Synchronization of oestrus in sheep of low-normal mass under range conditions: The use of different progestagens and PMSG

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The use of intravaginal progestagen sponges (MAP or FGA), 300 or 500 IU PMSG, and implementation of one or two inseminations following synchronization, were evaluated in 600 Merino ewes with a mean body mass of 30,6 kg, outside the normal breeding season. The conception rates obtained with AI were significantly ($P < 0,01$) higher than with natural mating at the second cycle (63,5 *vs* 47,6%). FGA-treated ewes (irrespective of PMSG dose, number of inseminations, or ram breed) gave a significantly ($P < 0,01$) higher conception rate than those treated with MAP sponges (68,3 *vs* 58,2%). The increase of PMSG dose from 300 IU to 500 IU did not significantly increase conception rate, although fecundity and lambing rates were significantly ($P < 0,01$) higher with a higher dose of PMSG (1,11 *vs* 1,29 and 69,4 *vs* 83,9% respectively). A significant ($P < 0,05$) interaction was recorded between sponge type and the number of inseminations regarding the lambing rate, with FGA sponges and two inseminations being superior (98,2%). Fecundity was not significantly affected by the sponge type and number of inseminations although a significant ($P < 0,05$) interaction between PMSG dose and the number of inseminations was recorded. Results confirm FGA sponges to be superior to MAP sponges ($P < 0,01$) in conception and lambing rate following synchronization and 500 IU PMSG being more advantageous ($P < 0,01$) for lambing rate and fecundity, outside the breeding season. Two inseminations did favour a higher ($P < 0,01$) conception and lambing rate, compared to a single insemination.

Die gebruik van intravaginale progestageensponse (MAP of FGA), 300 of 500 IE DMSG, en die implementering van een of twee inseminasies na sinkronisasie, is geëvalueer in 600 Merino-ooie met 'n gemiddelde liggaamsmassa van 30,6 kg, buite die normale teelseisoen. Die konsepsiesyfers verkry na KI was betekenisvol ($P < 0,01$) hoër as na natuurlike dekking by die tweede siklus (63,5 *vs* 47,6%). FGA-behandelde ooie (ongeag DMSG-dosis, aantal inseminasies of ramras) het 'n betekenisvol ($P < 0,01$) hoër konsepsie getoon as ooie wat met MAP-sponse behandel is (68,3 *vs* 58,2%). Die verhoging in DMSG-dosis van 300 IE na 500 IE het nie die konsepsiesyfer betekenisvol beïnvloed nie, alhoewel fekunditeit- en lampersentasie betekenisvol ($P <0,01$) verhoog is met 'n hoër dosis DMSG (1,11 *vs* 1,29 en 69,4 *vs* 83,9% respektiewelik). 'n Betekenisvolle ($P < 0,05$) interaksie is waargeneem tussen sponstipe en aantal inseminasies by lampersentasie – die beste resultate is verkry met FGA-sponse en 'n dubbele inseminasie (98,2%). Fekunditeit is nie betekenisvol deur die sponstipe en aantal inseminasies beïnvloed nie, alhoewel 'n betekenisvolle ($P < 0,05$) interaksie verkry is tussen DMSG-dosis en die aantal inseminasies. Resultate dui daarop dat FGA-sponse meer doeltreffend ($P < 0,01$) as MAP-sponse is in konsepsie- en lampersentasie na sinkronisasie, en dat 500 IE DMSG meer voordelig ($P < 0,01$) is vir lampersentasie en fekunditeit buite die teelseisoen. Twee inseminasies het beter ($P < 0,01$) konsepsie- en lampersentasies tot gevolg gehad, in vergelyking met 'n enkele inseminasie.

Keywords: Intravaginal progestagen, number of inseminations, PMSG dose, sheep, synchronization

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Introduction

The synchronization of oestrus with the aid of progestagens remains a tool with great potential in the controlled breeding of small stock (Haresign, 1978). Oestrus synchronization with progestagens has, however, often been associated with reduced fertility during the induced oestrous period (van der Westhuysen & van Niekerk 1971; Hawk & Conley, 1973). In addition to the modified pattern of uterine contractions (Hawk & Echternkamp, 1973) resulting in a reduced effect on sperm transport (Quinlivan & Robinson, 1969) in the progestagen-treated ewes, there remains a suspicion that the temporal relationship between the onset of oestrus and the preovulatory LH surge may be disturbed and that this also contributes to a lowered fertility (Baumgartner, Lishman, Louw & Botha, 1974; Hunter, 1980).

A major objective of this investigation was to verify that FGA (fluorogestone acetate) intravaginal sponges exhibit a more compact oestrous response and a greater conception rate following sponge withdrawal, than do MAP (medroxyprogesterone acetate) intravaginal sponges, in sheep outside the normal breeding season. More specifically, the effect of different doses of PMSG on synchronzation efficiency, the implementation of two (current practice) *vs* one insemination at a fixed time following synchronzation, as well as the effect of ram breed on fertility were investigated. This trial formed part of a larger genetic cross-breeding trial which will be reported seperately.

Procedure

During October 1986, a total of 600 Merino ewes, ranging from uniparous to multiparous, were treated with intravaginal progestagen sponges for 12 days. Three hundred ewes were treated with fluorogestone acetate (FGA, 40 mg Chrono-gest; Intervet) sponges and 300 ewes with medroxyprogesterone acetate (MAP, 60 mg Repromap; Upjohn) sponges.

Table 1 Treatments applied to 600 Merino ewes in the synchronization programme

	Ram breed							
	IF[a]		SAMM[b]		IF		DM[c]	
Ewes/Group	75	75	75	75	75	75	75	75
Sponge type	MAP[d]	MAP	MAP	MAP	FGA[e]	FGA	FGA	FGA
Dose PMSG (IU)	300	300	500	500	500	500	300	300
No. AI	1	2	1	2	1	2	1	2

[a] Ile de France.
[b] SA Mutton Merino.
[c] Döhne Merino.
[d] Medroxyprogesterone acetate.
[e] Fluorogestone acetate.

At sponge withdrawal, the ewes received subcutaneous injections of different doses (300 and 500 IU) and brands PMSG (Chrono-gest; Intervet and Fostim; Upjohn – corresponding to the intravaginal sponges used), to verify the importance of the application of a higher PMSG dose outside the normal breeding season. All these ewes were then inseminated on a fixed-time basis following sponge withdrawal with either two inseminations, 48 and 60 h following sponge withdrawal, or a single insemination, 54 h following sponge withdrawal. Ile de France (IF), SA Mutton Merino (SAMM) and Döhne Merino (DM) semen were used in the AI programme, as is set out in Table 1. All ewes were inseminated with 0,05 ml fresh, undiluted semen. The different treatments applied to all the ewes are given in Table 1.

The Merino ewes were thus allocated to eight subgroups (for practical and managerial reasons) and inseminated over a two-day period by staggering the time of sponge withdrawal. The use of the different ram breeds in the experiment was dictated by the genetic cross-breeding programme. Fourteen days following AI, fertile Merino rams were introduced to the ewes to naturally mate and later identify (lambing an oestrous cycle later) ewes that had not conceived to AI. Conception rate of this naturally mated group was expressed as ewes lambing as a percentage of those that did not conceive to AI.

Prior to synchronization, these recently shorn ewes were maintained on Atriplex pastures, but owing to the low body masses (mean of 30,6 kg) of the Merino ewes at the commencement of progestagen treatment, ewes were supplemented with maize throughout the trial period. Body masses of the Merino ewes at weaning were 35,8 kg. Data were analysed by means of the least square means computer program of Harvey (1977). Harvey (1982) indicated that discrete data could be analysed by this method and data were coded 0 or 1 for barren or ewes conceiving, and 1, 2 or 3 for singletons, twins or triplets born (fecundity). Ram breed, type of sponge, dose of PMSG and the number of inseminations were included in the model as fixed effects.

Results

Ram breed had no significant effect on the conception rate, lambing rate or fecundity of the ewes following AI and was therefore excluded in the statistical model. The effects of sponge type, dose of PMSG and number of inseminations on conception rate are set out in Table 2.

Table 2 Influence of sponge type, dose of PMSG[a] and number of inseminations on the conception rate in Merino ewes

Parameter	Least square mean		SE	
FGA[b] sponge	0,683	±	0,03	**
MAP[c] sponge	0,582	±	0,03	
1 Insemination	0,567	±	0,03	**
2 Inseminations	0,699	±	0,03	
300 IU PMSG	0,617	±	0,03	NS[d]
500 IU PMSG	0,649	±	0,03	

[a] Pregnant mare serum gonadotrophin.
[b] Fluorogestone acetate.
[c] Medroxyprogesterone acetate.
[d] No significant difference.
** Difference $P < 0,01$.

The number of inseminations and the type of sponge had a significant ($P < 0,01$) effect on conception rate whereas the dose of PMSG used had no significant effect on conception rate. No significant interaction was obtained between the type of sponge, the number of inseminations and the dose of PMSG administered on conception rate. Double *vs* a single insemination and FGA *vs* MAP sponges inserted intravaginally resulted in significantly ($P < 0,01$) higher conception rates (69,9 *vs* 56,7% and 68,3 *vs* 58,2% respectively). Regarding the lambing rate as such, sponge type, dose of PMSG and the number of inseminations had a highly significant ($P < 0,01$) effect (Table 3), with FGA, two inseminations and 500 IU PMSG significantly increasing lambing rate. A significant ($P < 0,05$) interaction was also found between sponge type and number of inseminations,

Table 3 Influence of sponge type, dose of PMSG[a] and number of inseminations on the lambing rate in Merino ewes (least square mean ± SE)

	MAP[b]	FGA[c]	Pooled value[d]	
FGA sponge	–	0,847 ± 0,04		
MAP sponge	0,686 ± 0,04	–	0,767 ± 0,03	**
1 Insemination	0,657 ± 0,06	0,712 ± 0,06	0,685 ± 0,04	
2 Inseminations	0,716 ± 0,05	0,982 ± 0,05*	0,849 ± 0,04	**
300 IU PMSG	0,602 ± 0,06	0,786 ± 0,05	0,694 ± 0,04	
500 IU PMSG	0,771 ± 0,06	0,907 ± 0,05	0,839 ± 0,04	**

[a] Pregnant mare serum gonadotrophin.
[b] Medroxyprogesterone acetate.
[c] Fluorogestone acetate.
[d] Pooled value was obtained by the combined data obtained from both FGA and MAP sponges.
* Interaction $P < 0,05$.
** Difference $P < 0,01$.

where FGA resulted in a larger increase in lambing rate than did MAP intravaginal sponges when used in a double insemination programme.

The fecundity of the ewes was significantly ($P < 0,01$) influenced by the dose of PMSG (Table 4). By increasing the dose from 300 IU to 500 IU, the fecundity was increased correspondingly (1,11 to 1,29). The dose of PMSG interacted significantly ($P < 0,05$) with the number of inseminations, where 500 IU PMSG gave a greater increase in fecundity with a single (1,06 to 1,33) than with a double insemination (1,17 to 1,25). Conspicious in this experiment are the significantly ($P < 0,01$) lower conception rates, lambing rates and fecundities ($P < 0,05$) achieved with natural mating at the natural oestrous cycle (Table 5). Unfortunately, the effect of mass of the ewes on the fertility results could not be attained.

Table 4 Influence of sponge type, number of inseminations and dose of PMSG[a] on the fecundity of Merino ewes (least square mean ± SE)

	300 IU PMSG	500 IU PMSG	Pooled value	
FGA[b] sponge	1,16 ± 0,04	1,31 ± 0,04	1,24 ± 0,03	
MAP[c] sponge	1,07 ± 0,05	1,26 ± 0,05	1,16 ± 0,03	NS[d]
1 Insemination	1,06 ± 0,05	1,33 ± 0,05*	1,19 ± 0,03	
2 Inseminations	1,17 ± 0,04	1,25 ± 0,04	1,21 ± 0,03	NS
300 IU PMSG	1,11 ± 0,03		1,11 ± 0,03	
500 IU PMSG		1,29 ± 0,03	1,29 ± 0,03	**

[a] Pregnant mare serum gonadotrophin.
[b] Fluorogestone acetate.
[c] Medroxyprogesterone acetate.
[d] No significant difference.
* Interaction $P < 0,05$.
** Difference $P < 0,01$.

Table 5 Mean conception rates, lambing rates and fecundities of Merino ewes following AI and natural mating (second cycle)

	AI	Natural mating
Conception rate %	63,5	47,6 **
Lambing rate %	76,9	48,3 **
Fecundity	1,21	1,01*

* Difference $P < 0,05$.
** Difference $P < 0,01$.

Discussion

Parr, Davis, Fairclough and Miles (1987) have demonstrated an association in sheep between nutrition, endocrinology and reproduction – especially during early pregnancy. The low fertility results (conception rate and fecundity) following AI and natural mating obtained in this trial could possibly be related to the relative low body masses of the ewes at the onset of the trial. Unfortunately these facts were not known prior to the trial and the availability of such numbers of ewes made such a trial ideal. The fact that ewes that were mated during the second (natural) oestrous period showed a significant decrease in conception rate and had an even lower fecundity than ewes inseminated, is contrary to expectations and thus seems to emphasize the suspicion that the animals experienced a nutritional stress. The success of progestagen-PMSG treatments in inducing ovarian activity is also closely correlated with the degree of seasonal anoestrus (Hunter, 1980).

It is interesting to note that an increase in the dose of PMSG from 300 to 500 IU in all the ewes had no significant effect on conception rate. The use of FGA intravaginal sponges (0,68 *vs* 0,58) and a double insemination (0,7 *vs* 0,57) did, however, lead to significantly ($P < 0,01$) higher conception rates. The possibility exists that the lower dose of progestagen present in the FGA sponge (40 mg) was partly responsible for this phenomena, when used outside the breeding season. An effect of endogenous or exogenous progestagen is essential in order to prime the hypothalamus for the feedback action of oestrogens, which must precede overt oestrus and ovulation (Hunter, 1980). The MAP (60 mg) sponges result in higher circulating residual progesterone and would therefore necessitate a higher FSH (PMSG) stimulation to initiate the same response as in FGA-treated ewes. The interval between sponge withdrawal and oestrus, resulting from different doses of PMSG, could have been a determining factor in the higher conception rate associated with double insemination. The response time of the 300 IU PMSG-treated ewes could have been slower and the double insemination covered a wider time interval following sponge withdrawal. The role that nutritional stress could have played is an aspect that must always be borne in mind when using these techniques in that the reproductive

endocrine system is possibly suppressed by nutritional stress.

The overall lambing rate for the FGA-treated ewes was significantly ($P < 0,01$) higher than that of the MAP-treated ewes, although still unsatisfactorily low (0,85 *vs* 0,69). This could be ascribed to the nutritional status of the ewes. The significant ($P < 0,05$) interaction found between sponge type and the number of inseminations indicate that FGA-treated ewes receiving the double insemination achieved a superior lambing rate.

As can be expected, the increase in dose of PMSG from 300 IU to 500 IU resulted in an increased ($P < 0,01$) fecundity, perhaps due to a higher ovulation rate, hence a greater number of offspring born per ewe lambing. Type of sponge and number of inseminations had no significant effect on fecundity as such. A significant ($P < 0,05$) interaction was, however, obtained between the dose of PMSG used and the number of inseminations performed – 500 IU PMSG and a single insemination gave the best results. The reason for this phenomena is unclear, but it would seem to emphasize the potential of a single insemination in a synchronization programme.

From results obtained, it would seem that FGA intravaginal sponges appear to be superior to MAP intravaginal sponges as a synchronizing agent outside the breeding season. It is recommended that 500 IU PMSG be used outside the breeding season in order to ensure high lambing rates. Although two inseminations (48 and 60 h following sponge withdrawal) resulted in higher conception and lambing rates, the implementation of a single insemination programme holds great promise for synchronized breeding programmes, in terms of minimum handling of the ewe and a reduction of labour input.

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