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Reproductive outcomes of Alpine goats primed with progesterone and treated with human chorionic gonadotropin during the anestrus-to-estrus transition season

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ABSTRACT

This study aimed to determine the possible effects of a single injection of human chorionic gonadotropin (hCG) as a means for estrus induction in acyclic French-Alpine goats during the reproductive transition period at 25°N, 103°W. The potential effects of hCG upon ovarian function and reproductive performance of goats were also assessed. Multiparous acyclic French-Alpine goats ($n = 39$; 37.4 ± 8.5 kg) were primed with 20 mg progesterone (P4) 1 day prior to hCG administration. Thereafter, does were treated either with saline (hCG-0; $n = 10$), 50 (hCG-50; $n = 9$), 100 (hCG-100; $n = 10$), or 300 IU of hCG (hCG-300; $n = 10$). Ovarian structures and pregnancy were monitored by transrectal ultrasonography. In addition, after hCG application, goats were monitored twice daily (0800 and 1800 h) to detect estrus signs, with the use of aproned, sexually active bucks treated with testosterone. Goats were bred 12 h after the onset of estrus. Two days after hCG administration, the number of large follicles was higher ($P < 0.05$) in the hCG-50 and hCG-300 groups (1.7 ± 0.1 and 1.8 ± 0.2, respectively) compared with the hCG-100 and hCG-0 groups (1.4 ± 0.2 and 1.1 ± 0.1, respectively). Although none of the hCG-0-goats depicted estrus, the estrus response from the hCG-50, hCG-100, and hCG-300 groups over the 7-d breeding period was 67%, 100%, and 90%, respectively ($P > 0.05$), being always accompanied by ovulation. Pregnancy rate (67, 100, and 70%), kidding rate (55%, 80%, and 70%), and litter size (1.6 ± 0.5, 1.5 ± 0.5, and 1.5 ± 0.5) for hCG-50, hCG-100, and hCG-300, respectively, did not differ among the hCG-treated does. Therefore, the combined use of P4-priming plus a 100-IU hCG injection is an effective protocol for inducing estrus in non-cycling Alpine goats during the anestrus-to-estrus transition period, which is of key importance for both goat producers and industrializers.

1. Introduction

The Comarca Lagunera, located in northern Mexico, is one of the main goat-milk producing regions in the Americas, with an extensive use of exotic and highly productive dairy goat breeds exerted by many stock breeders

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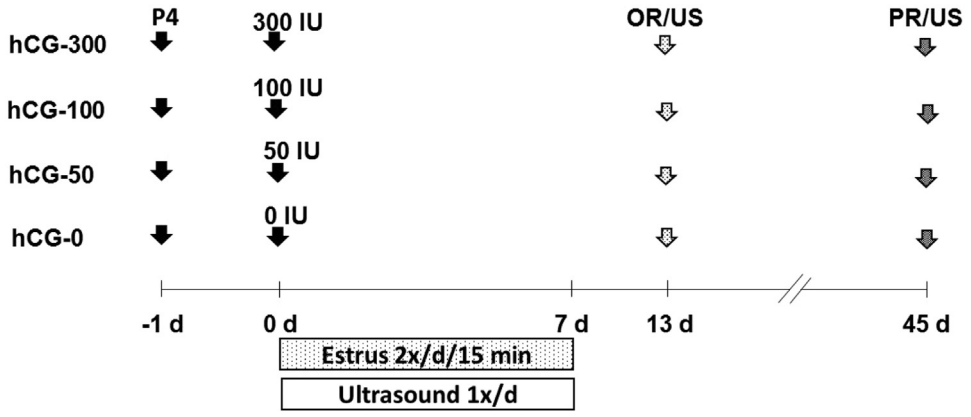

Fig. 1. A schematic representation of the experimental protocol to induce estrus in multiparous acyclic French-Alpine dairy goats during the transition anestrus-to-estrus period (June, 25°N). Goats were progesterone (P4) primed prior application of the experimental treatments which considered different concentrations (50, 100 or 300 IU) of human chorionic gonadotropin (hCG) or saline (hCG-0). Ultrasonographic scanning (US) was performed daily from d0 to d7 to confirm ovulation, on d13 to evaluate ovulation rate (OR) as well as on d45 to confirm pregnancy (PR).

turned out under intensive and semi-intensive production systems (Escareño et al., 2013; Meza-Herrera et al., 2014). Nevertheless, in addition to increased milk production, most breeds from temperate latitudes also show significant seasonal breeding (Gonzalez-Bulnes et al., 2011; Meza-Herrera et al., 2014). Such reproductive seasonality generates major constraints to the goat industry because it impedes accelerated kidding programs, limits access to favorable seasonal markets, and restricts flexibility to integrate parturitions into other farm activities, among others. To counteract these restrictions, multiple hormonal protocols have been developed to induce ovulation during the non-breeding season, with comparable reproductive outcomes to those found at the peak of the natural breeding season (Fonseca et al., 2006; Bobowiec et al., 2012; Fierro et al., 2013; Jackson et al., 2014). Therefore, estrus induction and synchronization are important management tools to be used as aids in artificial insemination protocols as well as to abolish reproductive seasonality in goats (Abecia et al., 2012).

Some of the protocols developed to induce ovulation during the non-breeding season make use of equine chorionic gonadotropin (eCG) (Abecia et al., 2012). This hormone is typically administered 24 h before progestagen withdrawal during the non-breeding season or at the time of progestagen removal during the breeding season, in order to stimulate and synchronize follicular growth in goats (Fonseca et al., 2005; Cox et al., 2012). Nevertheless, eCG is a peptide hormone that functions as an immunogen inducing an immune response. The formation of antibodies to eCG after repeated treatments not only diminishes the efficacy of estrus induction but also promotes concerns because it generates a reduction in both ovulation rate and kidding rate (Drion et al., 2001; Herve et al., 2004). The alternate use of different hormones, such as human chorionic gonadotropin (hCG), may minimize such immune reactions and maintain adequate estrous induction rates in goats (Fonseca et al., 2006; Cole, 2009). hCG has been efficiently used as gonadotropin for induction of estrus in goats outside the breeding season after a short-term protocol with progestagen (Fonseca et al., 2005). The main effect of progesterone priming is to increase the number of stimulated follicles by gonadotropin analogs and consequently the ovulation rate in anestrous females (Simoes, 2015). The working hypothesis of the present study is that the administration of single, low-dose hCG is effective in synchronizing estrus and ovulation in acyclic dairy goats during the anestrus-to-estrus transition season at 25°N and will enhance reproductive outcomes in these animals.

2. Material and methods

2.1. Location, animals, management, housing, and feeding

The study was conducted in a commercial herd of French-Alpine goats under intensive conditions in northern Mexico (25 N, 103°W; 1140 m). In this area, the annual average mean temperature is 23.5 °C (range: −2 to 43 °C), while the annual relative humidity ranges between 28% and 81%. The annual rainfall is 230 mm, and the day length is 13 h: 41 min in the summer solstice and 10 h, 9 min in the winter solstice. The study was conducted during early June, corresponding to the goats' anestrus-to-estrus transition period. Although females goats at this latitude–longitude demonstrate a seasonal reproductive arrest from March to August (Duarte et al., 2008), Alpine male goats at the same latitude show a seasonal pattern between January and July (Carrillo et al., 2010). The health status of all the experimental units was controlled by an experienced veterinarian during the whole experimental period; no health problems were observed during the trial. In addition, efforts were made to minimize any possible discomfort in the experimental animals. All the methods and management of the experimental animals used in this study were in strict accordance with accepted guidelines for ethical use, care, and welfare of animals in research at international (FASS, 2010), national (NAM, 2002), and institutional levels, with approval reference number UAAAN/UL/1330-8242-2825-March 03, 2014. Goats were housed in well-ventilated, open-lot, dirt floor pens with ample shade structures and 2.5 m of height in each pen and with feed bunks along pens.