THE EFFECT OF LITTER SIZE ON COLOSTRUM PRODUCTION IN CROSSBRED EWES

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SUMMARY

Adult Border Leicester X Merino ewes were fed a medium quality legume/grass hay (8.1 MJ ME/kg DM) from day 109 of pregnancy until 24 h after parturition. Colostrum production 90 min after birth was 218, 141 and nil g, and milk production for the remainder of the first day was 1597, 1263 and 402 g for single, twin and triplet-bearing ewes respectively. Progesterone concentrations before and after parturition increased with litter size. The reduced lactational output with increasing litter size may explain some of the losses due to starvation in multiple born lambs.

INTRODUCTION

The milk secreted prior to and shortly after parturition provides energy and nutrients in a concentrated form to the newborn lamb. This, together with initial lamb energy reserves, allows the lamb to survive the first few days of life (Mellor and Cockburn 1986). Colostrum also provides immunoglobulins which produce passive immunity in the newborn lamb (McCarthy and McDougall 1953). In addition an amount of colostrum may be needed by the lamb to ensure adequate ewe/lamb bonding as lack of early reward from sucking reduces the sucking drive (Alexander and Williams 1966). There are limited data relating colostrum production and litter size, and the relationship between number of lambs sucking and increased milk yield (e.g. Alexander and Davies 1959) may not apply at the onset of lactation. Alexander and Davies (1959) observed that a higher proportion of twin than single-bearing ewes had no colostrum at birth, and milk secretion rates at 12 to 14 h post-partum were lower for twin than single-bearing ewes (McCance and Alexander 1959). Also, lactose concentrations in colostrum were lower for twin than single-bearing ewes up to day one (McNeil1 *et al.* 1988) and up to day 4 (Thompson 1983) after parturition indicating a longer delay of lactogenesis. Thus increased mortality in multiple-born lambs may be partly caused by insufficient energy intake by the lamb because of low ewe colostrum production. The experiment reported here measured colostrum and early milk production in single, twin and triplet-bearing crossbred ewes. Some metabolite and hormone concentrations which may be associated with early lactation yields were also measured.

MATERIALS AND METHODS

Twenty adult Border Leicester X Merino ewes (59 kg s.e.m. $\pm$ 1.6) were mated from 1 (d 0) to 3 March 1988 after oestrous cycles *were* synchronised using intravaginal progestagen *sponges,* The ewes *were* maintained at approximately mating weight until entering an animal house on d 109. The feed from d 109 until after parturition was an equal mix of lucerne hay and grass/clover hay (87.3% DM) containing 2.1 g N/100 g DM and 8.1 MJ ME/kg DM and 2% of a standard mineral mix. On average 1216 g DM/d was fed and 1182 g consumed until d 134; this maintained maternal ewe weight. From d 135, 1200 g/d of feed was offered, an amount estimated to be approximately 60% of the energy and protein requirements of a twin-bearing ewe at d 141 (ARC 1980). Feed residues were collected each day, dried and weighed.

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Ewes were weighed and fat scored frequently from mating until after parturition and weights were adjusted to a fleece free basis. Body composition (Donnelly and Freer 1974) was estimated on d 133 and three days after lambing using tritiated water with a six h period of feed and water removal. Ewes were catheterised in a jugular vein on d 136. Blood samples via catheter or directly into heparinised syringes were obtained prior to feeding on d 133, d 140, daily from d 143 to parturition and also 90 min after parturition. The d 140 samples were analysed for glucose and 3-hydroxybutyrate (McMurray *et al.* 1984) and all samples were analysed for progesterone (Parr *et al.* 1987).

After parturition, lambs remained with the ewe until teat sucking was imminent, otherwise they were-removed after 90 min. They were then placed in an adjacent cage. The ewe was then given oxytocin ('Syntocin', Troy, Laboratories, 5 i.u. intravenously) and the ewe was milked by hand. The milking procedure was repeated at 5, 9, 14, 19 and 24 h post-partum. Dry matter content of each colostrum and milk sample was determined by freeze-drying. Lambs were bottle fed milk and to encourage bonding they were returned to their dam for about two min after each milking.

The effect of litter size (1, 2 or 3) on all of the parameters measured was analysed using one-way analyses of variance.

RESULTS

Table 1 Production of colostrum (g) after parturition and milk (g) 90 min to 24 h after parturition and 19 to 24 hours post-partum (adjusted to a 24 h period), dry matter of colostrum and milk (%), and glucose (mmol/1), 3-hydroxybutyrate (mmol/1) and progesterone (ng/ml) concentrations and standard error of mean of single, twin and triplet-bearing ewes

	Litter size			
	Single	Twin	Triplet	s.e.m.
Number of ewes	5	13	2	
Colostrum: yield	218	141	0	205
: DM %	44.1	44.9		4.2
Milk yield to 24 h	1597[c]	1263[b]	402[a]#	245
Milk from 19 to 24 h				
yield	2022[b]	1356[a]	702[a]	341
DM %	21.6[a]	24.7[a]	35.6[b]	8.8
Glucose d 140	2.58[b]	1.82[a]	1.75[a]	0.40
3-hydroxybutyrate				
d 140	0.59[a]	2.28[b]	3.39[b]	1.09
2 d pre-partum	0.87[a]	3.15[b]	4.22[b]	1.24
Progesterone				
d 133	9.1[a]	20.9[b]	21.7[b]	5.30
d 140	9.6[a]	15.9[b]	18.5[b]	4.13
12 h pre-partum	2.26	6.87	5.75	1.64
1 h post-partum	0.44[a]	1.37[b]	2.19[b]	0.67

Means in the same row with different superscripts differ significantly ($P<0.05$).

One-triplet-bearing ewe as other ewe had one functional teat from which no colostrum was obtained at the milking after parturition.

Table 2 Intake (g DM/d), live weight (kg), live weight change (g/d), estimated fat change (g/d), gestation length (days) and litter weight (kg) and standard error of mean for single, twin and triplet-bearing ewes

	Litter size			
	Single	Twin	Triplet	s.e.m.
Intake d 135- 144	1039	1011	932	64
Live weight: d 133	63.6	61.2	64.2	5.9
: d 1 post-partum	57.9	51.3	49.6	5.4
Weight change d 136 to d 145	-115	-30	-157	75
Fat change d 133 to d 3 post-partum	-221	-315	-344	166
Gestation length	146.7	145.8	146.5	1.5
Litter weight	4.76[a]	7.42[b]	8.96[c]	0.61

Means in the same row with different superscripts differ significantly ($P<0.05$).

As litter size increased, total milk production from 90 min to 24 h after parturition and milk production from 19 to 24 h decreased ($P<0.05$; Table 1). Glucose concentrations decreased and the concentrations of 3-hydroxybutyrate and progesterone between d 133 until after parturition increased with increasing litter size ($P<0.05$; Table 1). Triplet-bearing ewes also had the lowest roughage intake, highest fat loss, lowest fat score, lowest live weight after lambing and the least colostrum immediately after parturition although none of these values were statistically different to those from the other ewes (Tables 1 and 2). Over all ewes, fat scores averaged 1.5 at parturition. All of the single, eight of the twin and neither of the triplet-bearing ewes consumed all the feed offered from d 135 to parturition. The correlation of progesterone concentration after parturition, with colostrum production was -0.30 and with milk production for the remainder of the first day was -0.41 (both $P>0.05$).

DISCUSSION

Our results indicate that increased litter size reduces the amount of colostrum and early milk production. Other work (e.g. McCance and Alexander 1959; Mellor and Murray 1985) has shown that undernutrition of ewes during late pregnancy can also reduce the amount of colostrum and milk produced. The reduced colostrum and milk production in this experiment with increasing litter size strongly suggests that many multiple-bearing ewes may have inadequate lactational output for acceptable lamb survival. However, caution needs to be exercised when interpreting results of the triplet-bearing ewes due to the sample size of only one or two. If it is cold and wet, a situation common during paddock lambings, the chances of lamb death due to starvation will be further increased if initial lactation yields are low. Yet the ration offered was similar to feed which would often be available to autumn lambing ewes in Australia. The losses *in* live weight of the ewes and the *very* high concentrations of 3-hydroxybutyrate with some ewes indicates that many of the ewes were undernourished. The colostrum amounts were highly variable but there was evidence of a negative correlation with progesterone concentrations. This was consistent with the role of progesterone in inhibiting colostrum production. Lactogenesis could be hastened by low progesterone concentration which allows lactogenic hormones to become effective (Hartmann *et al.* 1973; Kuhn 1977) and thus the lower colostrum yields may not simply be due to a deficiency of energy and/or protein. Provision of the ration *ad libitum* would probably have had no major effect on the results as intake declined with increasing litter size, a result consistent with other experiments when ewes were fed roughage (Forbes 1970). Further experiments with multiple-bearing ewes in late pregnancy are required to establish the effects of nutrition on colostrum and early milk production, and on the role of hormones such as progesterone, in order to improve the supply of life-supporting nutrients to the neonate.

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REFERENCES

ALEXANDER, G. and DAVIES, H. (1959). Aust. J. Agric. Res. 10: 720.
ALEXANDER, G. and WILLIAMS, D. (1966). Anim. Behav. 14: 166.
ARC (1980). The Nutrient Requirements of Ruminant Livestock. (Commonwealth Agricultural Bureaux: Slough, Gt. Britain).
DONNELLY, J.R. and FREER, M. (1974). Aust. J. Agric. Res. 25: 825.
FORBES, J.M. (1970). J. Anim. Sci. 31: 1222.
HARTMANN, P.E., TREVETHAN, P. and SHELTON, J.N. (1973). J. Endocr. 59: 249.
KUHN, N.J. (1977). In 'Comparative. Aspects of Lactation' p. 165. editor M. Peaker. (Academic Press: New York).
McCANCE, I. and ALEXANDER, G. (1959). Aust. J. Agric. Res. 10: 699.
McCARTHY, E.F. and MCDOUGALL, E.I. (1953). Biochem. J. 55: 177.
McMURRAY, C.H., BLANCHFLOWER, W.J. and WRIGHT, D.A. (1984). Clin. Chem. 30: 421.
McNEILL, D.M., MURPHY, P.M. and PURVIS, I.W. (1988). Proc. Aust. Soc, Anim. Prod. 17: 437.
MELLOR, D.J. and MURRAY, L. (1985). Res, Vet. Sci. 39: 230.
MELLOR, D.J. and COCKBURN, F. (1986). Q. Jl. Exp. Physiol. 71: 361.
PARR, R.A., DAVIS, I.F., FAIRCLOUGH, R.J. and MILES, M.A. (1987). J. Reprod. Fert. 80: 317.
THOMPSON, G.E. (1983). Br. J. Nutr. 50: 151.