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THE EFFECT OF NUTRITIONAL RESTRICTION ON EMBRYONIC SURVIVAL DURING THE FIRST THREE WEEKS OF PREGNANCY IN THE PERENDALE EWE

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Summary

Embryonic survival and reproductive performance of 480 mature Perendale ewes were studied. The treatments were a 2^3 factorial set, the factors being restricted or non-restricted intake for 3 consecutive 7 day periods during the first three weeks of pregnancy.

Ewes underwent a laparotomy 3 days after first identification of onset of oestrus and corpora lutea were counted. Ewes were slaughtered 28-35 days after mating, and embryos were counted.

Increasing the period of nutritional restriction decreased embryonic survival in twin ovulating ewes. As the period of restriction increased so within the twin ovulating ewes, the percentage with no viable embryo increased, the percentage with a single viable embryo decreased, and the percentage with two viable embryos remained almost constant.

I. INTRODUCTION

Edey (1966) showed that in Merino ewes in fat condition early embryonic mortality can be induced by undernutrition, or possibly by the combined stresses of undernutrition and laparotomy. Under these conditions there was a proportionally greater loss of ova from ewes with twin ovulations than from ewes with single ovulations.

There is as yet no evidence as to relative susceptibility to nutritional restriction of ewes at different periods within the first three weeks of pregnancy. The effect of varying length of stress during these three weeks is also unknown. The present experiment was designed to study these effects.

II. MATERIALS AND METHODS

The observations were carried out at the State Research Farm, Werribee, 30 km south-west of Melbourne.

The experimental area was divided into two main areas. The first was a paddock of 24.3 ha on which the flock was grazed except when nutritional restriction was imposed. This was an annual dryland pasture and ewes were supplied with a supplement of hay and barley. Nutritional restriction was applied on a second area of 0.4 ha of bare ground where the ewes were fed daily an amount

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equivalent to 0.2 kg good quality pasture hay. The number of ewes on either area varied from day to day depending on the experimental treatments.

The experimental flock consisted of 480 Perendale ewes, 4-5 years old, in fat condition, with a mean liveweight of 53 kg at mating. Ewes were joined with 4 per cent of Poll Dorset rams.

All ewes were weighed on May 1, 1968 and listed in order of descending liveweight. Within groupings of 8, the ewes were individually allotted at random to one of the 8 treatment groups (Table 1). The design was a 2^3 factorial. The factors were restricted or non-restricted nutritional intake for 3 consecutive 7 day periods during the first 3 weeks of pregnancy.

TABLE 1

Experimental design, ovulation rates and embryonic survival

Group	Period of nutritional restriction* (Days after mating)	Number of ewes†			Mean ovulation rate (ova shed/ewe)	Embryos/ ewe	Percent of ova present as embryos	
		Single ovulating	Twin ovulating	Total			1 ovum shed	2 ova shed
1	No restriction	19	35	54	1.65	0.84	32	56
2	1-7	21	36	57	1.63	0.70	38	44
3	8-14	22	33	55	1.60	0.76	55	45
4	15-21	24	31	55	1.56	0.94	58	61
5	1-14	24	29	53	1.54	0.73	42	50
6	8-21	27	30	57	1.53	0.69	33	50
7	1-7 and 15-21	20	30	50	1.60	0.58	30	38
8	1-21	22	29	51	1.59	0.75	55	43

*Day 0 is first day of mating identification.
†Includes all mated ewes which were slaughtered.

Rams were fitted with Sire Sine crayons and the colours of the crayons changed at 10 day intervals. Every second day the rams from the restriction area were replaced by a number of rams from the main mating flock maintaining approximately 4 rams per 100 ewes on each area. Ewes were examined for raddle marks once daily. The day of mating identification was taken as Day 0. On the following day (Day 1) the nutritional treatment periods began.

On the third day after first identification of mating (Day 3) all ewes underwent midventrai laparotomy and active corpora lutea were counted. Operations were conducted under general anaesthetic using sodium pentobarbitone*. Ewes were returned to their flock within 6 hours. Of the 480 ewes in the flock, 432 ewes mated within a three week period and subsequently underwent laparotomy and nutritional treatment.

All ewes were weighed direct from pasture five times per week throughout the experimental period except after rain if their wool did not dry out by mid-afternoon.

Ewes were slaughtered 28-35 days after first mating. Prior to slaughter a

*"Nembutal" — Abbott.

poly-urethane plastic foam tampon (3.5 x 3.5 x 5.0 cm) was inserted into the vagina of each ewe. Each tampon had been heat branded with the ewe's number. After slaughter the reproductive tracts were excised in their entirety (vagina and vulva included). Genitalia were examined and embryos counted within 4 hours of collection.

Results were analysed using χ^2 tests. The data were analysed for single and twin ovulating ewes separately. Linear trends were examined by the method of Maxwell (1961).

III. RESULTS

(a) *Liveweight changes*

Mean daily liveweights for all groups are shown in Figure 1. The mean loss of liveweight for sheep not on restricted feeding during the first week of pregnancy was 1.8 kg in the first 2 days after laparotomy. However, there was considerable between group variation in liveweight loss following laparotomy.

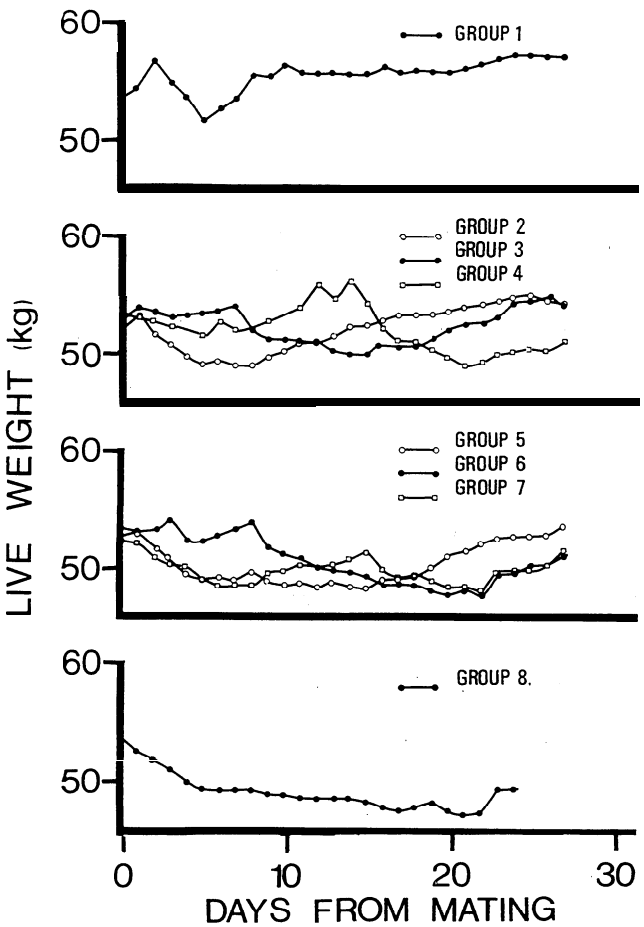

Fig. 1. — Average liveweight changes of ewes in the eight treatment groups.

The original liveweight was not regained in these ewes until 5 days after laparotomy. Thereafter the ewes remaining on a non-restricted intake (Group 1) gained liveweight at the rate of 0.1 kg/day until slaughter. Ewes nutritionally restricted for 3 weeks (Group 8) lost liveweight at an average rate of 0.1 kg/day from Day 5 to Day 22.

(b) ***Embryonic survival***

Corpora lutea represented by embryos per ewe ranged from 0.58 in Group 7 to 0.94 in Group 4 (Table 1). The data were analysed for single and twin ovulating ewes separately. In the first analysis the data were analysed as a 2^3 factorial but the results were not readily interpretable. A second analysis was undertaken, although this was not the original intention. In the second analysis the total period of stress was considered to be the operative factor, i.e. 0, 7, 14 or 21 days. This interpretation was permitted, for when considering the twin ovulating ewes, the Chi-squared values for within the 3 groups of ewes nutritionally restricted for 1 week (χ^2_2=3.28) and within the 3 groups of ewes nutritionally restricted for 2 weeks (χ^2_2=0.45) were non-significant.

Fig. 2. — Percentage of twin ovulating ewes with 0, 1 or 2 embryos present at slaughter in groups restricted for 0, 7, 14 or 21 days.

Figure 2 shows that in twin ovulators there was a linear trend (χ^2_1=4.85; $P<0.05$) for the percentage of ewes with no embryos. The effect of increasing the length of nutritional restriction was to decrease the expected lambing percentage

as indicated by the number of viable embryos present at slaughter. As the period of nutritional restriction increased, so — within the twin ovulators — the percentage of ewes with no viable embryo increased, while the percentage with a single viable embryo decreased, and the percentage of ewes with two viable embryos remained almost constant. When the data from the single ovulators were analysed considering the total period of stress as the operative factor, the response was shown to be heterogeneous.

IV. DISCUSSION

It would appear that laparotomy causes an immediate reduction in Iiveweight. This suggests a considerable post operative recovery period over which intake is considerably restricted. In the future an evaluation must be made of the effect on embryonic survival of both this reduction in liveweight and mechanical damage caused by manipulation of the reproductive tract.

Loss in liveweight of the amount recorded in the nutritionally restricted ewes after the initial abrupt liveweight decrease is not uncommon in sheep grazing annual pastures in Victoria (e.g. Sharkey and Hedding 1964).

Of greatest interest was the linear increase in the percentage of twin ovulating ewes without viable embryo as the period of stress increased. But unlike the results of Edey (1966) and Cumming (1972), this was accounted for mainly by a reduction in the percentage of twin ovulating ewes with only one viable foetus. Edey also showed that with stress more twin ovulators lost their total pregnancy than twin ovulating controls, though this difference did not reach significance. In this study it was found that the percentage of ewes with both ova surviving was unaffected by nutritional restriction. In the abovementioned experiments of Edey and Cumming the percentage of twin ovulating ewes with both ova surviving was reduced by imposing nutritional restriction.

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