Maximising lamb growth rates

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Abstract

A study was undertaken to evaluate the relative importance of milk and pasture to lamb growth during lactation under a high performance lamb production system. A total of 285 East Friesian x Romney (EFxR), Finn x Romney (FxR) and Romney (R) maiden 2-tooth ewes lambed following insemination with semen from six high growth rate Poll Dorset and composite rams. Mean lambing date was 16 July 1998. Breed groups were run together in either single or twin mobs and fed at high levels of nutrition (pasture covers were maintained at 1400 kg DM/ha or greater throughout lactation). Average lamb growth rates from birth to 15 weeks of age were 343 g/d and 292 g/d for single and twin lambs, respectively. Single and twin lambs reared by EFxR ewes grew significantly faster than lambs reared by the other ewe breeds. Ewes were milked at 3-weekly intervals using oxytocin with EFxR ewes producing significantly more milk than the other breeds throughout lactation. Milk composition varied significantly between ewe breeds with FxR ewes producing significantly higher fat % and total milk solids ($P<0.001$) than the other breeds. Reduced overall milk solids from EFxR ewes lowered a 30% advantage in milk volume to approximately 20% in terms of total milk energy production. Although positive, the correlation between milk production and lamb liveweight was generally poor, indicating that non-milk factors had an additional influence on lamb liveweight gain. The relative importance of milk to lamb growth was examined by calculating theoretical metabolisable energy (ME) requirements for single and twin lambs and comparing them with the ME supplied in the milk produced by the ewes. Assuming that lambs harvest all of the milk produced by the ewes, it was found that even in an optimum grazing situation, twin lambs needed to acquire over a third of their energy requirements from pasture by the time they were 6 weeks of age. At this age, lambs were unlikely to have a fully developed rumen and the opportunity for the lamb to select high quality, highly digestible pasture components would be critical for maximum growth. Therefore, in a situation where feed is limiting, competition between ewes and lambs for highly quality feed is likely to restrict lamb growth rate. This is likely to occur even at peak lactation with well fed, high milk producing ewes.

Keywords: East Friesian, ewe milk production, Finn, lamb growth rates, Romney, 2-tooth

Introduction

In recent years, there has been considerable interest in sheep genotypes with improved milking ability for improving lamb productivity. The milk production of New Zealand's traditional breeds has been quantified (Geenty 1979) and the benefits of the increased ewe milking ability of Poll Dorsets compared to Romneys has been demonstrated by Muir *et al.*(1998). However, there is little information about the influence of recently introduced breeds such as the Finnish Landrace and the East Friesian, on ewe milking ability and lamb growth rate.

In 1998, an integrated lamb production project was initiated at the Poukawa Research Station with the objective of comparing the milking ability of East Friesian x Romney, Finn x Romney and pure-bred Romney ewes. This study also provided the opportunity to compare the theoretical inputs of milk versus pasture on lamb growth rate under a high performance situation.

Materials and methods

A total of 399, maiden 2-tooth ewes (East Friesian x Romney, EFxR; Finn x Romney, FxR; and Romney, R) were purchased from at nine properties (in order to give a good breed representation) and transported to the Poukawa Research Station in Hawke's Bay. Semen from six high growth rate rams was used to artificially inseminate the ewes on 18 February 1998 after oestrus synchronisation using CIDRs. Mean lambing date was 16 July with 285 ewes lambing as a result of the synchronised mating programme.

The ewes were farmed on an area of generally old pasture (comprising ryegrass, annual grasses, and sub clover) and a balance of flat and rolling terrain.

Supplements (silage and barley) were fed as required during a period of drought from January to June. This also allowed average pasture covers to be built up to a desired minimum of 1400 kg DM/ha at lambing. Ewes were drafted into single- and twin-lambing mobs, based on pregnancy scanning data, and set-stocked in lambing paddocks 1 week prior to lambing. They remained in these mixed breed mobs throughout lactation. Stocking rate was conservative (approximately 8 ewes/ha) as a result of autumn drought conditions and partly because of the desire to have optimum feeding conditions over lactation to maximise performance. Surplus feed was harvested off the farmlet as baleage according to normal farm practice. Preventative treatments for internal and external parasites were administered and ewes were vaccinated against clostridial diseases.

Ewes were weighed and scored for body condition after mating, 2 weeks before lambing and at 6, 9, 12 and 15 weeks after lambing. Lambs were tagged and weighed at birth and re-weighed at 3-week intervals.

A sub-group of ewes (40 ewes from each breed, with equal numbers of single- and twin-lambing ewes) were milked at 3, 6, 9, 12 and 15 weeks after lambing. Ewes were machine-milked using a portable milking plant after injection with oxcytocin to stimulate immediate and complete milk let-down. The ewes were then separated from their lambs for 4 hours and then milked again using oxytocin (Corbett 1968; McCance 1959). Daily milk yield of the ewes was estimated from this "4-hour milk yield". Ewe and lamb liveweights were also recorded at this time. Milk samples were collected and analysed for protein, fat, lactose, and total solids.

The effect of sire, ewe breed, lamb sex, and rearing rank on milk production, milk composition, and lamb growth was analysed using the least-squares method (SYSTAT, Version 8.0, SPSS Inc. 1998). The analysis also examined the interaction of ram by ewe breed and the interaction of rearing rank on birth and 12-week lamb liveweight.

From the lamb liveweight and liveweight gain data, theoretical metabolisable energy (ME) requirements were calculated for single and twin lambs and compared with the ME supplied in the milk produced by the ewes. The gross energy content of milk was calculated from the fat, protein and lactose percentages of the milk (Table 1) using the factorial method (McDonald *et al.* 1973). Digestibility and metabolisability of milk components were estimated using the data of Blaxter (1962), Blaxter & Martin (1962), Joyce & Rattray (1970) and Ben-Ghedalia *et al.* (1976). ME requirements for growing lambs were calculated using data on lamb ME published by ARC (1980) and Geenty & Rattray (1987). In comparing ME requirements of lambs and ME supply by the ewes, an assumption was made that lambs harvested all of the milk produced by the ewes. It seems likely that this overestimated lamb milk consumption, though it was not possible to measure actual milk consumed.

Results and discussion

High levels of feeding were achieved over the experiment despite a period of drought during winter. Pasture growth rates were optimum during August (32 kg DM/ha/day) and September (66 kg DM/ha/day) resulting in average pasture covers being in excess of 1400kg DM/ha throughout lactation. Ewes averaged 60 kg at mating and increases in ewe liveweight gains of 12kg over the 15 weeks of lactation suggested that ewe milk production (Figure 1) was not limited by feed availability.

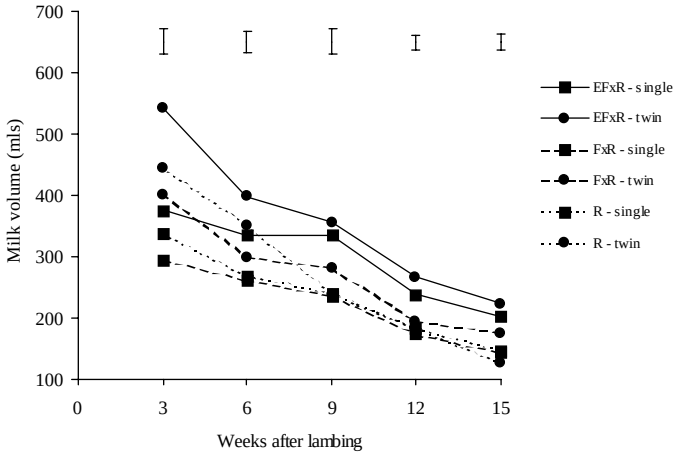
At peak lactation (3 weeks after lambing), there was almost a two-fold difference in milk production across the breed x rearing rank treatment groups (Figure 1). East Friesian x Romney ewes produced more milk than the other breeds throughout lactation, whilst R ewes produced more milk than FxR ewes only at peak lactation and for the rest of lactation the differences between FxR and R ewes were small. Twin-rearing ewes produced more milk than those rearing single lambs during the first 6 weeks of lactation, and in the remainder of lactation, twin-rearing ewes produced significantly more in three of the nine comparisons.

There were also significant differences in the concentrations of milk components between breeds (Table 1), particularly with regard to the percentage of fat and total solids, with FxR ewes producing significantly higher fat % ($P<0.001$) and total milk solids ($P<0.001$) than the other breeds. Therefore, even though EFxR ewes produced on average 30% more milk than either FxR or R ewes, the reduced overall milk solids concentration reduced the overall advantage in total milk-energy production to approximately 20%.

Table 1 Mean (± SEM) milk composition for East Friesian x Romney, Finn x Romney and Romney ewes measured over 15 weeks of lactation. For breed comparisons, numbers with different superscripts are significantly different ($P<0.05$).

Breed	Fat (%)	Protein (%)	Lactose (%)	Total solids (%)
East Friesian x Romney	8.4 [a]	5.8 [a]	5.5 [a]	20.4 [a]
Finn x Romney	10.2 [b]	6.0 [b]	5.4 [b]	22.3 [b]
Romney	8.5 [a]	6.2 [ac]	5.4 [b]	20.8 [ac]
Mean (over all breeds)	9.0	6.0	5.4	21.2

Figure 1 Four-hour milk production in East Friesian x Romney, Finn x Romney and Romney ewes rearing single and twin lambs over 15 weeks of lactation. Error bars indicate standard errors of mean milk production.



Average lamb growth rates from birth to 15 weeks were 343 g/d and 292 g/d for single and twin lambs respectively, and clearly demonstrate a high performance system (Table 2). Both single and twin lambs reared by EFxR ewes grew faster and were significantly heavier at 15 weeks ($P<0.001$) than lambs born to the other ewe breeds (Table 2). Whilst it is tempting to associate the increased lamb growth with the increased milk production of EFxR ewes, there is evidence that increased lamb growth rates may be also due to lamb genotype (i.e., mature size effect) and to hybrid vigour (Muir, unpublished data) for ewe milk production. Moreover, the half-East Friesian ewes in the present study produced similar daily milk yields to pure Poll Dorset ewes (Muir *et al.* 1998). Although the Poll Dorset ewes were milked in a different season, feeding conditions were very similar and lambs reared by Poll Dorset ewes grew only slightly faster than lambs reared by Romney ewes.

Although there was a positive correlation between milk production and lamb live-weight gain, the statistical correlation was generally poor ($r = 0.4$) in both ewes rearing singles and those rearing twins over the first 6 weeks of lactation. This may have two possible explanations. Firstly, the potential milk production being measured using oxytocin does not reflect the actual milk consumption of the lambs – e.g., behavioural interactions between the ewe and lamb(s) may influence their level of milk consumption. The second possibility is that given an adequate level of high quality pasture, lambs can substitute pasture for declining milk supply (Geenty 1979).

The critical role of pasture can be demonstrated from the data collected. Figure 2 shows, for both single and twin lambs, the calculated percentage of ME requirement met by ewes' milk (averaged across all breeds) and, by difference, the theoretical residual energy requirement of the lambs to be met by grazing, averaged across all ewe breeds. Even under the optimum feeding conditions in the present study, it appears that single lambs, without competition for milk by a sibling, obtained about 15% of their nutrient requirements from pasture 6 weeks into

Figure 2 The percentage of total ME requirement met by ewes' milk (averaged across all breeds) for both single and twin lambs, and, by difference, the theoretical residual energy requirement to be met by grazing.

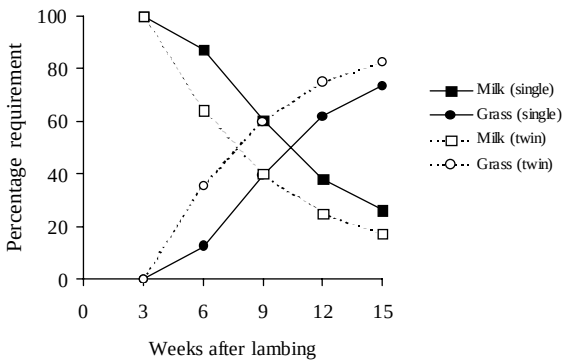


Table 2 Mean (± SEM) liveweight at age 15 weeks and corresponding liveweight gain over that period for single and twin lambs born to East Friesian x Romney, Finn x Romney and Romney ewes. For breed comparisons, numbers with different superscripts are significantly different ($P<0.05$).

Breed	Liveweight at 15 weeks (kg)		Liveweight gain from birth to 15 weeks (g/d)	
	Single	Twins	Single	Twins
East Friesian x Romney	44.5 [a]	37.9 [a]	374 [a]	323 [a]
Finn x Romney	39.6 [b]	32.9 [b]	334 [b]	278 [b]
Romney	39.3 [b]	33.3 [b]	322 [b]	275 [b]
Mean (over all breeds)	41.1	34.7	343	292

the lactation. At the same time, twin lambs were required to acquire over a third of their energy requirements from pasture. If the assumption that lambs consume all the milk produced by the ewes is indeed an overestimate, the lambs' requirement for pasture as an energy source is correspondingly underestimated.

During early- and mid-lactation, lambs are unlikely to have achieved full rumen function and the opportunity for lambs to select high quality, highly digestible pasture components will be critical for maximum growth rate. This emphasises the importance of providing high quality, digestible forage to the ewe and lamb(s) during lactation. It is probable that under any situation where feed is limiting, competition between ewes and lambs for highly quality feed will restrict lamb growth. This is likely to occur even at peak lactation with well fed, high milk producing ewes.

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