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Synchronization Of The Estrus Of Algerian Local Breed Goats: Reproductive Parameters Assessment And Effectiveness Of Using Vaginal Sponges With Fluorogestone Acetate Or Norgestomet Ear Implants

Nosiba Sulaiman Basher[1a] Takfarinas Idres[2b*], Nasir Adam Ibrahim[1c], Sofiane Boudjellaba[3d], Assia Derguini[4e], Mohammed Saad Aleissa[1f]

[1] Imam Mohammad Ibn Saud Islamic University (IMSIU), College of Science, Biology Department, 11623, Riyadh, SAUDI ARABIA

[2] Rabie Bouchama National Veterinary School of Algiers, Laboratory for Livestock Animal Production and Health Research, 16059, Algiers, ALGERIA

[3] Rabie Bouchama National Veterinary School of Algiers, Research Laboratory for Management of Local Animal Resources, 16059, Algiers, ALGERIA

[4] Abderrahmane MIRA University, Department of Microbiology, Microbial Ecology Laboratory, FSNV, 06000, Béjaïa, ALGERIA.

ORCID's: [a] 0000-0001-8814-5957; [b] 0000-0003-2519-4596; [c] 0000-0001-6382-8807; [d] 0000-0002-7563-5559; [e] 0009-0009-1040-1530; [f] 0000-0003-0118-414X

***Corresponding author**: Prince Faycal City, Riyad 12478, Saudi Arabia

E-mail: t.idres@ensv.dz

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Abstract

The effectiveness of the synchronization and the pic of the luteinizing hormone with various progestagens and routes of application was assessed in two experiments in which goats have received one of the following three progestagens protocols treatment: 1 : vaginal sponge soaked with 45 mg of fluorogestone acetate, 2. a half subcutaneous implant, 3. a whole ear implant concentrated at 3 mg of Norgestomet. In the experiment 1, we assessed the onset of estrous manifestations, the occurrence of the preovulatory peak of luteinizing hormone as well as the percentage of ovulation occurrence after the synchronization treatment of the estrous cycles of 234 cyclic goats. In the experiment2, 340 non-cycled goats were tested to determine the time of onset of estrous manifestations, the percentage of ovulation, of fertility as well as the rate of prolificity after the induction of estrus and the use of artificial insemination with frozen sperm-thawed 24 hours after the onset of estrous manifestations. The interval between the onset of estrus and the occurrence of the preovulatory peak of LH was significantly variable in goats that received half an implant of norgestomet. To conclude, the synchronization of the estrous cycles by means of implants or semi-implants of norgestomet does not seem to reduce the variability of the appearance of the estrous manifestations either the preovulatory peak of the luteinizing hormone.

Key words: Goat arabia; Implants Norgestomet; Peak LH; Sponges FGA; Synchronisation of the estrus.

Introduction

The synchronization of estrus in goats in Algeria as well as worldwide, offers interesting advantages in livesatock and economy (Adaouri *et al.*, 2022). It allows to inseminate the animals at a predetermined time once the treatment ends, it also allows a better optimization of the breeding management regarding the availability and abundance of forage resources (Idres et al 2019) The hormonal induction and synchronization of estrus are used as the initial tool for the biotechnology of reproduction in general, and for insemination (AI) in particular (Abecia et al 2012). These methods are designed to reduce the impact of seasonality on goat farming and to increase productivity (Fatet et al 2011). The method most widely used to synchronize estrus in small ruminants is the method of soaked vaginal sponges with (Fluorogestone) in combination with injections of eCG (chorionic gonadotropin) and prostaglandin analogue (cloprostenol) performed 48 hours prior to the vaginal sponges removal (Swelum et al 2015).

The use of this method of treatment has led to the fact that the fertility rate often exceeds 60 % after a single exocervix artificial insemination (AI) using frozen spermatozoa-thawed at a predetermined time after the end of the treatment (López-Sebastian et al 2007). But in some cases a low fertility rate is postponed, and it has recently been reported that this could be due to the variable moments in the appearance of estrus (Habeeb and Anne Kutzler, 2021). In some goat populations, this delay is associated with the appearance of antibodies on the ECG side directed against various hormonal drugs (Titi et al 2010). However, some animals (kids and adults) treated for the first time may also have significant differences in the timing of the onset of estrus, suggesting that factors other than the presence of antibodies eCG may influence the response to protocol for synchronization of estrus (Amiridis and Cseh, 2012).

The effectiveness of the implants of norgistomt and FGA vaginal sponges in the programs of estrus synchronization in the goat has already been compared previously (Abecia et al 2012; Fatet et al 2011; Thatcher et al 2001). However, in these experiments, the implants used are different from those available in Europe : implants with a matrix of polymethyl contains 6 milligrams of norgestomet, versus implants with silicon die containing 3 milligrams of norgestomet. In addition, the fertility of goats after artificial insemination (AI) has been obtained from a small number of animals and the data on the time of estrus onset is insufficient, it is therefore impossible to know if this method allows effective goats insemination at a predetermined time (Al Yacoub et al 2011) .

Thus, the objective of the present study was to evaluate the effectiveness of two doses of norgestomet transported in ear implants and to compare them with the effectiveness of vaginal sponges soaked in fluorogestone acetate in the synchronization of estrous cycles and the appearance of peaks of luteinizing hormone LH, as well as in the fertility and prolificity rates after AI in Algerian Arabic local goats breed.

Materials And Methods

Experiment 1:

This trial was designed to assess the effectiveness of different therapies progestagen-only in terms of the efficiency of estrus synchronization and the onset of the peak of LH, as well as the rate of ovulation.

In this experiment, two hundred thirty-four adult goats non-lactating (aged 3 to 8 years of age) of Algerian Arabia local breed were used. The cyclicity of goats, was confirmed by ultrasound imaging by monitor the structures follicular and luteal structures on the ovaries. These goats used in this experiment were divided, according to their age, in any of the three 11 days progesterone protocol groups.

The first group received vaginal sponge dosed with 45 mg of fluorogestone acetate. For the other goats, they were placed either half of a Norgestomet ear implant (1.5mg) (n = 88), or a whole implant (n = 78) impregnated with 3 mg of norgestomet (Crestard, Internet, Angers, France).

Half of the implants (0.2 cm in diameter and 1.5 cm in length) and all the implants (0.2 cm in diameter and 3 cm in length) were inserted subcutaneously into the external and superior region of ear using an implant device provided by the manufacturer. All the goats have also received an intramuscular injection of 400 IU eCG (Chrono-gest, Intervet, Angers, France) and 50 µg of cloprostenol (Estromat, Pitman Moore, Meaux, France) 48 hours prior to the removal of the implant. The implants and semi-implants have been removed through the initial point of insertion, by slight pressure after a small surgical incision.

The time of onset of estrus (day 0) was determined by monitoring the reaction of the goat to vasectomized buck each 4 hours, 12 to 60 hours after removal of the implant ear. The goats were defined as in estrus if they if they adopt the characteristic position of acceptance of the overlapping. To determine the preovulatory peak time of LH, blood samples were collected in tubes containing heparin every 4 hours during the first 24 hours, at the beginning of the estrus. After centrifugation, the plasma was collected and frozen at -20° C before being tested by radioimmunoassay (Pelletier et al 1982). The number of ovulating goats and the ovulation

rate were determined by laparoscopy performed 5 or 6 days after the estrus synchronization (Menchaca and Rubianes, 2004; Amiridis and Cseh, 2012)

Experiment 2:

In this trial, the efficacy of three treatment protocols previously described for the induction and synchronization of estrus and in association with treatment with progesterone was compared in lactating goats ; The fertility and the prolificity rates of goats after AI were also compared.

The experiment was conducted in four flocks of Algerian Arabia local breed adult lactating goats (2 to 8 years old) (n = 91, n = 64, n = 96, n = 89). At the beginning of the treatment, it was confirmed that all the goats in anoestrus phase by the absence of progesterone in two serum samples taken a week apart. The dose of injected eCG is adjusted according to the daily quantity of milk production (400 or 500 IU of goats, of a capacity of less than 1.5 kg or greater than or equal to 1.5 kg, respectively).

The goats were bred by extracervicale artificial insemination with 100 10^6 spermatozoa in frozen-thawed straws 24 hours after the beginning of estrus behavior is defined as in experiment 1. The sperm of three males are equally distributed among the treatment groups.

The number of ovulating goats and the fertility rate (the number of goats pregnant/number of goats treated) were estimated using a semi-quantitative progesterone essay in collected blood samples, respectively, 5 or 6 days and 21 or 22 days after the observation of estrus behavior (day 0). Fertility has been confirmed 45 or 46 days after the estrus by ultrasound and the birth of the kids. Fertility (number of kids born)/(number of goats kidding) was also reported.

Analysis of data

The proportions of goats in estrus, ovulation of goats, and the pregnancy rate were analyzed using the method of chi-square. Analysis of variance was used to compare the average time to onset of estrus and fertility rates between treatment groups (Markechová et al 2011). To

compare the timing of estrus and the highest point, the criterion of Kolmogorov-Smirnov was used, which compared the cumulative frequency of events in (Schultz, 2010) .

Results

In Experiment 1, a single goat, who has lost its half-ear implant and was de facto eliminated from the study. Almost all goats entered into estrus and ovulated and had no significant difference in the group of progestagen treatments (Table 1).

The appearance of estrous manifestations as well as the peak of LH were reported earlier ($P < 0.05$) in females who received a half implant compared to goats who were treated with vaginal sponges of fluorogestone acetates. The results obtained in the group of goats that received a whole implant, for these parameters, were not significantly different from those noted in the group of goats treated with a vaginal sponge or a half implant of norgestomet. The timing of the appearance of estrus was no different in the group of progestin treatments.

However, it should be noted that the interval between the onset of estrus and the preovulatory peak of luteinizing hormone was more variable ($P < 0.05$) in goats treated with semi-implant in comparison to those treated with a sponge or an implant. The ovulation rate was not influenced by the treatment with the progestagen.

Table 1. *Response of goats after estrus synchronization with the FGA vaginal sponges or implants and a half-implant of norgestomet (Expeperiment 1)*

Groups of traitement	Number of goats	% of goats		Interval (h) [1]			Rate of ovulation [1]
		In estrus	Have ovulated	PR—OE [2]	OE—LH - [3]	PR—LH [4]	
Sponge vaginales	34	97.1	94.1	33.0 [has] -6.6	13.7 [a] - 5.0	to 45.0 [has] -5.6	1.8 d-0.8
Half-implant	43	97.8	95.3	27.8 [b] -5.0	10.2 [b] -8.2	37,8[b] -10.3	1.7 j-0.8
Implant integer	39	97.4	94.9	31.2 [(a-b] -7.5	12.2 [a-b] -6.9	43.0 [a-b] - 7.9	1.7J0.8

The values in a column with different superscripts are significantly different (I' < 0.05).

[1] **Mean ± SD.**

[2] **Withdrawal of Progestagen - the onset of estrus.**

[3] **The onset of theoestrus - peak of LH.**

' **Withdrawal of Progestagen – LH peak**.

In Experiment 2, as in the first experiment, the goats that lost their progestagen (n = 5 half-implants and n =3 whole implant) were removed from the analysis of data. As no effect of herd has been observed, all data were grouped for further analysis.

In this experiment, most of the goats entered into estrus regardless of the progestagen protocol. The percentage of goats that ovulated was higher (P < 0.05) in goats treated with a vaginal sponge compared to those who received a half-implants. Neither the time nor the variability of the onset of the oestrus has been influenced by progestagen treatment (Table 2). The fertility rate was significantly higher (P < 0.05) for goats that received a vaginal sponge in comparison to those treated with a half norgestomet implant. Le rate of prolificacy was not affected by the treatment (Table 2).

Table 2. *Parameters of reproduction after estrus synchronization with FGA vaginal sponge or implants and a half-implant of norgestomet (Expeperiment 2)*

Treatment groups	N° goats	% of goats		Interval (hours)[1] PR-OE[2]	Fertility at :			prolificity[1]
		In œstrus	With ovule		Day 21/22	Day 45/46	New-nes	
Sponge vaginal	56	98,2	98,2 ^{was}	23.4±7.3	83.9 ^{has}	76.8 ^{a}	75.0 ^{a}	1.9±0.8
Half-implant	55	98.2	81.8 ^{b}	22.3 ±7.3	49.1 ^{b}	47.3 ^{b}	45.5 ^{b}	1.8 ±0.8
Implant entier	51	96.1	86,3 $^{a-b}$	24.7±7.7	66.7 $^{a-b}$	62.7 ^{b}	58.8 ^{b}	l. 9±0.8

The values in a column with different superscripts are significantly different *at P <* 0.05).

[1] **Mean ± SD.**

[2] **Withdrawal of Progestagen - the onset of estrus.**

The results obtained for goats treated with an implant, for all the parameters studied, were not different from those observed after the vaginal sponge or half-implant treatment groups. (Table 2).

Discussion

The main aim of the present work was to evaluate whether the variability over time of the estrus onset and the preovulatory peak of LH observed after the application of vaginal sponges impregnated with FGA could be reduced by the variation in the level of progestagen (norgestomet) and the route of administration (subcutaneous implant). In both experiments, the variability in the time of onset of estrus was similar, irrespective of the treatment. But the time of preovulatory peak of the LH was more variable ($pH < 0.05$) in goats treated with half of the norgestomet implant compared to those who received a FGA vaginal sponge or the whole implant. In sheep, it has already been documented an increase in the variability of the response with a decrease in the dose of progestagen to the beginning of the estrus (Pellicer-Rubio et al 2016; Swelum et al 2015), but not for the peak of luteinizing hormone (Habeeb and Anne Kutzler, 2021).

The second objective of the study was to evaluate the effectiveness of different treatments used to induce and synchronize the estral cycle. Almost all the goats treated, regardless of the dose and/or the nature of the progestagen, undergo oestrus. The high rate of occurrence of estrus is of the order of the observed when vaginal sponges impregnated with FGA (Habeeb and Anne Kutzler, 2021) or medroxyprogesterone (Knights and Singh-Knights, 2016), norgestomet (Swelum et al 2015)implants or semi-implants (Habeeb & Anne Kutzler, 2021; Thatcher et al 2001) or progesterone impregnated CIDR (Knights and Singh-Knights, 2016) were used.

Among the treatment groups in experiment 1, no difference in the frequency of ovulating goats has been observed, but in experiment 2, ovulation occurred in a lower percentage of

goats treated with a semi-implant compared to those treated with a FGA vaginal sponge ($p < 0.05$) in goats treated with an implant the decrease was not statistically significant. In the first experiment, cyclic and non-cyclic goats where treated, while experiment 2 lactating goats where treated during the non-breeding season. Thus, in the second experiment, two other factors have been reported to reduce the effectiveness of the estrus synchronization synchronous (Whitley and Jackson, 2004). This could explain the significant difference between the two experiences.

In practice, the main consequence is a reduction in the fertility of goats receiving semi-implants compared to goats treated with vaginal sponges (45,5%, respectively, versus 75,0%; $p < 0.05$). In goats that received the whole implant, the reduced fertility is insignificant. These observations contrast previous data obtained after the overlap of the temperatures with the norgestomet, where fertility rates are high, have been reported (East and Rowe, 1989). This difference can perhaps be explained by the method of reproduction: natural, twice a day during the estrus in the latter case, compared to the artificial insemination with spermatozoa frozen in our experience. A decrease of fertility has already been reported after the control of the estrus synchronization when the dose of progestagen was too much high (Freitas et al 1997), or the duration of the treatment is too long (López-Sebastian et al 2007; Menchaca & Rubianes, 2004), but these explanations are not relevant to the presentation of the data. The fertility of goats treated may also be low if the artificial insemination is not applied at the same time (Amiridis & Cseh, 2012; López-Sebastian et al 2007); in this study, the goats of each of the treated groups were inseminated in a similar manner shortly after the beginning of estrus. Therefore, we must assume that ovulation does not occur during the same time period after the beginning of estrus. In this regard, we noted that the time interval between the peak and the estrus is 3 hours shorter, and the oscillation frequency after the use of the semi-implants are higher than after the use of vaginal sponges. It may be that such a change in the interval between estrus onset and the peak of luteinizing hormone may reduce fertility, as in the current experiment, by changing the time of ovulation.

In conclusion, the comparison with the recorded data after FGA treatment, synchronization of estrus with a norgestomet implant or semi-implant did not reduce the variability in the occurrence of estrus and preovulatory LH peak. In addition, according to AI, depending on

the onset of estrus, fertility tends to be lower in animals treated with the entire implant and was significantly reduced in goats that received a half implant.

Informed Consent Statement:

The abovementioned project use of animals has been revised and approved by the University " "Animal-Welfare committee Body" according to University regulation, the project was reported to the Ministry of education of Saudi Arabia, which granted approval under the implied consent rule.

Data Availability Statement:

The data presented in this study are available within the article. Raw data supporting this study are available from the corresponding author upon reasonable request.

Conflict of interest statement

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

Animal Rights Statement:

The authors certify that animals were handled in accordance with local Ethical Committee laws and regulations concerning animal welfare rules.

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