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MINIMAL FEEDING OF PREGNANT EWES

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SUMMARY

Two comparative slaughter trials were conducted during the last third of pregnancy with Coopworth ewes that had been diagnosed pregnant by X-ray analysis on about day 90 of gestation. In the first trial from ditocous ewes an initial slaughter group of 9 was killed on day 95 of gestation, while the remaining were randomized into groups fed at an average of 1.0, 1.25, 1.5, 1.75 or 2.0 times non-pregnant maintenance, until slaughter at day 140. With increased level of feeding, ewe liveweight gains increased from 4.6 to 13.7 kg; empty body weight changed from —3.9 to 2.0 kg; average foetal weights from 3.9 to 4.7 kg; mammary weights from 1.2 to 2.3 kg; and wool growth from 0.43 to 0.71 kg. Foetal weight was negatively related to ewe empty body weight change and positively related to the day 90 weight of the ewes, suggesting that ewe body reserves may influence foetal growth under such circumstances.

In the second trial, 110 ewes were randomized after mating into two groups, one restricted (L/-) and one fed liberally (H/-) so as to achieve a 16 kg difference in liveweight by day 90 of gestation (51.4 kg vs. 67.2 kg). Ewes were diagnosed by X-ray into single and twin bearing, and initial slaughter groups taken on day 95. The remainder were randomized and fed at either 1.0 (-/L) or 1.75 (-/H) times non-pregnant maintenance until slaughter at day 135. From day 90, changes in various weights (kg) for LL, LH, HL, and HH twin-bearing ewes were, respectively: empty body weight, —8.1, —2.1, —8.9 and —4.1; average foetal weights, 2.9, 3.4, 3.5 and 3.7; mammary weights, 0.6, 1.2, 0.9 and 1.5; wool growth, 0.13, 0.17, and 0.35 and 0.30. For the LL, LH, HL, and HH single-bearing ewes: empty body weight, —5.9, —2.4, —7.3 and —0.7; average foetal weight, 3.6, 4.3, 4.0 and 4.5; mammary weights, 0.5, 1.3, 0.7 and 1.0; wool growth, 0.15, 0.23, 0.35, and 0.33. Level of feeding during mid pregnancy influenced foetal, mammary and wool weights, in spite of feeding levels in late pregnancy. Maternal reserves can compensate for considerable nutritional deprivation in late pregnancy when ewes are in good body condition.

INTRODUCTION

Numerous studies indicate that the energy requirements of the developing conceptus are quite small during the first two trimesters of gestation, but owing to foetal growth in late pregnancy the total feed requirements of the ewe increase significantly. Often, because of poor pasture growth, it is not possible to feed ewes adequately at this stage and the ewe has to rely partly on body reserves for foetal growth. Restricted feeding during this period is known to result in lowered birth weights of the lamb (Rattray *et al.*, 1974; Russell *et al.*, 1977). The extent to which a ewe's maternal reserves or body condition can compensate for nutritional deprivation is not known, and may have important practical implications in the feeding of pregnant ewes.

Two comparative slaughter experiments were conducted to provide information on the effect of ewe liveweight or body condition on foetal growth during late gestation.

EXPERIMENTAL

EXPERIMENT 1

From 200 six-year-old Coopworth ewes that had been synchronized with progestagen sponges, and mated to Suffolk rams, those carrying twins were diagnosed by X-radiography at approximately day 90 of gestation. These ewes were randomized on a liveweight basis into an initial slaughter group of 9 which was killed on approximately day 95 of gestation (to provide initial body and conceptus information) and five other groups that were offered for 6 weeks one of five feeding levels. These feeding levels were calculated to be 1.0, 1.25, 1.5, 1.75 and 2.0 times non-pregnant maintenance (M), which was assumed to be 40 g DM/kg$W^{0.75}$ (W = initial wool-free empty body weight). The diet was a pelleted mixture of 60% lucerne meal and 40% barley meal. Feed was offered individually in pens indoors, and was increased weekly in the following manner: 85, 90, 95, 100, 110 and 120% of the average nominal feeding level. The ewes were slaughtered at approximately 140 days of gestation, after being shorn and fasted for 18 hours. Slaughter and analytical procedures were similar to those used by Rattray *et al.* (1974).

EXPERIMENT 2

One hundred and ten 6-year-old Coopworth ewes were synchronized with progesterone sponges, then injected with 500 i.u. of PMSG, and mated to Suffolk rams. After mating the ewes were randomized into two groups, one of which was offered sub-maintenance grazing so as to lose weight (L/-) and the other offered liberal grazing plus supplementary feed so as to gain weight (H/-). At about day 90 of gestation the pregnancy status of the ewes was diagnosed by X-radiography, and initial slaughter groups taken on day 95. The remaining pregnant ewes were shorn and randomized on to two levels of feeding—approximately 1.0 and 1.75 × M (-/L and -/H, respectively). The aim was to have

TABLE 1: EFFECT OF FEEDING LEVEL DURING LATE PREGNANCY ON EWE BODY WEIGHT CHANGE, WOOL GROWTH AND WEIGHTS OF THE MAMMARY GLANDS AND COMPONENTS OF THE GRAVID UTERUS IN TWIN-BEARING EWES

Feeding Level ($\times M$)	*Ewe Empty*[a] *Weight Change* (*kg/6 weeks*)	*Wool Growth* (*kg/6 weeks*)	*Mammary Gland* (*kg*)	*Gravid Uterus* (*kg*)	*Foetus* (*kg*)	*Membranes and Placenta* (*kg*)	*Uterus* (*kg*)	*Fluids* (*kg*)
1.0 (n = 8)	−3.92	0.43	1.18	12.27	3.89	1.01	0.94	2.40
1.25 (n = 7)	−1.23	0.49	1.54	12.16	3.91	0.97	0.91	2.40
1.5 (n = 7)	−0.40	0.62	1.75	13.19	4.22	1.10	0.93	2.63
1.75 (n = 7)	1.99	0.65	1.58	13.67	4.49	1.21	1.00	2.45
2.0 (n = 8)	2.01	0.71	2.25	14.14	4.68	1.10	0.99	2.84
SE (diff)[b]	1.373	0.191	0.279	0.911	0.236	0.094	0.073	0.327
Significance								
among means	$P < 0.001$	n.s.	< 0.01	< 0.10	< 0.01	n.s.	n.s.	n.s.
linear trend	$P < 0.001$	n.s.	< 0.01	< 0.01	< 0.01	< 0.10	n.s.	n.s.
quadratic trend	P n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

[a] Ingesta-free, wool-free, conceptus-free basis.
[b] Average standard error of mean differences.

five animals per initial slaughter group and six per late-pregnancy feeding group, but errors in interpreting radiographs led to some alterations in final numbers. The diet and feeding regimes were similar to those used in Experiment 1 but the ewes were penned outdoors. The ewes were slaughtered on approximately day 135 of gestation.

RESULTS AND DISCUSSION

EXPERIMENT 1

The mean weights (kg) of the various components of the initial slaughter group were: gravid uterus 4.27, foetus 0.64 (males 0.66, females 0.61), membranes plus placenta 0.83, uterus 0.58, foetal fluids 1.36, mammary gland 0.31, and empty body weight 39.1. Empty body weight is on an ingesta-free, conceptus-free basis. The conceptus includes the foetuses, membranes plus placenta and foetal fluids.

Liveweights of each group are shown in Fig. 1. Ewe gains and weight of mammary glands, gravid uteri and foetuses all increased significantly with level of feeding (Table 1). Wool growth follow-

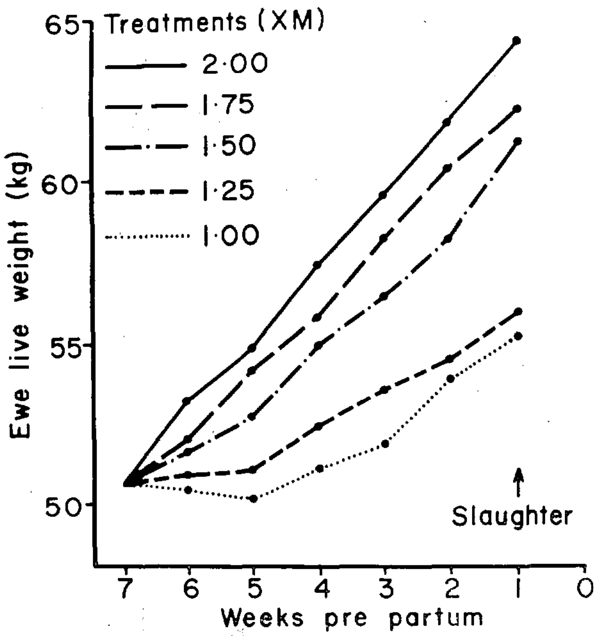

FIG. 1: *Ewe liveweights during Experiment 1.*

TABLE 2: WEIGHTS (kg) OF THE EMPTY BODY, MAMMARY GLANDS AND COMPONENTS OF THE GRAVID UTERUS FOR INITIAL SLAUGHTER GROUPS
(Day 95 of gestation)

Group	*Empty Body Weight*	*Mammary Gland*	*Gravid Uterus*	*Foetus*	*Membranes and Placenta*	*Uterus*	*Fluids*
Twins H (n = 6)	54.9	0.40	5.01	0.71	1.14	0.64	1.75
L (n = 5)	40.0	0.25	4.03	0.62	0.90	0.58	1.29
Singles H (n = 3)	46.2	0.36	2.32	0.68	0.70	0.39	0.73
L (n = 3)	35.2	0.21	2.21	0.56	0.67	0.37	0.59
SE[a]	6.31	0.084	0.420	0.056	0.154	0.084	0.168
Significance:							
Level of feeding	$P < 0.05$	< 0.05	< 0.05	< 0.05	n.s.	n.s.	< 0.05
Singles *vs.* twins	P n.s.	n.s.	< 0.001	n.s.	< 0.005	< 0.001	< 0.001

[a] Standard error of an observation—from analyses of variance.

ed a similar trend but was not significantly different among treatments. The membranes plus placenta, empty uterus and foetal fluids did not differ among treatments and followed no obvious trends.

Even though all groups gained liveweight (Fig. 1), ewes on the lower level of feeding lost a considerable amount of weight from their own body (Table 1). This is disguised by the increase in weight of the foetuses in particular and the fluids over this period. The liveweight changes of the ewe include the increase in weight of the mammary gland, so the actual loss from maternal tissues would be larger than that shown in Table 1.

Except for the highest feeding level there was considerable variation in empty weight change and foetal weight within each group, with foetal weight being negatively related to ewe weight change (r = —0.6 to —0.8) and positively related to the day 90 weight of the ewes (r = 0.7 to 0.8). Certain ewes deviated quite widely from the general relationships, suggesting that these ewes may have been genetically superior at diverting nutrients for foetal growth. Weight change of the ewe was itself related to initial weight (r = —0.6 to —0.7), with heavy ewes either losing more or gaining less than lighter ones, indicating that heavier ewes have greater maternal reserves that can be mobilized during underfeeding to support foetal growth.

Ewes at the low feeding levels lost considerable amounts of empty body weight but no cases of pregnancy toxaemia occurred. This was probably due to the type of feeding regimes adopted, with weekly increases in intake paralleling increases in foetal requirements. This might not have been the case if feeding levels had remained constant, or had declined during the last 2 months.

EXPERIMENT 2

After mating, the ewes averaged 57.7 kg and by day 90 after differential grazing in mid-pregnancy the two groups weighed 51.4 (L/-) and 67.2 kg (H/-), respectively.

The data for the initial slaughter groups are summarized in Table 2. By day 95 differences had arisen in weights of the mammary gland, gravid uterus, foetus, and foetal fluids due to level of feeding. Except for mean foetal weights, components from the dictocous ewes were heavier than those from the monotocous ewes.

The results for the animals slaughtered at day 135 of gestation after further differential feeding from day 95 are summarized in

TABLE 3: EFFECT OF DIFFERENTIAL FEEDING DURING MID AND LATE PREGNANCY ON EWE EMPTY BODY WEIGHT CHANGE, WOOL GROWTH AND WEIGHTS OF MAMMARY GLANDS AND COMPONENTS OF THE GRAVID UTERUS

(Day 135 of gestation)

Group	*Initial*[a] *Empty Weight (kg)*	*Empty*[a] *Weight Change (kg/6 wks)*	*Wool Growth (kg/6 wks)*	*Mammary Gland (kg)*	*Gravid Uterus (kg)*	*Foetus (kg)*	*Membranes and Placenta (kg)*	*Uterus (kg)*	*Fluids (kg)*
Twins LL ($n=8$)	35.6	−8.1	0.13	0.61	10.07	2.94	1.03	0.69	2.45
LH ($n=9$)	41.3	−2.1	0.17	1.19	11.03	3.43	1.05	0.89	2.20
HL ($n=6$)	48.4	−8.9	0.35	0.87	11.46	3.45	1.06	0.86	2.65
HH ($n=7$)	49.8	−4.1	0.30	1.49	12.14	3.73	1.09	0.93	2.71
Singles LL ($n=6$)	38.7	−5.9	0.15	0.52	5.74	3.56	0.61	0.61	0.99
LH ($n=3$)	37.2	−2.4	0.23	1.25	6.86	4.32	0.62	0.64	1.24
HL ($n=6$)	50.4	−7.3	0.35	0.71	6.62	4.04	0.67	0.68	1.22
HH ($n=6$)	51.5	−0.7	0.33	1.01	7.54	4.50	0.85	0.76	1.45
SE[b]	6.50	1.12	0.064	0.374	0.088	0.424	0.195	0.092	0.181
Significance:									
Level of feeding									
pre day 95 (L/- vs. H/-)	$P<0.01$	n.s.	<0.01	<0.05	<0.001	<0.001	<0.05	<0.001	<0.001
post day 95 (-/L vs. -/H)	P n.s.	<0.01	n.s.	<0.001	<0.001	<0.005	n.s.	<0.005	n.s.
Singles vs. twins	P n.s.	<0.05	n.s.	n.s.	<0.001	<0.001	<0.001	<0.001	<0.01

[a] Ingesta-free, wool free, conceptus-free basis.

[b] Standard error of an observation — from the analyses of variance.

Table 3. Weight losses were greater in this experiment than those in Experiment 1 at similar levels of feeding, probably because of the higher maintenance requirements caused by the outdoor housing and the shorn condition of the ewes. Level of feeding prior to day 95 of gestation had significant effects on the weights of all components but not ewe weight change. Feeding levels after day 95 influenced ewe empty weight change and the weights of the mammary glands, gravid uteri, foetuses and empty uteri, but not wool growth, membranes plus placenta and fluids. Placental development is virtually completed by the end of the second trimester of pregnancy (Rattray, 1977). There were significant interactions between level of feeding in late pregnancy and birth rank (single vs. twins), in foetal fluids ($P < 0.05$), and between levels of feeding in mid and late pregnancy for wool growth ($P < 0.05$).

Twin-bearing ewes lost more weight, and had lighter foetuses, than single-bearing ewes. However, their other components of the gravid uterus were heavier. In contrast to the findings of Rattray *et al.* (1974), the mammary glands were not significantly heavier for ditocous ewes.

Although the LH and HL ewes had similar foetal weights, the heavier HL ewes compensated for their lower level of feeding in late pregnancy by losing more weight ($P < 0.01$) to support foetal growth.

CONCLUSIONS

These experiments have shown that the body condition of the ewe in late pregnancy can influence the birth weight of lambs. Heavy ewes have greater maternal reserves than light ewes, and seem able to mobilize these to support foetal growth during long-term moderate underfeeding. In contrast, for ewes that are in poor body condition at the begining of the third trimester, it is essential that they be well fed ($1.75 \times M$) during the last 6 weeks of gestation if satisfactory birth weights, mammary development, and probably lamb survival, are to be achieved. For ewes which are well fed in mid-pregnancy, level of feeding in the last trimester is of lesser importance. These findings have important practical implications, as submaintenance feeding is commonly advocated after mating in seasons of pasture shortage (Coop and Clarke, 1969). This practice has its merits in conserving pasture *in situ,* but could lead to depletion of maternal reserves. Depleted maternal reserves in late gestation, in addition to influencing foetal growth, may have carryover effects on lactation in terms of onset of milk secretion and the levels or persistence of milk yield that can be achieved. Trials are continuing to examine these aspects and to define optimum pasture allowances so that recommended feeding levels can be easily put into practice in intensive and hill country situations.

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