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THE USE OF PROGESTAGENS TO CONTROL THE OESTROUS CYCLE OF THE DAIRY GOAT

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SUMMARY

Seasonal reproduction in the European dairy goat is very marked.

During the breeding season, satisfactory synchronization of oestrus may be obtained with 45 mg FGA vaginal sponges when PMSG is injected at the end of an 18-21 day treatment. The treated females are systematically inseminated without oestrus detection, using liquid or frozen semen and provided adequate numbers of motile sperm are used, fertility is also satisfactory.

During the non-breeding season, PMSG is injected 48 ± 2 hours before the vaginal sponge is removed. Synchronization of oestrus is satisfactory but post-treatment fertility is severely reduced by seasonal and milking anoestrus. However, the effects of both types of anoestrus may be overcome by using relatively large numbers of motile sperm. This is possible when liquid semen is used.

Since it is impossible to deep freeze highly concentrated buck semen owing to the adverse effect of seminal plasma on post-thawing survival of spermatozoa, semen has been preserved, devoid of seminal plasma. Preliminary results indicate that washing, under proper conditions, does not alter the fertilizing capacity of spermatozoa and does improve post-thawing survival of sperm in highly concentrated semen.

Fertilizing capacity of such deep frozen semen is at present being tested in synchronized animals.

Preliminary fertility results are also given in a comparison between a long and a short lasting progesterone treatment.

INTRODUCTION

An important factor in discussing the use of progestagens for the control of the oestrous cycle in the dairy goat is the marked seasonal reproduction, characteristic of the French breeds. For progestagen treatments to be effective, the

different problems which arise during the breeding season and in seasonal anoestrus, must be taken into account. This paper discusses these problems and the solutions proposed to overcome them, in terms of artificial insemination and oestrus control.

I. — THE BREEDING SEASON OF THE FRENCH DAIRY GOAT

In a single flock, ovarian activity and behavioural oestrus are observed only in late summer and throughout the autumn, after several months of complete sexual rest. This is indicated by the percentage of females having ovulations and/or showing behavioural oestrus in each month over a one year period (fig. 1). At the onset of

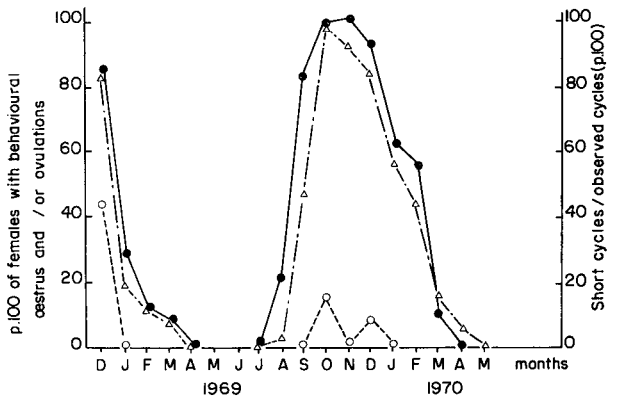

FIG. 1. — *Seasonal variations in the frequencies of behavioural oestrus* (△ — · — △ : normal cycles ; ○ - - - - - ○ : short cycles) *and ovulation* (● ——— ●) *in the french* Alpine Goat (COGNIE, 1970)

the breeding season, ovarian cycles resume in 90 p. 100 of the females, while oestrous behaviour re-appears in all females in no longer than six weeks (COGNIE, 1970). However, there are highly significant differences among flocks in the average date of onset of the breeding season (CORTEEL, 1969 ; LAHIRIGOYEN, 1973).

In a large population, it is three months before 95 p. 100 of females have shown behavioural oestrus for the first time. This is shown indirectly by the monthly frequency of first inseminations in the breeding season, since the large majority of goats are inseminated during the first oestrous cycle of the season (fig. 2 ; CORTEEL, 1971).

In spite of the flock effect which disperses the resumption of sexual activity, French dairy goats are highly seasonal breeders.

II. — OESTRUS CONTROL BY MEANS OF PROGESTAGENS AND PMSG

A. — *During the breeding season*

Only two progestagens have been widely used to control the oestrous cycle of the goat during the breeding season : MAP and FGA.

MAP has been given orally (LYNGSET, AAMDAL and WELLE, 1965) or administered by the vaginal route (COGNIE and CORTEEL, 1970 ; MINOTAKIS *et al.*, 1972). FGA has been administered exclusively by the vaginal route (BARKER, 1966 ; VLACHOS, TSAKALOF and VLACHOS, 1966 ; CORTEEL *et al.*, 1967, 1968, 1972, 1974).

Both progestagens appear to be effective inhibitors of the oestrous cycle. The subsequent synchronization of oestrus and post-treatment fertility are satisfactory provided adequate doses of gonadotrophic hormones (PMSG and/or HCG) are administered when the treatment ceases (CORTEEL *et al.*, 1967 ; DHINSDA, HOVERSLAND and METCALFE, 1969, 1971 ; MINOTAKIS *et al.*, 1972).

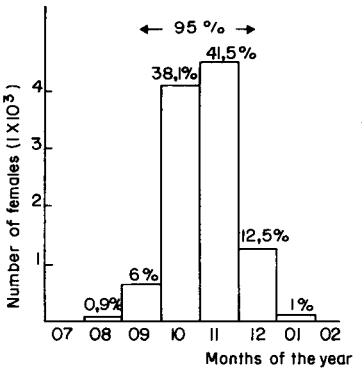

FIG. 2. — *Numbers of females inseminated for the first time in the year over a ten year period* (CORTEEL, 1971).

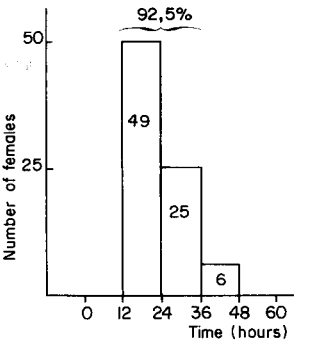

FIG. 3. — *Oestrus synchronisation during the breeding season : time between sponge removal and onset of oestrus.*

We will summarize here, results obtained with vaginal sponges impregnated with 45 mg FGA, left in place for 18 to 21 days, 400 IU PMSG being injected at sponge removal. Synchronized oestrus is shown by 95 p. 100 of treated females, 92.5 p. 100 of these coming into oestrus within a 24-hour period beginning 12 hours after sponge removal (fig. 3). Post-treatment fertility is expressed as the percentage of treated goats inseminated on a fixed time basis actually kidding (table 1).

TABLE I

Post treatment fertility during the breeding season. Liquid vs. deep frozen semen

Sponges removed at	Time from sponge removal to 1rst and 2nd AI (hours)		Sperm stored as	Numbers of motile sperm per œstrus	Kidding p. 100 ( ) : number of females	
09.00 A.M.	31	55	liquid semen	100 to 200 (10^6)	55.8 (640)	
09.00 A.M.	31	55	deep frozen	40 to 120 (10^6)	55.8 (448)	56.8 (769)
06.00 P.M.	36	60	deep frozen	40 to 120 (10^6)	58.3 (321)	

A single AI timing has been used for liquid semen : the sponge is removed in the morning, the first insemination is performed in the afternoon of the following day, and the second insemination 24 hours later. The same timing has been used for deep-frozen semen, and compared with another procedure in which the sponge is removed in the afternoon, the first insemination is done two days later in the morning and the second insemination 24 hours after the first.

Post-treatment fertility is the same whether liquid or deepfrozen semen is used. In the latter case, both AI timings are followed by equivalent fertility rates, but post-treatment fertility decreases with decreasing numbers of inseminated motile sperm (table 2).

TABLE 2

Post treatment fertility during the breeding season. Deep frozen semen. Effect of motile sperm numbers per induced oestrus

( ) : Numbers of females

Mean numbers of motile sperm (10^6)	120	80	40
Inseminate volume (ml)	0.5	0.2	0.2
Kidding percentages	65.2 (322)	54.0 (517)	42.5 (80)

B. — *Before the breeding season*

Experimental data (CORTEEL *et al.*, 1968) have led us to modify the time of PMSG injection before the breeding season. Then, PMSG is injected 48 hours before the sponge is removed. Oestrus is induced in nearly 100 p. 100 of treated females, and in 84 p. 100 of these, oestrus occurs in a 24-hour period beginning 12 hours after sponge removal (fig. 4).

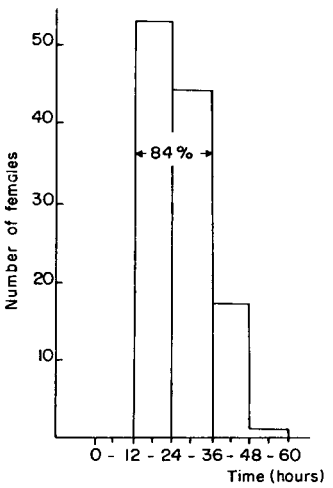

FIG. 4. — *Oestrus induction before the breeding season : time between sponge removal and onset of oestrus*

Post-treatment fertility has been measured under standard and varying AI conditions.

1. *Under standard AI conditions.*

All females are inseminated according to the AI timming indicated for liquid semen during the breeding season, and liquid semen is also used (around 200 million motile sperm per female).

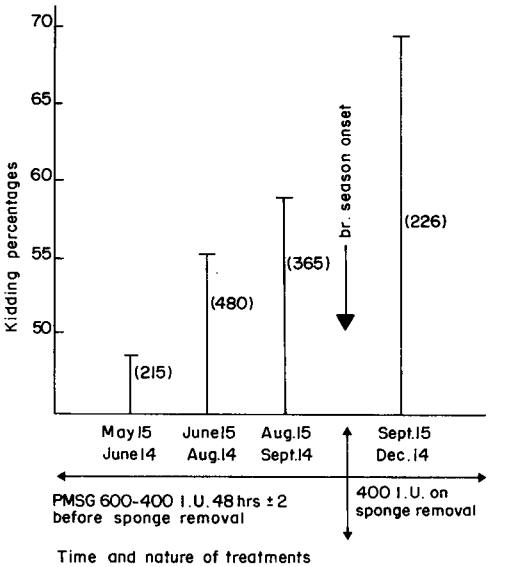

FIG. 5. — *Fertility* (kidding p. 100) *of synchronized goats before and after the onset of the breeding season* (liquid semen)
( ) : Number of females

Figure 5 indicates that post-treatment fertility increases as the breeding season approaches. Obviously it may be said that seasonal anoestrus is one of the limiting factors of post-treatment fertility. For a given period of treatment, post-treatment fertility also increases with time from parturition to beginning of treatment (fig. 6). It is clear that milking anoestrus is another limiting factor of post-treatment fertility.

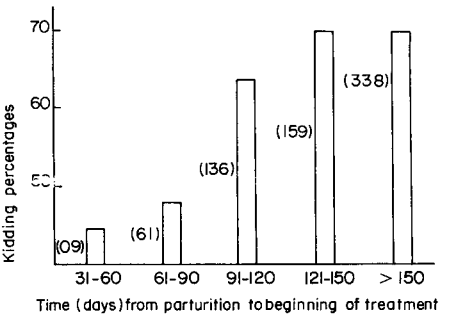

FIG. 6 — *Effect of lactation on post-treatment fertility* (liquid semen)
( ) : Number of females

2. *Under varying AI conditions.*

Females producing significantly different quantities of milk are inseminated with different numbers of motile sperm (table 3). When small numbers of motile sperm are used, high milk yields severely depress post-treatment fertility. With increased sperm numbers, the milk effect disappears. When motile sperm numbers are raised again, it seems that the depressive effect of seasonal anoestrus on fertility also disappears.

TABLE 3

Post-treatment fertility according to milk production and numbers of motile sperm inseminated
( ) : Number of females. Anoestrus period

Milk produced in the year of treatment (kg)	Numbers of inseminated motile sperm (1×10^6)			
	2×25 (DFS) 2×40 (1)	2×75 (LS) 2×100 (1)	2×150 (LS) 2×185 (1)	Sperm effect
< 600	50.0 (112)	48.7 (158)	77.8 (9)	$p < 0.05$
600-799	34.3 (108)	58.9 (95)	85.7 (14)	$p < 0.01$
$\geqslant 800$	22.4 (76)	52.5 (40)	76.5 (17)	$p < 0.01$
Milk effect	$p < 0.01$	$p > 0.05$	$p > 0.05$	$p < 0.001$

DFS = deep frozen semen, LS = liquid semen.
(1) Kidding percentages.

As previously mentioned for the breeding season, numbers of inseminated motile sperm play a decisive role in post-treatment fertility (table 4).

TABLE 4

Post-treatment fertility before the breeding season : relationship between numbers of motile sperm inseminated and conception rates

Mean numbers of motile sperm/oestrus	65 (10^6) (1)	175 (2)	335 (2)
Conception rates	40.5	52.5	80.0
Number of females	(296)	(293)	(40)

(1) Kidding percentages (deep frozen semen).
(2) — — (liquid semen).

III. — EXPERIMENTAL APPROACHES FOR RAISING FERTILITY BEFORE THE BREEDING SEASON

A. — *Fertility may be raised by increasing the numbers of inseminated motile sperm*

It is possible to do this by using semen at a higher concentration of 500 million sperm per ml in liquid semen, which cannot be stored for longer than 12 hours at this concentration. In the past few years, we have never been able to deep-freeze successfully such highly concentrated goat semen. This is probably why we have never succeeded in obtaining a satisfactory post-treatment fertility when deep-frozen semen has been used before the breeding season. An experimental approach is in progress to deep-freeze highly concentrated semen. Experimental data (CORTEEL, 1974) led us to suspect an adverse effect of seminal plasma on post-freezing and -thawing survival of goat sperm, so we have deep-frozen semen devoid of seminal plasma.

By washing the seminal plasma from the semen, *in vitro* survival of goat spermatazoa is significantly improved before and after deep-freezing. Figure 7 indicates the estimated percentages of motile sperm and motility ratings following glycerol addition (A), upon thawing (B) and two hours later, thawed semen being incubated at 37°C (C). The favorable effect of washing is such that it increases by three times, the percentage of deep-frozen-thawed ejaculates suitable for insemination in terms of motile sperm and motility after 2 hours of incubation : 23.2 p. 100 vs 70.0 p. 100 in unwashed and twice-washed semen respectively ($P < 0.01$).

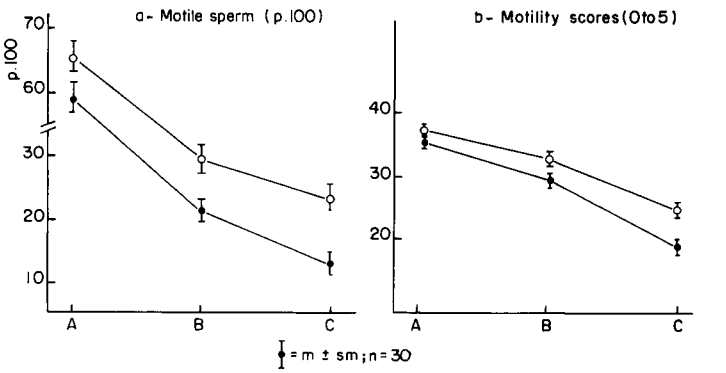

FIG. 7. — In vitro *survival of un-* (●———●) *and twice washed* (○———○) *goat sperm after glycerol addition* (A), *Upon thawing* (B) *and after two hours of incubation* (C). *Split ejaculates*

Measurement of the fertilizing capacity of twice-washed spermatazoa is in progress. Preliminary results indicate that double washing does not alter the fertilizing capacity of goat spermatazoa in liquid semen : the conception rates

indicated in table 5 do not differ significantly. The sa meis true for doublewashed semen deep-frozen at a dilution of 300 million sperm per ml and used in untreated goats. Twice-washed deep-frozen semen containing 500 million sperm per ml is at present being tested in synchronized animals.

TABLE 5

Post-treatment fertility before and during the breeding season : fertilizing capacity of un-and twice-washed he-goat spermatozoa

(Liquid semen. Split ejaculates. 400 × 10^6 total spz./oestrus)

	Kidding percentages	Number of females	Statistical difference
Un-washed spz.	60.4 %	48	P > 0.05
Twice-washed spz.	64.0 %	50	

Thus, it is reasonable to think that subfertility may be overcome by adapting AI conditions to the synchronizing treatment. The other approach is to modify the synchronizing treatment itself.

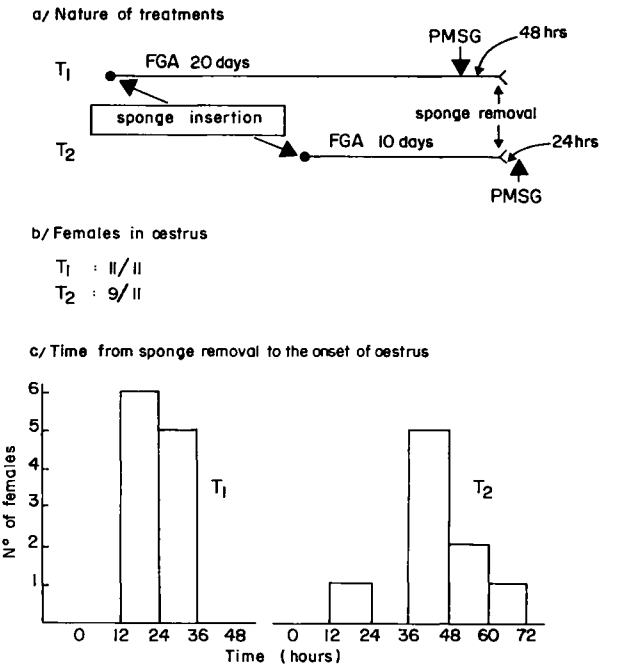

FIG. 8. — *Long VS short progestogen treatment before the breeding season*

B. — *Comparison between a short and a long progestagen treatment with different times of PMSG injection* (fig. 8)

Shortening the FGA treatment (10 days) and modifying the time of PMSG injection (24 hours after sponge removal) led to a more dispersed synchronization of oestrus, but this has to be confirmed in a larger number of animals. In spite of this apparent dispersion in oestrus synchronization, the same AI timing as that used after a 20 day treatment does not decrease post-treatment fertility when liquid semen is used (table 6 *a*). A more suitable AI timing might improve post-treatment fertility in the short treatment. The AI timing indicated in table 6 *b* was tested in too small a number of animals to be analyzed satisfactorily in statistical terms, and remains to be improved.

TABLE 6

Long vs. short progestogen treatment for the induction of oestrus before the breeding season : post-treatment fertility (pregnancy rate)
Liquid semed 200 × 10^6 motile sperm per oestrus

a) All goats inseminated blindly 31 and 55 hours after sponge removal			*b*) Short treatment for all goats inseminated 31-55 or 55-79 hours after sponge removal		
	Percentage pregnant (progesterone assay)	Number of females		Percentage pregnant (progesterone assay)	Number of females
T_1	55.4	83	31-55	65.0	20
T_2	56.8	81	55-79	72.2	18

CONCLUSION

According to the data presented, it may be said that the administration of progestagens and PMSG is a dependable technique for oestrus control and AI during the breeding season of the dairy goat.

Before the breeding season, the depressive effects of seasonal and milking anoestrus may be corrected by increasing the numbers of motile sperm, but this remains to be proven when using deep-frozen semen. However, this method of increasing post-treatment fertility is highly sperm-consuming. The other approach, that is, a modification of the synchroizing treatment may be more benefical, provided the new treatments do not alter the mechanisms supporting fertility, especially sperm transport in the genital tract of the female.

RÉSUMÉ

UTILISATION DES PROGESTAGÈNES POUR LA MAÎTRISE DES CYCLES SEXUELS CHEZ LA CHÈVRE LAITIÈRE

Les chèvres laitières européennes ne se reproduisent naturellement qu'en fin d'été et tout au long de l'automne. Ceci conduit à considérer le contrôle et l'induction du cycle sexuel en période d'activité et de repos sexuels.

Pendant la période d'activité sexuelle, une synchronisation satisfaisante des œstrus peut être obtenue à l'aide d'éponges vaginales (FGA 45 mg) maintenues en place 18-21 jours et une injection de 400 UI de PMSG effectuée au moment du retrait de l'éponge. Lorsque les femelles traitées sont inséminées sans détection d'œstrus, à des moments précis après la fin du traitement, la fertilité à l'œstrus induit est satisfaisante, que l'on utilise du sperme conservé quelques heures à l'état liquide ou du sperme congelé : 55,8 contre 56,8 p. 100 de mise-bas pour 640 et 769 chèvres respectivement. Avec le sperme congelé, la fertilité augmente très significativement avec le nombre de spermatozoïdes mobiles inséminés : 42,5 ; 54,0 et 65, 2 p. 100 de chèvres mettant bas pour 40, 80 et 120 millions de spermatozoïdes fléchants.

Pendant la période d'inactivité sexuelle, l'injection de PMSG est effectuée 48 $\pm$ 2 heures avant le retrait de l'éponge vaginale pour une durée de traitement et une dose de FGA identiques à celles utilisées en période d'activité sexuelle. La synchronisation des œstrus induits est satisfaisante. La fertilité à l'œstrus induit varie en fonction de la saison (subfertilité liée à l'anoestrus saisonnier) et en fonction de l'intervalle parturition — début de traitement (subfertilité liée à l'anœstrus de lactation). En augmentant le nombre de spermatozoïdes mobiles inséminés, il est possible de corriger l'effet dépressif de ces deux types d'anœstrus, mais ceci n'a jusqu'ici été possible qu'avec le sperme conservé à l'état liquide pendant seulement 12 heures.

Les difficultés rencontrées pour congeler le sperme de bouc peu dilué ont été surmontées par la mise au point d'une nouvelle technique de congélation dont l'efficacité est démontrée eu égard à la survie *in vitro* des spermatozoïdes. La mesure de la « fécondance » de ces spermatozoïdes est en cours et les résultats préliminaires indiquent que cette fécondance n'est pas altérée par le nouveau procédé de congélation. Il est donc permis de penser que la subfertilité liée aux anœstrus saisonnier et de lactation pourra également être corrigée avec le sperme congelé.

Si l'adaptation des conditions d'insémination aux états physiologiques de l'animal doit permettre d'obtenir une fertilité élevée tout au long de l'année, cette adaptation entraîne néanmoins l'utilisation de nombres de spermatozoïdes importants. Il paraît donc souhaitable d'améliorer aussi le traitement hormonal. Les résultats préliminaires d'essais allant dans ce sens sont indiqués.

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