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EFFECTS OF SUPPLEMENTS DURING PREGNANCY ON REPRODUCTIVE PERFORMANCE AND WOOL GROWTH BY MERINO EWES

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SUMMARY

During the last trimester of pregnancy single and twin-bearing ewes were fed chopped oat hay *ad libitum* and supplements (300 g/day) of cottonseed meal (CSM) (T1) or barley grain plus urea and sodium sulfate (Bar+N+S) (T2), or CSM and oat hay restricted to the level consumed by the T2 ewes (T3). T1 ewes consumed 47% more hay and approximately 13% more digestible organic matter than T2 ewes. T1 ewes had higher liveweight and condition score at parturition than T2 or T3 ewes, and birth weight of single lambs was also higher ($P < 0.05$). During lactation all ewes were fed oat hay *ad libitum* and 300 g CSM/day. Milk production at day 7 was lower for T2 (P c 0.05), but colostrum availability, milk production at days 14 and 21, and lamb growth were not affected by treatments during pregnancy. The lower birth weight of single lambs from ewes given treatments T2 and T3 appeared to be due principally to a lower roughage intake by these ewes during late pregnancy.

Keywords: ewes, pregnancy, lactation, nutrition.

INTRODUCTION

High protein supplements for ewes fed low quality roughage in late pregnancy can increase lamb birth weight, early milk production and lamb survival (Hall 1989; Hinch and Thwaites 1990; Lynch *et al.* 1990), but the importance of the rumen degradable protein and undegraded dietary protein components of the supplements is not clear. The objective of this experiment was to examine the effects on intake and ewe and lamb productivity of 2 high nitrogen (N) supplements for ewes fed low quality roughage *ad libitum* in late pregnancy. Cottonseed meal (CSM) and barley grain fortified with urea and sodium sulfate (Bar+N+S) were used as examples of supplements high in protein undegraded in the rumen and in protein degradable in the rumen respectively. An additional treatment consisted of the CSM supplement with intake of roughage restricted to that consumed voluntarily by ewes supplemented with Bar+N+S.

MATERIALS AND METHODS

The oestrus cycles of Merino ewes were synchronized and the ewes joined. From day 95 of pregnancy 36 ewes were housed individually indoors, and were treated with anthelminthic (Ivomec, Merck, Sharp and Dohme) on days 87 and 123 of pregnancy. Ewes were blocked on the basis of liveweight (LW) and dietary treatments allocated at random within blocks were imposed from day 103 of pregnancy until parturition as follows: T1, chopped oat hay fed *ad libitum* (20% excess) supplemented with 300 g/day of air dry CSM; T2, oat hay fed *ad libitum* supplemented with 300 g/day of air dry whole barley grain plus 30 mL aqueous solution containing 9 g urea N and 0.9 g sodium sulfate-S which was mixed with the barley immediately before feeding (Bar+N+S); and T3, oat hay fed at a level equal to that consumed by ewes in T2, and supplemented with 300 g/day of air dry CSM. Since these T3 ewes usually had some hay refusals when offered the same hay intake as T2 ewes, up to 10% excess hay was offered to T3 ewes. From parturition until day 21 of lactation all ewes were fed oat hay *ad libitum* and 300 g/day of CSM. All ewes were moved to metabolism crates on day 123 of pregnancy. Ewes which did not consume at least 80% of their previous intake by day 126 were returned to the pens along with the other ewes in their respective block. Faeces and urine were collected from day 13 1 to 137 of pregnancy from 18 ewes. Ewes were blood sampled before feeding and 6 h after feeding on day 140 of pregnancy for measurement of growth hormone (GH), insulin-like growth factor I (IGF-I), insulin and glucose concentrations in plasma (Campbell *et al.* 1990). At parturition lambs were weighed and the colostrum available 1 h after parturition was measured following oxytocin injection. Milk production between 20 and 24 h after parturition, and during 4 h intervals on days 7, 14 and 21 of lactation was similarly measured by machine milking and hand stripping, and the gross energy content of milk was calculated from milk DM content (Brett *et al.* 1972). Measurements were made of feed intake, LW and condition score (CS) of the ewes and LW of the lambs. Wool was clipped from 100 *x* 100 mm midside patches on day 122 of pregnancy and days 7 and 28 of lactation, and wool

samples were taken at shearing for staple strength. Results were analysed statistically to examine the effects of treatment, litter size and block using a generalized linear model procedures.

RESULTS

The oat hay contained 927 g OM, 722 g neutral detergent fibre, 405 g acid detergent fibre and 7.30 g N/kg DM, and *in vitro* OMD was 524 g/kg. CSM contained 63.8 g N/kg DM, and barley grain 17.7 g N/ kg DM. During pregnancy *ad libitum* intake of oat hay was 244 g/day higher ($P < 0.05$) with the CSM supplement (T1) than with the Bar+N+S supplement (T2) (Table 1). However OM digestibility was higher (P c 0.01) for T2 than for T1, so that average digestible OM intake of T1 was about 13% higher ($P <$ 0.05) than that of T2.

Table 1. Intake of hay DM by ewes fed hay *ad libitum* and 270 g/day CSM (T1) or 292 g/day Bar+N+S (T2) supplements or restricted hay and CSM (T3) during pregnancy, and T1 during lactation, and intake, digestibility and N balance of a subgroup of these ewes between days 131 and 137 of pregnancy

Effects of litter size and treatment x litter size interaction on intake were not significant

Measurement	T1	T2	T3	s.e.m.	Signif.
	Intake of hay DM by all sheep				
Number of ewes	11	12	12	–	–
Pregnancy days					
103–109	1101	831	885	118	*
110–116	1077	757	723	98	**
117–123	1028	683	641	89	**
124–130	709	479	491	110	*
131–137	776	585	528	113	*
138–146	776	574	562	106	n.s.
Lactation days					
1–21	1347	1137	1240	106	n.s.
	Total collection measurements				
Number of ewes	5	6	6	–	–
DM intake (g/day)					
Hay	939	640	586	66	**
Total	1206	929	853	66	**
OM digestibility (g/kg)	512	581	557	13	**
ADF digestibility (g/kg)	371	385	377	20	n.s.
Total N intake (g/day)	25.1	18.7	22.4	–	–
Faecal N (g/day)	9.8	6.1	8.2	0.43	**
Urine N (g/day)	8.8	5.7	9.0	0.80	*
N balance (g/day)	6.5	6.9	5.2	0.91	n.s.

*$P < 0.05$; **$P < 0.01$; n.s. not significant.

The mean condition score (CS) at day 99 of pregnancy was 2.8. Ewes fed T2 and T3 gained less LW and were lower in CS ($P <$ 0.05) at day 139 and at parturition than T1 ewes (Table 2). Also twin-bearing ewes were lower in CS than single-bearing ewes. Birth weight of lambs from T2 and T3 ewes were lower ($P <$ 0.05) than from T1 ewes (Table 3). Neither colostrum availability nor milk production 20-24 h after parturition was affected by treatment. Milk production for T2 ewes was lower than for T1 and T3 ewes at day 7, but no differences were observed later in lactation (Table 3). At day 140 of pregnancy twin-bearing ewes had higher ($P <$ 0.01) plasma GH concentrations, and 6 h after feeding lower ($P <$ 0.05) IGF-I concentrations than single-bearing ewes (Table 4). Bar+N+S supplement was associated with elevated ($P <$ 0.05) GH concentrations 6 h after feeding.

DISCUSSION

Even though approximately 14 kg of supplements was fed to each ewe during pregnancy, the low CS at parturition indicated that this level of the Bar+N+S supplement was barely adequate, particularly in

Table 2. Liveweight (kg), condition score, wool growth (mg greasy/patch/day) and staple strength (N/ktex) and milk production (MJ/day) of ewes bearing single lambs (S) or twins (T) and fed hay *ad libitum* and CSM (T1) or Bar+N+S (T2) supplements or restricted hay and CSM (T3) during pregnancy (P), and T1 during lactation (L)

Treat, treatment main effect; S/T, litter size main effect; Int, interaction effect

Measurement	T1		T2		T3		s.e.m.	Significance		
	S	T	S	T	S	T		Treat	S/T	Interaction
Number of ewes	5	5	9	2	4	6	–	–	–	—
Ewe liveweight										
Day 99 P	54.3	54.9	54.2	51.7	54.4	53.2	1.56	n.s.	n.s.	n.s.
Day 139 P	57.5	59.5	54.7	54.1	56.1	55.5	1.76	*	n.s.	n.s.
Day 1 L	51.9	48.7	48.0	42.7	51.9	46.3	1.85	*	**	n.s.
Day 21 L	51.6	49.6	49.0	43.0	52.1	47.2	1.98	n.s.	*	n.s.
Ewe condition score										
Day 99 P	2.8	2.9	2.9	2.5	2.7	2.9	0.18	n.s.	n.s.	n.s.
Day 139 P	2.2	2.0	1.9	1.3	2.2	1.5	0.16	*	**	n.s.
Day 1 L	2.0	1.6	1.7	1.0	2.0	1.5	0.15	*	**	n.s.
Day 21 L	1.6	1.3	1.4	1.0	2.0	1.3	0.23	n.s.	*	n.s.
Wool growth										
Day 122P–7L	115	107	74	47	92	85	11.5	**	n.s.	n.s.
Day 7L–28L	80	102	72	82	94	91	11.5	n.s.	n.s.	n.s.
Wool staple strength	15	13	12	12	15	11	1.3	n.s.	n.s.	n.s.
Milk production										
Day 7	8.9	8.9	7.4	7.3	9.2	9.1	0.71	*	n.s.	n.s.
Day 14	8.0	6.4	6.9	10.3	8.9	8.3	0.66	n.s.	n.s.	n.s.
Day 21	7.5	6.1	6.8	7.4	8.0	6.3	0.64	n.s.	n.s.	n.s.

*$P < 0.05$; **$P < 0.01$; n.s. not significant.

Table 3. Birth weight and liveweight of lambs at day 21 of age (kg)

Measurement	T1	T2	T3	s.e.m.	Significance
Birth weight					
Singles	4.6	4.2	4.3	0.04	**
Twins	3.4	3.4	3.1	0.19	n.s.
Day 21					
Singles	9.8	8.9	9.6	0.39	n.s.
Twins	5.7	5.7	5.3	0.19	n.s.

**$P < 0.01$; n.s. not significant.

:win-bearing ewes, to avoid excessive losses of ewe body reserves. The large difference in *ad Zibitum* hay intake suggests that in pregnant ewes substitution effects are much greater with cereal grain than with oilseed meal supplements, even when microbial substrates are adequate. Birth weight of single lambs appeared to be dependent on intake of metabolizable energy rather than undegraded dietary protein during late pregnancy since at similar hay intakes replacement of Bar+N+S (T2) with CSM (T3) should have substantially increased undegraded dietary protein supply. This suggests that for ewes fed low quality roughages the benefits of high protein supplements on lamb birth weight and survival (Hall 1989; Lynch *et al.* 1990; Hinch and Thwaites 1990) are associated with higher roughage intake rather than a direct effect of additional absorbed amino acids.

The dietary treatments imposed during pregnancy had little effect on milk production. Ewes in all treatments were able to produce sufficient milk for a high growth of single lambs, but were unable to increase milk production in response to increased milk withdrawal by twin lambs. Replacement of CSM

Table 4. Concentrations of growth hormone (GH, ng/mL), insulin-like growth factor I (IGF-I, ng/mL), glucose (mg/100 mL) and insulin (IU/mL) in plasma of ewes with single (S) or twin (T) foetuses at day 140 of pregnancy fed hay *ad libitum* and CSM (T1) or Bar+N+S (T2) supplements or restricted hay and CSM (T3)

Treat, treatment main effect; S/T, litter size main effect; Int, interaction effect

Measurement	T1		T2		T3		s.e.m.	Significance		
	S	T	S	T	S	T		Treat	S/T	Interaction
Number of ewes	5	5	9	2	4	6	–	–	–	–
GH										
0830 hours	5.2	8.9	6.5	9.5	5.0	7.3	1.18	n.s.	**	n.s.
1430 hours	6.8	9.5	8.8	17.9	6.8	9.6	1.39	**	**	n.s.
IGF-1										
0830 hours	176	161	144	173	159	131	12.4	n.s.	n.s.	n.s.
1430 hours	184	149	144	141	166	127	13.1	n.s.	*	n.s.
Glucose										
0830 hours	42.7	37.6	37.3	29.1	42.8	32.4	3.9	n.s.	*	n.s.
1430 hours	62.0	53.9	51.5	42.9	53.5	50.7	5.1	n.s.	n.s.	n.s.
Insulin										
0830 hours	13.3	11.5	14.3	10.9	17.6	16.3	2.26	n.s.	n.s.	n.s.
1430 hours	21.7	14.7	14.1	11.4	21.3	16.9	3.10	n.s.	n.s.	n.s.

*$P < 0.05$; **$P < 0.01$; n.s., not significant.

by Bar+N+S tended to reduce wool growth in early lactation, particularly in twin-bearing ewes, suggesting that additional undegraded dietary protein from CSM tended to maintain wool growth. In conclusion for ewes in late pregnancy CSM was more satisfactory than a cereal-grain based supplement, apparently due principally to a higher hay intake with CSM.

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