

Chapter 8 Preparation and use of intravaginal sponges for induction of estrus in hair sheep

Capítulo 8 Elaboración y uso de esponjas intravaginales para la inducción del estro en ovejas de pelo

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Abstract

The aim of the study was to assess the effectiveness of handmade sponges for the induction of estrus in hair sheep. Sixty multiparous females were used, which were divided into three groups: 1) ChronogestCR commercial sponge, 2) FGA commercial sponge and 3) handmade sponge. A sponge was inserted intravaginally to each sheep according to the assigned treatment and remained *in situ* for 12 days, two days before the sponge was removed 300 IU of eCG was administered intramuscularly, and 24 hours after removal of the sponge, estrus was detected using tester ram, and were controlled breeding (morning and afternoon). At 17 ± 1 day, the estrous detection was performed again to obtain the percentage of repetition of estrus. All the sheep in the three groups were in estrus. The percentage of non-return to estrus was 73% in ewes with Chronogest sponge, 65% in ewes with handmade sponge and 63% in ewes with FGA sponge, without statistically differentiating ($p>0.05$). In conclusion, the use of a handmade sponge for the induction of estrus in sheep was as effective as the two commercial sponges in the presentation of estrus.

Sheep, Estrus induction, Intravaginal sponge, FGA

Resumen

El objetivo fue valorar la efectividad de las esponjas elaboradas artesanalmente para la inducción del estro en ovejas de pelo. Se utilizaron 60 hembras multíparas, las cuales fueron divididas en 3 grupos: 1) esponja comercial ChronogestCR, 2) esponja comercial FGA y 3) esponja artesanal. A cada oveja se le insertó intravaginalmente una esponja de acuerdo al tratamiento asignado y permaneció *in situ* durante 12 días, dos días antes del retiro del dispositivo se aplicaron 300 UI de eCG vía intramuscular, y 24 horas después del retiro del dispositivo se detectó el estro utilizando un macho cubierto con mandil, y se realizó la monta dirigida (mañana y tarde). A los 17 ± 1 día se realizó nuevamente la detección del estro para obtener el porcentaje de repetición de celos. Todas las ovejas de los tres grupos presentaron celo. Respecto al porcentaje de no retorno a celo, las ovejas con esponja Chronogest obtuvieron el 73%, las ovejas con esponja casera el 65% y las ovejas con esponja FGA el 63%, sin diferenciarse estadísticamente ($p>0.05$). En conclusión, el uso de una esponja de elaboración artesanal para la inducción del celo en ovejas fue tan efectivo como las dos esponjas comerciales en la presentación del celo.

Inducción de estro, Esponja intravaginal, Ovejas, FGA

1 Introduction

Lamb meat in Mexico is mainly consumed in the form of barbacoa and mixiote, typical dishes from the central region of the country (Martínez *et al.*, 2011). Among the main sheep meat producers, the State of Mexico stands out nationally. Per capita consumption of sheep meat is estimated between 0.800 and 1.0 kg and imports approximately 10,379 tons (SAGARPA, 2017; Valadez *et al.*, 2020) from New Zealand and Australia, where they have production subsidies and large forage extensions superior in quantity and quality with respect to the Mexican ones (Bobadilla-Soto *et al.*, 2017; Valadez *et al.*, 2020).

The need to supply the demand for sheep meat makes the search for production alternatives, one of these alternatives is reproductive biotechnologies.

Sheep are seasonal polyestrous, which means that their reproductive behavior is linked to the time of year, with photoperiod being the main environmental factor that influences the onset or cessation of reproductive activity; therefore, there is a reproductive period during short days and an anestrus period when the length of the day is longer, which affects production (Porrás *et al.*, 2003). The induction of estrus and ovulation in ewes consists of the use of effective and easily applicable pharmacological methods (Lozano *et al.*, 2012), which allow manipulating the reproductive physiology of ewes, allowing the implementation of reproductive programs and optimizing production and reproduction (Córdova-Izquierdo *et al.*, 2008).

There are two situations in which exogenous hormone treatments can be applied: the first is when ewes are in anestrus and their ovaries are not active, generally this occurs in the months of March, April and May in all breeds, therefore, estrus or oestrus is induced.

The usefulness of inducing estrus is to have lambs at times when there are generally no births, reducing the interval between lambing ewes and increasing the number of offspring born. The second situation is when the ewes are in the reproductive season, therefore, their ovaries are active and the ewes present estrus every 17 days, in this case the hormonal treatment only groups the presentation of estrus, that is, synchronizes estrus, which allows having groups of ewes of similar reproductive status and the use of technologies such as artificial insemination or embryo transfer (Trejo, 2016). The most commonly used methods for induction and/or synchronization of estrus and stimulation of follicular growth in ewes include prostaglandins, progesterone, progestogens and intramuscular administration of equine chorionic gonadotropin (eCG). The use of progestogens is the simplest artificial method to induce estrous behavior and ovulation in ewes, since it mimics the presence of a corpus luteum of a natural estrous cycle (Mejia, 2019). The synchronization of the estrous cycle associated with artificial insemination schemes, constitute a useful tool to improve reproductive efficiency, flock productivity, concentrate lambing at pre-established times, favor the spread of specific genotypes and improve flock genetics (González-Stagnaro, 1993). In rural production systems with low technology, synchronization is not applied due to the low availability of the products, mainly because of the cost, since these are imported products and have high costs, which makes their acquisition difficult for producers.

2 Material and Methods

The research was conducted in a Livestock Production Unit located in the municipality of Tihuatlán, Veracruz, which is located in the northern part of the state at coordinates 18° 27' north latitude and 96° 21' west longitude at an altitude of 60 meters above sea level. Its climate is warm-regular, with an average annual temperature of 22°C; its average annual rainfall is 1,076.2 mm (INEGI, 2015).

Sixty hybrid ewes (*Katahdin x Pelibuey*), multiparous, with body condition of 3 on a scale of 0-5 (Russel et al., 1969) were used. All were fed wet orange silage (2.7 kg daily), 2 kg of hayed insurgent grass (*Brachiaria brizanta*) and 0.5 kg of balanced feed at 18% crude protein and water at free access. The ewes were divided proportionally into three groups: the first group (n=20) was given a commercial sponge, Chronogest CR®, a controlled-release sponge containing 20 mg of cronolone. The second group (n=20) was inserted with a commercial sponge, FGA-30, an intravaginal sponge containing 40 mg of fluorogestone acetate (FGA). The third group (n=20) was inserted with a handmade sponge, made of polyurethane, measuring 4 cm wide by 3 cm high, sterilized and impregnated with 20 mg of progesterone (Progesterona®).

The induction protocol for the three groups lasted 12 days, considering the day of application as day 0. On day 10, 300 IU of equine chorionic gonadotropin (eCG; Novormon 5000®) were applied to each ewe and on day 12 the sponge was removed. Oestrus detection was performed 24 hours after sponge removal, in the morning and afternoon, using a male covered with an apron. Once estrus was detected, directed mating was performed with previously evaluated males.

To determine the percentage of females that did not repeat estrus, at 17±1 days after directed mating, estrus detection was performed again with a male covered with an apron. Statistical analysis was performed using the SPSS 24 for MAC statistical package (IBM SPSS, 2016). The variable hours of estrus presentation was analyzed with the univariate general linear model and differences between means were analyzed using Tukey's test. The variables percentage of estrus presentation and percentage of non-return to estrus were analyzed using the Chi-squared test. The significance level considered was $p < 0.05$.

3 Results

According to the results obtained, it was demonstrated that the use of handmade intravaginal sponges for the induction of estrus in hair ewes was as effective as the use of commercial sponges, since 100% of the ewes of the 3 treatments presented estrus, however, in the time of estrus presentation statistically significant differences were observed ($P < 0.05$) among the treatments, the ewes with Chronogest CR commercial sponge presented estrus in less time (29.62 ± 1.45 hours after the removal of the intravaginal sponge) with respect to the ewes of the group with handmade sponge that presented estrus at 30.94 ± 1.94 hours, while the ewes with FGA commercial sponge did not present differences with the two previous protocols by presenting estrus at 30.21 ± 1.11 hours (Table 8.1).

Table 8.1 Hours of estrus presentation (mean \pm standard deviation) after intravaginal sponge removal in ewes with estrus induction. Different literals in the column indicate statistical difference ($P < 0.05$)

Group	Oestrus presentation times
Chronogest CR	29.62 \pm 1.45 ^a
FGA	30.21 \pm 1.11 ^{ab}
Handmade	30.94 \pm 1.94 ^b

In the variable rate of non-return to estrus, the Chronogest group had the highest percentage of ewes that did not return to estrus (73%), and the FGA commercial sponge group had the lowest percentage (65%), while the handmade sponge group had 68% of ewes that did not return to estrus, with no statistically significant differences between the groups.

4 Discussion

In this study, 100% of the ewes presented estrus, both the ewes in the groups with commercial sponges and the group with handmade sponges with 20 mg of progesterone, which means that the homemade sponges are as effective for estrus induction in hair sheep as the commercial sponges. The results obtained in the groups with commercial sponges coincide with Martinez et al. (Similarly, Córdova-Izquierdo *et al.* 2007) who performed an estrus synchronization protocol with intravaginal sponges impregnated with 65 mg of medroxyprogesterone acetate (MPA) for 12 days and application of 200 U. I of eCG 48 h before removal of the sponges during the low fertility period (March-April) and under tropical climate conditions in Mexico, also reported 100% estrus presentation during the first 72 hours after removal of the sponges. (1999) obtained a 100% response when synchronizing Creole ewes in the months of May-June, i.e., during the seasonal anestrus period, by using sponges impregnated with 30 mg of FGA and application of 460 IU of pregnant mare serum gonadotropin. Likewise, Cruz (2018) when comparing a long protocol of 12 days and a short protocol of 6 days in the months of March-April with polyurethane sponge with 20 mg of chronolone (Chronogest CR®), 100% of the ewes in both groups presented estrus.

Regarding the time of estrus presentation after the removal of the intravaginal sponge, statistically significant differences were found between the commercial Chronogest sponge and the handmade sponge; ewes with commercial sponge presented estrus at 29.62 \pm 1.45 h and ewes with handmade sponge came into estrus at 30.94 \pm 1.94 h, being normal in both cases, since the manifestations of estrus can start from 20 hours after removal of the device and take place, on average, between 30 to 36 hours (González et al., 2010). Cruz, (2018) obtained similar results when using the polyurethane sponge with 20 mg of cronolone (Chronogest CR®), recording estrus behavior 30.31 \pm 0.5 after device removal.

The percentage of ewes that did not return to estrus was higher in the protocol with the Chronogest sponge 73%, followed by the handmade sponge with 65% and FGA with 63%, without statistical differences. Martinez et al. (2007) obtained a gestation percentage of 66.6% when using a 12-day protocol with 65 mg of medroxyprogesterone acetate and the application of 200 I.U. of eCG. In contrast to what was obtained by Perez, (2015) who obtained a gestation percentage of 78.95% when using a 12-day long protocol with FGA and 500 IU of eCG considering that this study was carried out during the reproductive season. In relation to the results obtained in the percentage of non-return Ishida et al. (1999) mentioned that generally the gestation percentages of estrus induced during the low fertility period are lower (40-60%) than those induced during the reproductive period. In the same way Ungerfeld and Rubianes, (1999) and Viñoles (2011) agree that fertility results improve when short treatments of 6 days duration are applied with respect to long treatments, both in seasonal anestrus and in the reproductive season.

5 Conclusion

Handmade sponges impregnated with 20 mg of progesterone are a viable alternative for the induction of estrus in hair sheep by obtaining a level of response comparable to commercial sponges in estrus presentation and fertility.

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