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INCREASING THE OVULATION RATE IN EWES BY IMMUNISATION

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SUMMARY

The immunisation of Coopworth and Romney ewes against androstenedione and oestrone increased their ovulation rate by up to 30% and in the case of the oestrone group this was reflected in a 27% increase in the number of lambs weaned. The response to immunisation was additive to that obtained by increased pre-grazing herbage allowance for 6 weeks premating and to that between breeds.

INTRODUCTION

The single most important factor contributing to the variation between flocks in lamb tailing percentage is the ovulation rate (Kelly and Knight, 1979). Whilst it is possible to increase the ovulation rate and lambing percentage dramatically by means of flushing with pasture or silage (Smith *et al.*, 1979; Rattray *et al.*, 1980) it is not always possible to obtain the necessary pasture growth or conserved feed needed.

The discovery that ewes immunised against the ovarian steroids androstenedione and oestrone have increased ovulation rates (Cox *et al.*, 1976; Scaramuzzi *et al.*, 1977) led to speculation that such techniques may have commercial application. Studies on larger numbers of animals (Martin *et al.*, 1979; Scaramuzzi, 1980) have confirmed that immunisation can increase the ovulation rate but this is not always reflected in increased lamb production. It was therefore proposed to test the effects of immunisation against these steroids on oestrus, ovulation and lamb production in two breeds under New Zealand conditions.

EXPERIMENTAL

Mixed-age Romney (209) and Coopworth (209) ewes were allocated to groups and treated as follows. Group 1: Immunised with a conjugate of oestrone-3-HSA in a DEAE Dextran adjuvant (Cox and Wilson, 1976) with a booster injection 29 days later (Oestrone

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1); Group 2: Immunised with the same conjugate as Group 1 with a booster injection 15 days later (Oestrone 2); Group 3: Immunised with a conjugate of androstenedione-7-HSA in Freunds complete adjuvant with a booster injection 30 days later (Androstenedione); Group 4: Unimmunised control. The immunogens used were pre-tested in sheep and were selected to give a response of approximately 30% for the oestrone while the androstenedione was chosen to produce an over-response. The 4 treatment groups of each breed were each further subdivided into 2 subgroups and were grazed at allowances of 2 or 6 kg DM/ewe/d on pasture having a pre-grazing herbage mass of 3000 kg/ha, for a period of 6 weeks before mating and for a further 5 weeks of mating. At other times all ewes received the same pasture allowance which altered according to their physiological state. All ewes were treated with intravaginal sponges containing 70 mg medroxy progesterone acetate (MAP) to synchronise oestrus and were naturally mated at the second oestrus following sponge withdrawal. Entire mating occurred 30 days after the ewes received their booster immunisation injection.

Oestrus was recorded using harnessed rams. Eight to ten days later all ewes were laparoscoped to determine their ovulation rate and were re-examined on returning to service. Lambing data and lamb survival to weaning were recorded.

TABLE 1: SUMMARY OF REPRODUCTIVE PERFORMANCE

	Immunisation Treatment			
	Oestrone 1	*Oestrone 2*	*Androstenedione*	*Control*
Number of ewes treated (EJ)	104	105	105	104
Ewes in oestrus, 1st cycle (%)	87.5	86.7	53.3	87.5
Ovulation rate of all ewes at 1st cycle	1.99	1.98	1.79	1.67
No. ewes dead or without records	14	5	7	8
No. dry ewes	6	9	38	9
No. ewes lambing	84	91	60	87
Ovulation rate of ewes lambing (at cycle of conception)	2.14	1.91	2.53	1.69
No. of lambs born (LB)	152	152	107	126
No. embryos lost	28	22	45	21
Wastage rate (%)	15.6	12.6	29.6	14.3
No. lamb deaths (LD)	31	26	13	23
LD/LB (%)	20.4	17.1	12.1	18.3
No. lambs weaned (LW)	121	126	94	103
LW/EJ (%)	116	120	90	99
LW/EPL* (%)	134	126	96	107

* EPL = ewes present at lambing including dry ewes.

RESULTS

The reproductive performance of the groups is summarised in Table 1. The immunised ewes had a higher ovulation rate ($P < 0.01$) than the control ewes. With the exception of the androstenedione treated ewes (61.2%) the percentage of ewes lambing was similar to that of the controls (90.6%). The androstenedione group had the highest level of embryonic wastage ($P < 0.001$) but lamb mortality was not significantly different. This resulted in oestrone treated groups having 19 to 27% more lambs weaned than the controls. The androstenedione group weaned 11% less than the control group. The increased ovulation rate was due to a greater proportion of ewes having multiple ovulations and in particular the proportion of ewes having three or more ovulations (Table 2). The response to androstenedione was the most variable with a higher incidence of zero ovulations.

TABLE 2: PERCENTAGE DISTRIBUTION OF OVULATIONS AT THE FIRST CYCLE

Immunisation treatment	*Number of Ovulations*					
	0	*1*	*2*	*3*	*4*	*5*
Oestrone 1	4	19	54	21	1	1
Oestrone 2	3	24	48	24	1	0
Androstenedione	19	24	23	27	7	0
Control	5	34	53	6	1	1

There was a significant ($P < 0.001$) effect of ewe breed on ovulation rate, Coopworths being higher than Romneys (2.02 v 1.71). There was also a significant effect ($P < 0.01$) of amount of herbage available on ovulation rate (2 kg DM/ewe/d = 1.79; 6 kg DM/ewe/d = 1.92). The respective liveweight gains were 96 g/ewe/d and 198 g/ewe/d for the 50-day premating period. There were no interactions between breed and nutrition level on ovulation rate.

There was an interaction between immunisation treatment and nutrition level ($P < 0.01$) with the androstenedione ewes showing a reduced ovulation rate at the higher level (Table 3), due mainly to the increased proportion of anovular ewes. A comparison of the control group and the combined oestrone treatments indicated that the responses due to immunisation, nutrition level and breed were additive.

TABLE 3: EFFECT OF IMMUNISATION TREATMENT, BREED OF EWE AND LEVEL OF NUTRITION ON OVULATION RATE AT THE FIRST CYCLE

Level of Nutrition (kg DM/ewe/d)	*Coopworth* 2	6	*Romney* 2	6
Immunisation Treatment				
Oestrone 1	1.76	2.48	1.85	1.88
Oestrone 2	2.16	2.31	1.65	1.81
Androstenedione	2.13	1.58	1.81	1.69
Control	1.69	2.04	1.35	1.62

The antibody titres of the immunised ewes were higher in the androstenedione (mean 1:11000) than in the oestrone (mean 1:1965) treatments. Coopworths had a lower titre level than Romneys with the oestrone treatments (1:1427 v 1:2486 $P<0.001$) while the androstenedione group showed the same trend (1:9092 v 1:12713, NS). The level for the Oestrone 1 treatment was higher than that for the Oestrone 2 treatment (1:2258 v 1:1656, $P<0.05$).

DISCUSSION

Immunisation against oestrone and androstenedione increased the ovulation rate of both Coopworth and Romney ewes. Similar results have been obtained with Welsh Mountain (Scaramuzzi *et al.*, 1977), Merino (Cox *et al.*, 1976; Martin *et al.*, 1979) and Dorset Horn (Scaramuzzi, 1980) ewes and indicate that the prolificacy of the breed does not have a major effect on the immunisation response. The response to immunisation against oestrone appears to be unaffected by level of nutrition (at least when ewes are gaining weight) and the increase in ovulations is additional to that obtained by increased level of feeding. The increase in numbers of ovulations is quite precise and contrasts with the wide range seen when PMS gonadotrophin is used (Smith, 1976).

Ewes immunised against oestrone showed no detrimental effects on overall reproductive performance and the increased ovulation rate was reflected in an increased number of lambs weaned.

The androstenedione treatment resulted in a higher proportion of barrenness due to an increase in both anovular and anoestrus ewes. This, combined with the higher level of embryonic wastage counteracted the effect of the increased ovulation rate and resulted in fewer lambs being weaned. Although the androstenedione treatment was expected to produce high titre levels and a considerable

degree of anoestrus (R. I. Cox, pers. comm.) it was chosen so that the anoestrous problem could be investigated. However, with a different adjuvant, and titre levels similar to those obtained with oestrone, immunisation to androstenedione gives satisfactory responses (Scaramuzzi, 1980).

It would appear that the technique of immunisation against steroid hormones has considerable potential for increasing the lambing performance of flocks. However, further investigation of its interaction with level of nutrition and breed or genotype of ewe is needed before commercial use can be recommended.

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