and the first ovulation did not differ among groups of goats in contact with bucks for 15 minutes, 30 minutes, 1 hour, or 2 hours. However, in these groups, this ovulation occurred about 2 days later than in females in contact with males during 4 or 24 hours (6.3 vs. 4.4 days; $P < 0.05$). We conclude that 15 minutes of daily contact with sexually active buck is sufficient to stimulate the ovulatory activity in seasonally anestrous goats, but the first ovulation is delayed in goats exposed to males for 2 h/day or less during 15 days in comparison with those in contact with males for 4 or 24 h/day.

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1. Introduction

The “male effect” is a powerful technique of sexual stimulation where the sudden introduction of a male can induce the sexual activity of female goats and ewes during the seasonal anestrus [1–3]. It is particularly useful in some breeds of goats and ewes originating from temperate or subtropical latitudes that show a reproductive seasonality

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that hinders out-of-season reproduction. In practice, the exposition of female goats and ewes to a male induces and synchronizes the secretion of LH and ovulation [4–6]. Indeed, most goats exposed to males show a preovulatory LH surge, display estrous behavior, and ovulate within the first 5 days of contact with bucks [7,8]. After this first ovulation, females show a short ovulatory cycle and ovulate again between 5 and 8 days later. This second ovulation after introduction of males is usually followed by a normal life span CL [9–11].

The ovulatory response of goats and ewes exposed to males can be influenced by the intensity of sexual behavior. Indeed, bucks rendered sexually active during the nonbreeding season by previous exposure to long days induce most females to ovulate, whereas untreated, sexually inactive ones, failed or induce few females to ovulate [12,13]. Similar results are observed in sheep. Rams displaying a high sexual behavior induce a greater proportion of ewes to ovulate, whereas rams that display a weak sexual behavior lead to a small percentage of females to ovulate [14,15].

Another factor involved in the variation of the ovulatory response of goats and ewes exposed to males is the duration of contact between sexes. In fact, only 18% of ewes ovulate when exposed to rams for 1 day, whereas the proportion of females that ovulate increases to 53% and 61% when exposed to males 24 h/day for 4 and 15 days, respectively [14]. In contrast to ewes, in goats, the duration of daily contact between males and females can be drastically decreased without affecting the ovulatory response. In fact, all goats ovulated at least once when exposed 24 h/day for 1, 5, 10, or 15 days to sexually active bucks [16]. Interestingly, more than 89% of goats ovulated when exposed to sexually active bucks for 1, 2, or 4 h/day during 15 consecutive days, and this percentage did not differ from females in contact with males for 24 h/day (>95%) [17–19]. However, in females exposed to males for 2 or 1 h/day, ovulations tended to be delayed in comparison to those in contact with males for 4 or 24 h/day. In fact, from Days 1 to 4 after introducing the males, only 14% of females exposed to males for 1 h/day ovulated, whereas 50% of those exposed to males for 4 or 24 h/day did so. Nonetheless, at Day 18 after the introduction of the males, the percentages of females that ovulated in response to the male effect did not differ significantly between females in contact with males for 1, 4, and 24 h/day [19].

In this latter study, ovulations were assessed from the pattern of daily plasma progesterone concentrations from Days 1 to 10 and on Day 18 after exposure to males. Considering the low percentage of females that ovulated in the first 4 days of contact with males and the fact that at Day 18 the proportion of females that ovulated did not differ from those remaining in contact with males 24 h/day, the pattern of secretion of plasma progesterone did not allow to determine precisely the ovulatory events in these females (i.e., when the females ovulated and the characteristics of the ovulatory cycles: short or normal ovulatory cycles).

In addition, there are no data indicating whether the sexually active bucks are able to induce ovulations in goats exposed to them for less than 1 hour for 15 consecutive

days. Therefore, considering the arguments described previously, we conducted the current experiment to determine (1) whether the sexually active bucks are able to stimulate the ovulatory activity of seasonal anestrus goats when the daily contact is reduced to 15 min/day during 15 days and (2) the exact ovulatory activity in anestrus goats exposed to bucks for 2 hours or less per day during 15 days. Considering the previous results obtained with the sexually active males, we hypothesized that all durations of contact per day with sexually active bucks induce ovulatory activity of all females but that ovulation timing could be affected by the shorter durations of contact.

2. Materials and methods

2.1. Ethical note

The experimental procedures used in the present study were in accordance with the Official Mexican Rule for the technical specifications for the production, care, and use of laboratory animals [20].

2.2. General conditions of the study

The present study was conducted during the anestrus season using goats (*Capra hircus*) from the Laguna region in the state of Coahuila, Mexico (Latitude 26° 23' N and longitude 104° 47' O). The photoperiod in this region varies from 13 hours 41 minutes of light at the summer solstice to 10 hours 19 minutes of light at the winter solstice. In females isolated from males, the anestrus season lasts from March to August, and in males isolated from females, the sexual rest lasts from January to May [21,22]. All females were multiparous and had given birth between September and November; they were milked manually once a day during the study. Females and males were maintained in shaded open pens and fed with 2 kg of alfalfa hay (18% CP) and 200 g of commercial concentrate feed (14% CP; 1.7 Mcal/kg), with free access to water during the whole experiment.

2.3. Stimulation of the sexual behavior of males by exposure to long days

Six adult male goats were placed in a 10 × 5-m shaded open pen and subjected to a treatment of long days to stimulate their sexual activity during the nonbreeding season [13]. Briefly, males were exposed to artificial long days (16-hour light/8-hour darkness) from November 1, 2014 to January 15, 2015. From January 16, males were exposed to natural variations of photoperiod conditions until the end of the study (April 15). This photoperiodic treatment stimulates the secretion of testosterone from late February to late April and, as a consequence, enhances the intensity of sexual behavior and odor of males during these months corresponding to the nonbreeding season [13,16,23]. On March 23, males were individually exposed for 15 minutes to an anestrus goat, and we recorded the anogenital sniffings, nudgings, and mounting attempts [13,24,25]. All males displayed all the components of sexual behavior.

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