BRIEF COMMUNICATION: High crude protein in autumn pasture does not impair reproductive performance in sheep

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INTRODUCTION

Embryos exposed to ammonia may degenerate or their growth enhanced (McEvoy *et al.,* 1997). Kelly (1982) reported reproductive wastage of 24.9% in South Island sheep. New Zealand pastures contain high concentrations of crude protein (Chaves *et al.,* 2002) but whether reproductive wastage can partly be explained by ammonia and/or urea toxicity from high protein pasture is unknown. The aims of the present study were to determine the effect of plasma urea concentration on ovulation rate, embryo survival, conception rate and lamb birth weight in ewes joined with the ram on high protein pasture.

MATERIALS AND METHODS

In a Lincoln University Animal Ethics Committee approved study, four hundred and fifty four mature Coopworth ewes were adapted by feeding hay and barley grain for 10 days prior to joining with rams. Ewes were thereafter blocked by weight and body condition into two groups, then randomly allocated to diets of similar metabolizable energy (ME) concentration which provided either 214 g crude protein (CP)/kg dry matter (DM) of ryegrass/red clover pasture (RCP) (n = 227) or 119 g CP/kg DM of hay and barley grain as a supplement to a very short pasture (HB) (n = 227). Four harnessed entire rams were introduced to each group on the day diets commenced. At the end of each week after joining, ovulation rate (OR) in marked ewes was determined by laparoscopy. Fifty days after start of mating the number of fetuses was determined by ultrasonography. Embryo loss was the difference between OR and the number of fetuses. Urea concentration in plasma was determined at joining and at laparoscopy using a Cobas Mira Plus autoanalyser. Birth date was checked against laparoscopy and expected conception date to eliminate animals which had conceived to ovulations other than those observed. One hundred and thirty one ewes were excluded. The resultant sample size, live weight and body condition score prior to joining were n = 158, 60.2 ± 0.4 and 2.8 ± 0.03 in the RCP group and n = 165, 60.5 ± 0.4 kg and 2.8 ± 0.03 in the HB group respectively. Effects of diet treatment on ewe parameters, plasma urea concentration and birth weight were performed using the GLM procedure (SAS, 1999). Ewes, irrespective of treatment group, were categorized into high plasma urea (HU) and low plasma urea (LU) when their plasma urea concentration was higher or lower than the sample mean of 51.5 mg urea/dL at laparoscopy, and the differences between the two groups were examined as for diet treatments. Lambs which weighed greater than the mean plus one standard deviation for their litter size were classified as oversize. Analysis for proportions was carried out using Chi-square (SAS, 1999). Reproductive wastage data were analysed using the Proc Mixed procedure (SAS, 1999), with ewe size as a random factor. Results are reported as least square means ± standard error as appropriate

RESULTS

Mean live weight of ewes at laparoscopy and mean lamb birth weight were not affected (P >0.05) by diet treatment or urea category (Table 1). The proportion of lambs categorised as oversize and their mean birth weight was similar (P >0.05) between diet treatments and between urea categories. The proportions of lambs born as singles, twins or triplets and classified as oversized were 17.8, 9.3 and 18.2% and on average weighed 7.3 ± 0.2, 6.8 ± 0.2 and 5.9 ± 0.4 kg. Plasma urea concentration at laparoscopy was slightly higher (P <0.001) for RCP than HB ewes. HU ewes had significantly higher (P <0.001) plasma urea concentration than LU ewes.

Ovulation rate was similar (1.6 ± 0.1) for RCP and HB and between HU and LU ewes. Conception rate was not affected (P > 0.05). Embryo loss tended (P = 0.06) to be higher in the HB than RCP ewes but there was no corresponding difference between HU and LU ewes. There were also no differences between RCP and HP ewes or between HU and LU ewes for foetal loss, neonatal loss and total lamb loss (Table 2).

DISCUSSION

Diet type did not affect ovulation rate or conception rate, embryo mortality, fetal death or lamb viability. The lack of anticipated difference in plasma urea concentration between diet types may indicate that although ewes were kept on pasture less than 3 cm in length degradable protein intake was greater than anticipated. Even when ewes were categorised as having relatively high or low plasma urea concentrations, embryo mortality, fetal death rate and neonatal viability were similar. There are

TABLE 1: Average ewe live weight, plasma urea concentration and lamb birth weight of ewes of different plasma urea status in autumn pasture during mating. RCP = Ryegrass/red clover pasture; HB = Hay and barley grain as a supplement to a very short pasture; HU = High plasma urea; LU = Low plasma urea.

Parameter	Diet treatment			Urea category		
	RCP	HB	P value	HU	LU	P value
Urea concentration before joining (mg urea/dL)	49.6 ± 0.9	49.3 ± 0.9	0.71	51.1 ± 1.4	47.8 ± 0.5	0.03
Live weight at laparoscopy (kg)	59.4 ± 0.6	60.4 ± 0.6	0.15	60.1 ± 0.9	59.7 ± 0.4	0.64
Urea concentration at laparoscopy (mg urea/dL)	58.6 ± 0.6	56.1 ± .07	<0.001	65.4 ± 1.0	49.3 ± 0.4	<0.001
Lamb birth weight (kg)	4.9 ± 0.1	4.9 ± 0.1	0.77	4.9 ± 0.1	4.9 ± 0.1	0.76
Percentage of over size lambs (%)	13.3	12.1	0.74	12.0	12.3	0.93
Over size weight (kg)	6.7 ± 0.2	6.6 ± 0.2	0.99	6.6 ± 0.2	6.7 ± 02	0.78

TABLE 2: Reproduction and reproductive wastage of ewes of different plasma urea status in autumn pasture during mating. RCP = Ryegrass/red clover pasture; HB = Hay and barley grain as a supplement to a very short pasture; HU = High plasma urea; LU = Low plasma urea.

Parameter	Diet treatment			Urea category		
	RCP	HB	Pvalue	HU	LU	P value
Ovulation rate (%)	1.6 ± 0.1	1.6 ± 0.1	0.86	1.6 ± 0.1	1.6 ± 0.4	0.44
Conception rate (%)	92.1	92.1	0.99	92.3	92.0	0.99
Litter size (%)	1.5 ± 0.1	1.4 ± 0.1	0.62	1.4 ± 0.1	1.5 ± 0.04	0.10
Embryo loss (%)	10.9 ± 2.7	16.5 ± 2.8	0.06	13.3 ± 4.1	14.1 ± 1.8	0.84
Fetal loss (%)	6.4 ± 1.7	6.1 ± 1.7	0.86	7.9 ± 2.5	4.7 ± 1.1	0.21
Neonatal death (%)	3.8 ± 2.3	4.2 ± 2.3	0.86	4.0 ± 3.3	4.0 ± 1.7	0.99
Total loss (%)	22.5 ± 4.0	25.5 ± 4.0	0.52	24.5 ± 6.0	23.6 ± 2.5	0.89

two inferences from the lack of difference. Either both groups were affected to a similar degree or high plasma urea concentrations were without effect, possibly as a consequence of adaptation. A recent study with dairy cows (Ordonez *et al.,* 2007) similarly found no impairment of reproductive performance when serum urea was increased from 27 to 42 mg urea/dl as a result of urea fertiliser treatment of pasture. Plasma or serum urea concentrations in the present work and that of Ordonez *et al*. (2007) were 150 to 200% greater than the 30mg urea/dL reported by McEvoy *et al.* (1997) to be associated with abnormal embryo development in sheep. Plasma urea concentrations in excess of 40 to 50mg urea/dL are common in pastoral situations (Sykes, 1978) as are high reproductive rates (Davis *et al.,* 1987). This suggests either longer term adaptation to high plasma urea concentrations or a more complex relationship between diet and embryo development as discussed by Ordonez *et al* (2007).

Reproductive wastage in sheep in the South Island of New Zealand was estimated to be 24.9% (Kelly, 1982), similar to that recorded in the present study. This author and Kleemann and Walker (2005) noted embryo deaths of 15.1% and 14.7% respectively, a figure comparable to 14% found in the present study.

McEvoy *et al.* (1997) found that embryos that surviving the degenerative effect of ammonia had enhanced growth rates. In the present work both the high and low protein diets and the high and low plasma urea concentration groups had similar means and variances for birth weight suggesting lack of effect on development.

While we were unable to achieve large differences in plasma urea concentrations between diet types the high levels of plasma urea operating were consistent with normal reproductive wastage rates. Together with similar findings from studies in dairy cattle the data suggest either that, findings from controlled studies have a more complex aetiology or that pastoral animals can adapt to tissue ammonia/urea status resulting from large amounts of highly degradable protein in their diet.

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