THE EFFECT OF LUCERNE FEEDING ON OVULATION RATE IN EWES

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SUMMARY

The percentage of ewes exhibiting multiple ovulations was linearly related to the coumestan content of pelleted lucerne fed immediately prior to oestrus. Feeding a coumestan-containing diet for 7 days prior to oestrus reduced multiple ovulations markedly. Removing ewes from the oestrogenic diet 11 days prior to oestrus allowed a high degree of recovery.

INTRODUCTION

The major factor limiting lamb production in many areas of New Zealand is the lack of feed for the ewes over late summer and autumn. One way of overcoming this problem in the Central Plateau of the North Island is to increase the use of lucerne. However, the use of lucerne for feeding prior to mating is limited because ewes grazing lucerne can have very low levels of twinning (Coop and Clark, 1960). This is due to a reduction in ovulation rate caused by the presence of an oestrogenic compound, "coumestrol", in lucerne plants affected with foliar disease (Smith *et al.*, 1979).

This paper reports on the effects on the ovulation rate of ewes of the level of coumestrol in the diet and the duration of feeding of lucerne prior to mating.

The experiments were conducted at the Wairkaei Research Station, Taupo, in 1978 and 1979.

MATERIALS AND METHODS

EXPERIMENTAL ANIMALS

Mixed-age Perendale ewes (250) were used in 1978 and mixed-age Coopworth ewes (300) in 1979. Thirty vasectomized Dorset Horn rams fitted with "sire-sine" harnesses and crayons were used to detect oestrus.

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Lucerne Pellets and Feeding of Ewes

In each year two stands of lucerne were harvested and pelleted at about the 50-day regrowth stage. One stand was sprayed to control foliar disease, while the other was untreated (Smith *et al.*, 1979). The pellets from the sprayed stand were non-oestrogenic (0 to 5 ppm coumestrol), while those from the untreated stand were oestrogenic (100+ ppm).

Ewes were group fed on a daily ration of pellets in troughs and run in small paddocks or pens with zero grazing.

Experiment A (1978)

Five groups of 50 ewes were fed (2.0 kg/ewe/day) pellets containing different amounts of coumestan for 35 days (Table 1). Ovulation rates were determined at the start and end of the feeding period.

Experiment B (1979)

Six groups of 50 ewes were fed (1.5 kg/ewe/day) either oestrogenic (100+ ppm) or non-oestrogenic (0 ppm) pellets for varying periods before oestrus and ovulation (see Table 2). The ovulation rates were determined at the beginning of the feeding period, then again after two cycles to determine the effect of duration of feeding and at the end of a further cycle to determine the rate of recovery.

Treatment of Ewes

To facilitate the management of animals and conduct of laparoscopy, all ewes were synchronized with intravaginal sponges (containing 70 mg medroxy progesterone acetate) inserted for a period of 14 days before the experimental feeding period.

The ovaries of all ewes were examined by laparoscopy (Kelly and Allison, 1976) to determine the number and location of corpora lutea.

At the commencement of the trial and at each occasion when examined by laparoscopy, ewes were weighed after a 24 h fast.

Analysis of Data

The ovulation data are presented in the form of a percentage of ewes in the group having multiple (two or more) ovulations (% EMO) and were analysed by chi-squared procedures.

RESULTS

Coumestan Effect on Multiple Ovulations

Experiment A

There was a significant linear effect of the level of coumestan on the proportion of ewes having multiple ovulations (χ^2_{lin} = 23.1, $P < 0.001$, Table 1). The higher the level of coumestan, the lower the proportion of ewes with multiple ovulations.

Experiment B

The feeding of oestrogenic lucerne to ewes for periods of 7 to 28 days before oestrus and ovulation resulted in all cases in a significantly ($\chi^2 = 21.0$, $P < 0.001$, Table 2) lower % EMO compared with ewes fed non-oestrogenic pellets.

There was no effect on % EMO of the duration of feeding of the oestrogenic pellets.

Ewes previously fed oestrogenic pellets and then fed non-oestrogenic pellets (recovery period) showed a higher ($\chi^2 = 3.96$, $P < 0.05$) % EMO compared with those ewes maintained continuously on oestrogenic pellets, but lower than that of ewes maintained continuously on non-oestrogenic pellets ($\chi^2 = 5.3$, $P < 0.05$).

Although those ewes which had the longer recovery period tended to have the higher % EMO, there was no significant effect of period of recovery.

Weight Change and Multiple Ovulations

Experiment A

The weight gains for all groups were similar at an average of 7 kg/ewe over the 35-day period. The % EMO in the group

TABLE 1: EFFECT OF LEVEL OF COUMESTAN IN THE FEED

Group	Dietary Coumestan (ppm)	Ewes	% EMO[1] Initial	% EMO[1] After 35 Days
1	0	49	14.6	40.8
2	25	48	14.6	20.8
3	50	49	15.6	19.5
4	75	49	12.2	10.2
5	100	49	14.0	4.1

[1] Percentage of ewes having two or more ovulations.

TABLE 2: EFFECT OF DURATION OF COUMESTAN FEEDING ON MULTIPLE OVULATIONS

Group	Early Period[1]		Late Period[1]		EMO %		
	0 C	100+ C	100+ C	0 C	Initial	Mid-point	Final
A	0	28	17	0	24	26	18
B	0	28	12	5	22	10	32
			6	11			28
C	7	21	12	5	22	16	20
			6	11			40
D	14	14	12	5	20	18	32
			6	11			40
E	21	7	12	5	22	18	28
			6	11			32
F	28	0	0	17	22	48	50

[1] Days fed coumestan-free and coumestan-containing (100+ ppm C) diets during the 28-day period prior to the mid-experimental oestrus and the 17 days prior to the final oestrus.

receiving only non-oestrogenic pellets increased from 14.6 to 40.8% after 35 days of feeding.

Experiment B

The weight gain for all groups of ewes was low (1.2 kg) over the first 35-day feeding period. The % EMO in the group fed non-oestrogenic pellets increased from 22 to 48% over this period.

Oestrous Cycle Length and Proportion of Ewes Exhibiting Oestrus

The level of coumestan in diet or duration of feeding did not alter either the length of the oestrous cycle (mean = 17.2 days) or the proportion of ewes exhibiting oestrus. The proportion of ewes detected in oestrus was lower at the synchronized oestrus than at subsequent cycles (86% vs. 95%, $\chi^2 = 17.4$, $P < 0.001$).

DISCUSSION

Quite low levels of coumestans can depress the % EMO. The variation between years and locations in response to lucerne feeding is most likely explained by differences in the coumestan content. The observation that as little as 7 days of feeding on pellets containing 100 ppm coumestans could exert as great a

depression on the % EMO as could 28 days of feeding (Table 2) indicates that the mechanisms involved in coumestan action are operative in the latter stages of the oestrus cycle. This is further supported by the data on the rate of recovery where, if feeding of the oestrogenic material ceased 11 days before oestrus, there was almost complete recovery — the recovery rate at the shorter period of 5 days was not as great. Similarly, McLeod (1978) has shown that with a "cross over" in diet at day 9 of the cycle, only ewes receiving oestrogenic material in the latter stages of the cycle were affected.

It has been hypothesized that the effect of coumestans is due to their interference with the supply of gonadotrophins. Recent data, however, would raise some doubts about this hypothesis. No marked differences in the levels of follicle-stimulating hormone (FSH) during the last 5 days of the cycle were found between ewes being fed pellets with either high or low levels of coumestans (Smith, Payne, McGowan, unpublished). In addition, McLeod (1978) found no differences in the concentrations of luteinizing hormone (LH) between ewes grazed on oestrogenic lucerne or on non-oestrogenic grass pasture.

Examination of the ovulation data revealed that some ewes (17%) continued to have multiple ovulations even after 5 days of feeding on pellets with a high level of coumestan. This indicates that, rather than reducing the basal ovulation rate, coumestans act by inhibiting the expected increases in multiple ovulations following improved nutrition. This flushing effect was most noticeable in the present trials with increases in % EMOs of 26% in both trials over 35 days of pellet feeding.

The response in terms of liveweight gain represents increases of 4% (Experiment A) or 21% (Experiment B) per kilogram, which suggests that some of the response may be independent of liveweight and similar to that observed with lupin grain (Knight, 1979).

Smith *et al.* (1979) reported a 6% increase in ovulation rate per kilogram of liveweight increase for ewes grazing non-oestrogenic lucerne. Thus, lucerne may have considerable potential as a flushing feed provided some means of controlling the level of coumestan can be found. In the long term this is highly likely with the development of disease-resistant, low-coumestan-containing cultivars through plant breeding programmes. In the short term consideration should be given to the possibility of protecting the ewe against coumestan by a system of immuniza-

tion. Meanwhile, strategic grazing management can minimize the effect by having young fresh lucerne available for grazing during the joining period.

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