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Effect of a new device for sustained progesterone release on the progesterone concentration, ovarian follicular diameter, time of ovulation and pregnancy rate of ewes

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ABSTRACT

This study evaluated the effectiveness of a new progesterone intravaginal device (DPR) in ewes through four experiments: Experiment 1 compared the circulating progesterone concentration of ovariectomized ewes that received either a new or a re-used DPR. Experiment 2 compared the progesterone concentration between DPR-estrous-synchronized ewes and naturally estrous-cycling ewes. Experiment 3 evaluated the effect of new and re-used DPRs on ovarian follicular dynamics and time of ovulation of estrous cycling ewes. Experiment 4 compared the pregnancy rate after the use of a DPR and Controlled Internal Drug Releasing Device (CIDR). The mean concentration of progesterone released by the DPR device during its first use (New Group: 5.1 ± 0.5 ng/ml) was greater than that during the second use (Re-used Group: 2.4 ± 0.3 ng/ml). There was no difference between the animals that received DPR devices for first and second use in terms of ovulatory follicle diameter, follicular wave emergence day for ovulatory follicle and period of ovulatory wave of ovarian follicular development. However, there was a significant difference between groups regarding the time between DPR device removal and first ovulation (New Group: 71.7 ± 2.5 h and Re-Used Group: 63.9 ± 2.7 h). Pregnancy rates were similar between ewes with DPR and CIDR devices. It was concluded that DPR is effective in increasing and maintaining progesterone concentrations, controlling follicular dynamics, promoting synchronized times of ovulation from healthy follicles, promoting development of a competent corpus luteum and when used results in pregnancy rates similar to that with use of the CIDR.

1. Introduction

The most efficient technique to synchronize time of estrus and ovulation in food producing animals is through the use of hormonal protocols. Synchronization of time of ovulation is essential to ensure acceptable reproductive

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rates when using fixed-time artificial insemination (FTAI; Fierro et al., 2013). Together, these two techniques allow the following benefits: choice of the most desirable times of birth for production efficiency, synchronization of time of births within the shortest period possible, management of genetic breeding systems (Fatet et al., 2011), and use of artificial insemination without the need for estrous observation.

The most common hormonal treatments in ovine reproduction programs use intravaginal devices impregnated with progesterone or other progestogens (Abecia et al., 2012). More specifically, these devices are made either of polyurethane sponges impregnated with flurogestone acetate (FGA; Gaston-Parry et al., 1988) or methylacetoxyprogesterone (MAP; Robinson, 1965) or of silicone impregnated with natural progesterone (CIDR®; Wheaton et al., 1993). Studies show that there are no differences in the efficiency of these devices for reproductive cycle control (Ozyurtlu et al., 2010; Romano, 2004; Ungerfeld and Rubianes, 2002), except for the fact that sponges are generally less costly than silicone (Wheaton et al., 1993). However, use of sponges can result in a greater rate of vaginitis and adherence to vaginal tissue than silicone (Carlson et al., 1989; Romano, 2004); sponges can also negatively affect the sexual attraction of estrous cycling ewes, probably due to changes in vaginal flora (Gatty and Ungerfeld, 2012).

The objective of the present study was to evaluate the use of a new progesterone device impregnated with 0.36 g of natural progesterone (DPR – Dispositivo Pequenos Ruminantes, Tecnopec, Brasil) on progesterone concentration, follicular diameter, period over which ovulations occurred, corpus luteum competence and pregnancy rate in ewes. Four experiments were conducted: Experiment 1 compared the circulating progesterone concentration after progesterone intravaginal device insertion in ovariectomized ewes that received either a new or a re-used DPR. Experiment 2 compared the progesterone concentration between DPR estrous-synchronized ewes and natural estrous cycling ewes. Experiment 3 evaluated the effect of new and re-used DPRs on the follicular dynamics, time of ovulation and progesterone concentration of estrous synchronized ewes. Experiment 4 compared the pregnancy rate using laparoscopic AI of estrous synchronized ewes with DPR.

2. Material and methods

2.1. Location of experiments

Experiments 1, 2, and 3 were performed in the Animal Reproduction Department of the College of Veterinary Medicine of the University of São Paulo (23° S, São Paulo, Brazil) during the normal reproduction season for ewes. Experiment 4 was performed in Jarinu, São Paulo (23 °S, São Paulo, Brazil), during the reproduction season for ewes. The ewes were fed a pellet and hay diet (600 g/ewe/day and 2 kg/ewe/day, respectively) and had access to mineral salt (Ovinofós®Tortuga) and water *ad libitum*. All experiments were performed in accordance with the FMVZ-USP Animal Experimentation Bioethics Committee (protocol number: 2460/2011).

2.2. Adaptation management

There was concern about the research animals' well-being (Roger, 2012) because chronic stress can suppress ovarian follicular development and impact GnRH/LH preovulatory pulse amplitude and frequency (Dobson et al., 2012; MacFarlane et al., 2000). To overcome this concern, adaptations were made to the rectal ultrasonogram exams that had been planned for follicular dynamic monitoring. During the first week, researchers were responsible for feeding the animals and remaining at the location where the animals were for 1 h or until ewes approached the researcher or there was physical contact with at least one of the animals. During the month of this adaptation period, there was noticeable increase in the willingness of animals to contact researchers. Animals were subsequently placed in the restraining station, where the ultrasonography exams would be performed for a few minutes each day. After exiting the restraining station, each animal received a handful of pellet food from the researcher's hand as positive reinforcement. By repeating this positive reinforcement throughout the study, it was observed that the animals remained calm and trusting of the researchers during the exams and successive blood collection.

2.3. Experiment 1

2.3.1. Experimental design

The experiment was conducted in two phases with intervals of 2 months in the cross-over system. Six ovariectomized Santa Ines ewes have received a treatment protocol for 9 days using DPR intravaginal device. On day zero (D0), the ewes were divided into two groups: the groups treated with the new device (New Group) and those treated with the re-used device (Re-Used Group). Ewes in the New Group received a new intravaginal device of slow progesterone release made of silicone and impregnated with 0.36 g of natural progesterone (DPR – Dispositivo Pequenos Ruminantes, Tecnopec, Brasil), and the ewes in the Reused Group received a used DPR device (previously used for nine days). After nine days, the DPR devices were removed from the ewes in both experimental groups.

2.3.2. Blood sampling and progesterone assay

Blood was collected for measuring serum progesterone concentration through puncture of the external jugular vein with a needle and tube without anticoagulant (Vacutainer system, BD®). Blood collection occurred on the following days and times: D-1, D0 (time of device insertion), D0 + 1 h (1 h after device insertion), D0 + 2 h, D0 + 4 h, D1, D3, D5, D7, D9 (before device removal), D9 + 1 h (1 h after device removal), D9 + 2 h, D9 + 4 h, D10 and D12 after device insertion.

Serum progesterone concentrations were determined using a solid-phase radioimmunoassay (RIA) by means of a Siemens® commercial diagnostic kit (Coat-A-Count, Diagnostic Products Corporation, Los Angeles, CA, USA). These kits were developed to quantify progesterone in