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Control of Reproduction By Hormones In Small Ruminants

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Abstract

Several strategies developed in recent decades can be used to regulate the reproduction of small ruminants. Some of these entail administering hormones that alter the physiological sequence of the sexual cycle's events. Progesterone or its analogues are used in methods that mimic the effects of natural progesterone produced by the corpus luteum after ovulation, which is in charge of regulating LH release from the pituitary, on the luteal phase of the cycle. By removing the corpus luteum and producing an additional follicular phase with ovulation, the use of prostaglandins is a different technique for managing reproduction. Given how challenging it is to detect oestrus in these species, the use of hormones to induce oestrus has permitted small ruminants to use artificial insemination at higher rates. At the commercial level, timing of oestrus permits management of kidding and lambing, followed by timing of weaning of young animals for slaughter. Additionally, it permits the more effective use of labour and animal facilities. Oestrus synchronisation and artificial insemination can also be used in multiple ovulation and embryo transfer regimens. Finally, ewe-lambs and doelings have been given hormone therapy to make them go through puberty.

Introduction

There are seasonal cycles of reproduction in several ruminant species, such as those of sheep and goats. The seasonal pattern of reproduction that these animals displayed in the wild, which was intended to guarantee that lambs and young were born at the best time of the year, typically in the spring, was not altered by domestication of these species. These species' reproductive season consists of a series of oestrous cycles, which typically start in the summer or early fall as a result of the dwindling day length and terminate in late winter or early spring. The transition phase extends from late spring to the beginning of the ovulatory period, while the anoestrous period spans from late winter/early spring to early or mid-summer. If animals are milked, this seasonal breeding pattern also produces a seasonal pattern of milk production and a distinct period of lambing or kidding. Due to this circumstance, product prices follow a seasonal pattern, with prices falling from late spring to early autumn, when the supply of meat and milk is at its peak, and vice versa. Inducing oestrous cycles during the seasonal anoestrus would allow farmers to produce crops "out-of-season," taking advantage

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of greater pricing for them throughout the winter.

Numerous techniques created in recent decades can be used to regulate the reproduction of small ruminants. Some of them entail administering exogenous hormones that alter the physiological sequence of the sexual cycle's events. Others solely use "natural methods," such as light control or exposure to a man, and do not use hormones. The luteal phase of the cycle will be altered by the administration of hormones like progesterone or its analogues (progestagens) and prostaglandins. Since the 1970s, artificial insemination has been used more frequently in these species due to the use of progestagens to induce oestrus, which is a huge benefit given how difficult it is to detect oestrus in these animal species. At the commercial level, synchronising oestrus enables control and expedited kidding and lambing, followed by synchronised weaning of young animals for slaughter. Additionally, it enables the more effective utilisation of labour and animal facilities. Oestrus synchronisation and artificial insemination are also used in multiple ovulation and embryo transfer (MOET) programmes. Finally, ewe-lambs and doelings have been given hormone therapy to make them go through puberty.

Progesterone and analogues (progestagens)

Progesterone or its analogues are used in methods that mimic the activity of natural progesterone produced in the corpus luteum after ovulation, which is in charge of regulating LH secretion from the pituitary, by acting on the luteal phase of the cycle. Oestrus and ovulation can therefore be regulated by changing the life of the corpus luteum or the levels of circulating progesterone. The initial course of treatment involved 14 daily subcutaneous injections of 10 mg of progesterone dissolved in 2 mL of maize oil; this decreased the animal breeding period to 8 days. In some following studies, progesterone therapy was combined with the administration of human chorionic gonadotrophins and pregnant mare serum. However, because of progesterone's lingering impact on the uterine and tubal environments, conception rates were low. Therefore, a progestational agent would yield superior results because its activity would end rather abruptly following the conclusion of the treatment. This was proposed by Southcott et al. (1962), who effectively induced oestrus synchronisation in sheep using the progesterone analogue 6-methyl-17-acetoxyprogesterone. Additionally, it was discovered that administering progesterone or analogues intravaginally made it easier for those hormones to be abruptly removed. Intravaginally inserted pessaries impregnated with progestagens have been used to coordinate sheep oestrous cycles since the early 1960s and have been discovered to be as efficient for synchronising oestrus in goats. Fluorogestone acetate (20 mg/sponge) and medroxyprogesterone acetate (60 mg/sponge) are the two progestagens that are most frequently employed in commercial settings. Both seem to be potent temporal oestrous cycle inhibitors. The inert silicone elastomer controlled internal drug release (CIDR) dispenser, which is often impregnated with natural progesterone, has also been employed. The gadget, which has 0.30 g of progesterone, was created in New Zealand in the late 1980s. Plasma progesterone concentrations increase quickly following device implantation, peaking 3 days later, and then progressively declining after that. The device's use accelerates the start of the typical breeding season and, when combined with the ram effect, can encourage out-of-season breeding. Progestagen-impregnated intravaginal sponges, also known as CIDRs, are placed intravaginally for 12–14 days in sheep. 48 hours or so after the removal of the device, ewes begin to display oestrus for mating or artificial insemination. In goats, CIDRs are left in situ for 18–21 days while progestagen-impregnated sponges are placed intravaginally for 16–18 days. After removal, the majority of does will go into oestrus 48 hours later. Equine chorionic gonadotrophin (eCG, also known as "pregnant mare serum gonadotrophin" or "PMSG"), a placental glycoprotein hormone made from the serum of pregnant mares, is given to animals at the time of removal.

The eCG exhibits concurrent FSH and LH-like activity. In order for progestagen therapy to be effective, there must be enough gonadotrophin on hand to start the preovulatory processes. This can be accomplished by boosting endogenous gonadotrophins with "exogenous" FSH provided via the FSH-like activity of the eCG administration. It should be used with caution during breeding season since it increases ovulation rates, which results in more lambs being born. eCG dosage in sheep varies from 250 to 750 IU depending on breed, age, and season. Higher doses (up to 1000 IU) might be necessary in goats. In the breeding season, a male to female ratio of 1:10 is advised for mating; however, during the anoestrus or transition period, the ratio should be between 1:5 and 1:7. After the device has been removed, insemination can be done between 47 and 55 hours later (intrauterine or intracervical). The synchronisation of oestrus and ovulation by a brief exposure to progestative treatment is a potential substitute for reducing the duration of permanence of vaginal devices. Briefly stated, the treatment involves inserting CIDR or sponges impregnated with progestagen for 6 days. Because this time frame is shorter than the half-life of any potential corpus luteum in the ovary, prostaglandin F2 or one of its equivalents must be administered concurrently with the insertion of the sponge in order to cause the lysis of the corpus luteum. The treatment's reaction is comparable to that of long-term therapy.

Prostaglandins and analogues

The induction of luteolysis, removal of the corpus luteum, and subsequent induction of a follicular phase with ovulation are alternate techniques for managing reproduction in sheep and goats. Prostaglandin F2 (PGF2) is the main luteolytic factor in ruminants, hence exogenous PGF2 or its analogues can be administered to induce luteolysis. The ability to administer by intramuscular injection is the main benefit of prostaglandin therapy. In contrast to intravaginal devices, animal management and welfare are enhanced. In addition, because the product is swiftly and almost entirely (99%) metabolised in the lungs, the output of chemical residues is lowered. The primary drawback of employing PGF2 is that it must be administered in the presence of an active corpus luteum and responding to exogenous PGF2 for the hormone to be effective. Animals in anoestrus or in the early, late, or follicular phases at the time of injection will not respond to treatment since the corpora lutea can respond to PGF2 as early as day 3 of the oestrous cycle and as late as the day of spontaneous luteolysis. Given that it is impossible to predict the oestrous cycle phase in a group of females, PGF2 must be administered twice, 9–10 days apart. This ensures that nearly all of the animals in the group will be in mid-luteal phase at the second dosage and will respond to therapy. In tropical breeds, where there is a continuous breeding season and no seasonal anoestrus, this technique can be used all year long; however, in temperate regions, it can only be utilised during the breeding season. However, the use of prostaglandins after establishing reproductive cyclicity by using the "male-effect," which entails reintroducing male animals into the female flock after a separation time, may provide a solution during the transition period. The second drawback is that while the 9–10-day procedure successfully synchronises oestrus, the ewes' first-mating fertility is only about 70%, which is much lower than it is following progestagen treatments and natural services. However, the presence of an active corpus luteum alters the functionality and final maturation of preovulatory follicles as well as normal luteogenesis (high progesterone concentrations during the mid-luteal phase of the oestrous cycle decrease LH secretion, which is crucial for final growth and maturation of preovulatory follicles). Treatment at either the early or late luteal phase of the oestrous cycle may help with the first issue, which is reduced follicular function and poor synchronisation of follicle growth during mid luteal stages. Due to the existence of developing follicles from the first wave of development, treatment during the early luteal phase appears to be the most effective course of action. When the corpus luteum of small ruminants is receptive to PGF2, which occurs on the third day of the oestrous cycle, the treatment can be started right away. The second dose of prostaglandin should be administered, however, at the hypothetical fifth day of the oestrous cycle (i.e., seven days after the first dose), from a practical standpoint. Treatment on the fifth day would prevent the possibility that animals would be on the first or second day of the cycle and not respond to PGF2. The luteolytic efficiency, percentage and timing of appearance of oestrus, preovulatory release of LH, ovulation, and functionality of subsequent corpora lutea are similar after administration at either the third or fifth day of the cycle. In addition, treating in the early luteal phase would promote follicle maturation and synchronisation of the preovulatory LH peak and ovulation because younger, less progesterone-secreting corpora lutea would allow for earlier restoration of LH pulsatile until reaching the preovulatory peak. As a result, the window of time during which a population of animals exhibits oestrus and ovulation would be reduced; this technique may even be applied for timed artificial insemination. Applying the "male effect" concurrently with the second PGF2 injection may further reduce the variability in ovulation timing after therapy. Although the "male effect" is frequently used to induce an LH surge and ovulation during seasonal anoestrus, it also increases LH secretion during the breeding season in ewes that are cycling. Therefore, in the absence of earlier oestrus detection, the combination of PGF2 during the early luteal phase with the "male effect" may be a sufficient substitute for synchronising oestrus prior to artificial insemination.

Conclusion

The hormonal options for small ruminant reproductive control are well described; these are practical strategies for raising farm profitability. However, a novel strategy that proposes the use of "biostimulation" in place of exogenous hormones and drugs to regulate and enhance the productivity of sheep and goats may be worthwhile to consider in the future. Biostimulation is defined as the stimulatory effects on reproductive characteristics of females, such as the onset of puberty, oestrus expression, and ovulation induction, that are induced by the presence of a male. It makes sense for animal producers in all nations to start shifting towards clean, ethical, and sustainable practises as this might be a long-term phenomenon.

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