Do ewes with twin and triplet lambs produce different yields of milk and does the grazing behaviour of their lambs differ?

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ABSTRACT

This trial was designed to determine if ewes with triplets produce more milk than those with twins, and, if not, do triplet lambs compensate by extra grazing. Milk yield (MY) of ewes with twin (n=13) and triplet (n=8) lambs, grazing pasture in spring was measured four, seven and ten weeks postpartum. Ewes and lambs were separated in the morning and MY was measured by the oxytocin method. MY did not differ in ewes with triplets (2525±243 g/d) from that in ewes with twins (2204±149 g/d) at week four, week seven (1847±238 versus 1684±111 g/d), or at week ten (1448±139 versus 1264±85 g/d). NIRS analyses showed no significant consistent difference in fat (triplet: twin 7.7: 7.5±0.4%), protein (4.4: 4.3±0.2%), lactose (4.71: 4.72±0.03%) and total solids (17.48: 17.36±0.35%) composition of milk from ewes with triplet or twin lambs (data are means of all samples). Mammary gland dimension B, the distance across the gland next to the teats, was better correlated (R^2 0.31, $P<0.05$) with MY than other dimensions tested. Behaviour observations (whether the lamb was grazing or suckling) were made weekly 3-9 weeks postpartum. The time spent grazing by triplets (39.4±1.94 % on lactation day 29) was significantly greater ($P<0.05$) than the time spent grazing by twins (37.7±1.94% on lactation day 29) on three observation days and, overall, triplet lambs spent more time grazing than twin lambs. Birth weight of twin lambs (4.39±0.14 kg) was not significantly greater than that of triplets (4.00±0.20 kg), but they grew significantly faster ($P<0.05$) from week four till week ten, gaining 17.0 kg compared to 14.9 kg for triplets. Triplets suffer a relative lack of available milk nutrients compared to twins and are not able to completely compensate for this by increasing grazing time.

Keywords: milk yields, milk composition, mammary gland dimensions, sheep, twins, triplets

INTRODUCTION

Triplet-born lambs display lower survival and growth rate to weaning compared to their twinborn counterparts (Morris and Kenyon 2004). Lower individual milk intake is likely to be a contributing factor. Under New Zealand pastoral conditions milk production of triplet-bearing ewes has not been thoroughly examined although it is well established that twin-bearing ewes produce proportionally less milk per lamb than their single-bearing counterparts (Doney & Munro, 1962; Moffat *et al.*, 2002; Peterson *et al.*, 1997; 2005). Since ewes with twins usually produce about 25% more than do ewes with single lambs, it is conceivable that ewes with triplet would produce a similar amount more than ewes with twins. However, in overseas reports, triplet-bearing/rearing ewes have not produced more colostrum or milk in the first 24 hours post-partum (Shubber *et al.*, 1979; Hall and Egan, 1988; Hall *et al.*, 1990) or in late lactation (Peart, 1972) compared to twin bearing/rearing ewes. Morris and Kenyon (2004) reported that during late pregnancy and lactation, feed intake of triplet-and twin-bearing/rearing ewes did not differ. This may suggest that triplet ewes are in a state of relative under-nutrition. Under-nutrition in late pregnancy negatively affects colostrum yield, colostrum quality, total milk yield and peak lactation (Thompson and Thompson 1953; McCance and Alexander 1959; McDonald 1962).

If triplet lambs have less milk available on a per lamb basis they may compensate by starting to graze herbage at an earlier age or, at a given time period, spend more time grazing and, thus, increase herbage intakes compared to twin lambs, although this is also not known. Moffat *et al.* (2002) reported that twin lambs compensated for less milk intake by spending more time grazing, however, they were still lighter at weaning than singletons.

The aims of the present study were first, to determine if triplet-rearing ewes produced proportionally more milk than their twin-rearing counterparts, second, to determine if the composition of the milk differed, and third, to determine if triplet-reared lambs spent more time grazing than their twin-born counterparts. An additional aim was to determine if mammary dimensions could be used to predict milk yield.

MATERIALS AND METHODS

Animals

Twenty-one five-year-old, Romney ewes (13 twin-bearing and 8 triplet-bearing) were ultimately used in the milk-yield study and up to 32 twin lambs and 39 triplet lambs included in the behaviour study. During the grazing observation and milking period they were grazed as one group. Ewes were set stocked and, although pasture DM intake of the ewes was not estimated, the minimum pasture cover was 1200 kgDM/ha indicating that they were not underfed during lactation. At lambing, ewes with twin and triplet lambs were included if they safely delivered the appropriate number of lambs indicated by previous scanning. Ewes were removed from the trial if one of their lambs died or if they had mastitis that did not respond rapidly to treatment. The Massey University Animal Ethics Committee approved this work (AEC 04/25).

Treatments

The experiment was carried out in late spring (milking in October and November) at Massey University's Keeble farm, three kilometres south west of Palmerston North (latitude 40.23° S and longitude 175.37° E). At mating, oestrus was synchronised in all ewes using progesterone CIDRs.

Ewes were milked on one day during each of weeks four, seven and ten of lactation. Milk yield of the ewes was estimated by the "oxytocin method" first described by McCance & Alexander (1959). The technique involves i.v. injection of 1 i.u. oxytocin V (Vetpharm LTD) then emptying the udder by machine and hand milking, and repeating the milking procedure a measured time (about 6 h) later, at which time the milk yield is measured. A sample (~20 ml) was collected from each ewe at the afternoon milking. The lambs were separated from the ewes (and bottle fed as required) during the 6-h period. Before each milking, the udder of each ewe was measured, as described by Mellor & Murray (1985). Dimension A was the mean of three vertical measurements across and between the teats. Dimension B LR was one lateral measurement across the gland at the teats. Dimension B TB was one vertical measurement on the midline between the teats. Dimension C was the circumference of the gland at the base. The ewe was held on its rump in a semi-upright position during measurement.

Milk samples were preserved with 0.03% bronopol (2-bromo-2nitro-1,3-propanediol (Aldrich Chemical Company. Milwaukee) and refrigerated at 4° C until analysed one day later by NIRS (at AgResearch, Palmerston North). The assay was calibrated by comparing NIRS values with those obtained by "wet chemistry" for a range of samples.

On days 19, 22, 26, 29, 33, 40, 47, 54 and 68 of lactation, lamb behaviour was observed, by interval observations, in two two-hour periods, at fixed times in the morning and in the afternoon by two observers. Each day, before observations, the paddock was divided into two parts by an electric fence and the sheep were divided into groups (twins & triplets). After observations, the fence was removed and the sheep were mixed again.

Each fifth minute, the total number of twins and triplets grazing or suckling was recorded. It was assumed they continued this behaviour for the entire five-minute interval (Penning & Rutter, 2004). The total percentage of time twins and triplets spent on grazing or suckling during each observation period of each day was calculated.

At birth and on day 18, the first day of the trial, all lambs were weighed. Weighing was repeated on the milking days (day 28, 49 and 70) during the time between the morning and afternoon milkings.

Statistical Analyses

Multivariate (repeated measures) analysis of variance was used to analyse all time-series data. No adjustments were made for live weight of the ewes. The computer programme was REG (Gilmour, 1990). Behaviour data was analysed by analysis of variance for each observation period. Pearson's correlations were used to relate mammary gland dimensions with milk yield.

RESULTS

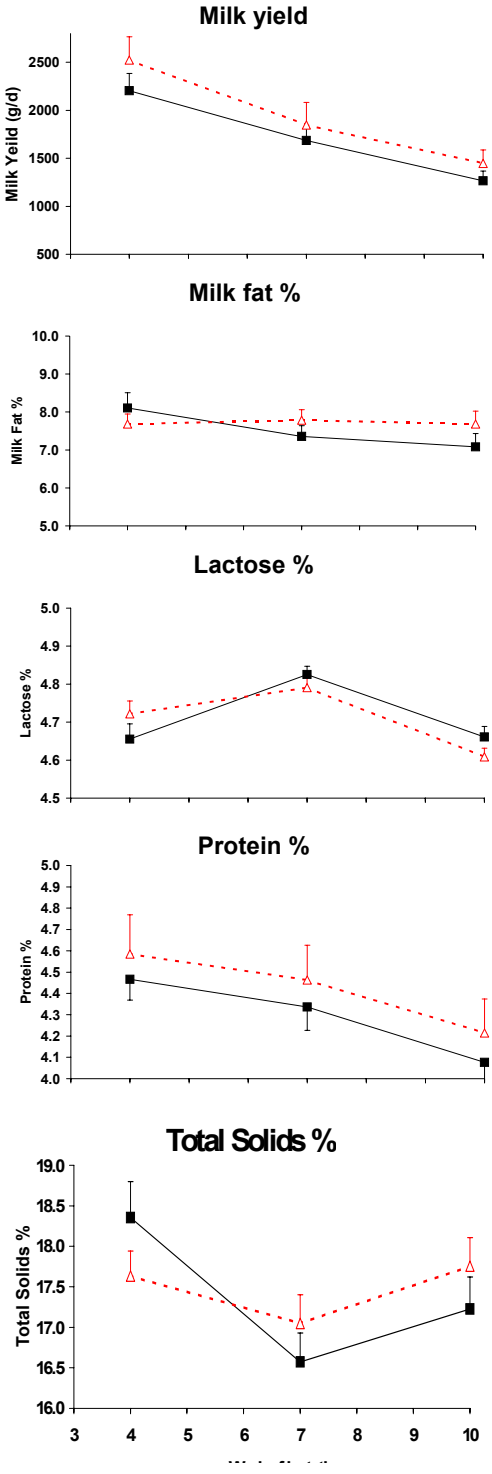
Mean milk yield did not differ significantly between the ewes with twin lambs and those with triplets (Table 1). Twin- and triplet-bearing ewes showed a similar decrease in milk yield from the fourth till the tenth week of lactation. Similarly, there were no significant differences in the mammary gland dimensions between the ewes with twin lambs and those with triplets (Table 1). Pearson's correlations of milk yield and Dimension A, Dimension B LR, Dimension B, TB and Dimension C, showed that milk yield correlated best with Dimension B LR. The regression equation was: Milk yield = -690 + 37.3 Dimension. B LR ($R^2 = 0.312$)($P<0.05$).

TABLE 1: Mean±SEM milk yield and pre-milking mammary gland dimensions of groups of Romney ewes with twins and ewes with triplets at days 28, 49 and 70 of lactation. There were no significant differences between ewes with twins and those with triplets.

Group	day 28 milk yield (g/d)	day 49 milk yield (g/d)	day 70 milk yield (g/d)	Dim. A (cm)	Dim. B LR (cm)	Dim. B TB (cm)	Dim. C (cm)
Twin (n=13)	2204±149	1684±111	1264±85	70.1±1.1	30.0±0.4	24.3±0.4	65.1±0.9
Triplet(n=8)	2511±193	1847±238	1448±139	72.2±1.3	31.2±0.5	24.7±0.5	64.4±1.0

Mammary gland dimensions are the means of measurements made on days 49 & 70 in the afternoon before milking. Dimension A is the mean of three vertical measurements across and between the teats. Dimension B LR is one lateral measurement across the gland at the teats. Dimension B TB is one vertical measurement on the midline between the teats. Dimension C is the circumference of the gland at the base.

Figure 1: Mean±SEM daily milk yields, milk fat, lactose, protein and total solids concentration (%) of milk of groups of ewes with twins (n=13; ■—■) and ewes with triplets (n=8; Δ-------Δ) at days 28, 49 and 70 of lactation.



Composition of milk from ewes with twins and those with triplets did not differ significantly during the sampling period (Figure 1) although there was a tendency for protein concentration to be higher in ewes with triplets than in those with twins, whilst milk fat and total solids showed that trend only for the latter two sampling dates. Milk fat percentage (MF%) remained between 7 and 8 % and lactose was between 4.6 and 4.8 %. Protein concentration declined over the three sampling days, lactose increased then declined, whilst total solids declined then increased at week 10.

On three lactation days (29, 40 and 47), triplets spent significantly ($P<0.05$) more time grazing than twins (Figure 2). On the other observation days the time spent grazing was not significantly different between twins and triplets. Percentage of time spent on grazing increased for both rearing ranks (twins 19.8% - 39.2% and triplets 22.7% – 41,9%) over the nine observation periods (data not shown). However, overall, triplet lambs spent more time grazing than did twin lambs ($P<0.05$).

Figure 2: Proportion of time (%) spent grazing by twin lambs (■———■) and triplet lambs (Δ-------Δ) versus age for nine observation days. The number of twin/triplet lambs was 32/39 at the first observation and declined to 28/24 at the last observation. Asterisks indicate significant differences on three days ($P<0.05$).

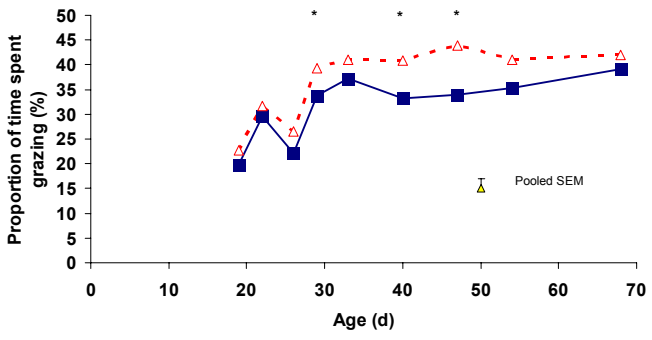


TABLE 2: Mean±SEM live weight (kg) and growth rate (ADG, g/d) of groups of Romney twin and triplet lambs at age 1,18, 28, 49 and 70 days. Means in columns with differing superscripts differ significantly (P<0.05). The number of twin/triplet lambs was 32/39 at day one and declined to 28/24 at day 70.

	Age					ADG
(d)	1	18	28	49	70	(g/d)
Twin	4.39±0.14	8.83±0.28	10.89±0.32[b]	16.40±0.46[b]	21.4±0.61[b]	243
Triplet	4.00±0.20	8.02±0.28	9.21±0.35[a]	14.34±0.52[a]	18.9±0.68[a]	213

Triplets spent a significantly (P<0.05) greater proportion of time suckling than did twins on three of the nine observation days (day 19 twin 3.1±0.1%; triplet 5.1±0.1%, day 22 twin 1.5±0.1%; triplet 3.1±0.1%, day 29 twin 1.0±0.1%; triplet 1.4±0.1%). The time spent suckling decreased for both rearing ranks (for twins from 3.1% to 0.3% and triplets from 5.0% to zero) during the period of observations.

Twin lambs were not born significantly heavier than triplets, but grew significantly faster (P<0.05) from week four till week ten (Table 2) resulting in a weight gain of 17.0 kg for twins compared to 14.9 kg for triplets, which is 243 and 212 g/d respectively.

DISCUSSION

Davis *et al.* (1980) measured mammary volume by water displacement and found it to be a good indicator of milk yield, however that method is slow and inappropriate for large numbers of sheep. In this trial, mammary gland dimension B LR, the distance across the gland at the level of the teats prior to milking, was shown to be a simple indicator of the milk yield of the ewe and better than the other dimensions proposed by Mellor *et al.* (1985). It is possible that adequate estimates of milk yield may be obtained by milking the ewe with oxytocin and separating her from her lamb for about sixurs before measuring the gland, thus removing the need for the usual second milking.

Ewes with triplets did not have bigger mammary glands, or produce significantly more milk, or milk of a different composition compared to ewes with twin lambs. Hence, a triplet is at a nutritional disadvantage compared to a twin lamb in terms of milk. Furthermore, although triplets are usually smaller/lighter than twin lambs, in this trial, triplets were not significantly lighter at birth than the twins (and no reason is apparent for this result). To partially compensate for the proportionately lower supply of milk, the triplets spent more time grazing than did twins, which is in agreement with the report by Moffat *et al.* (2002) who found that twin lambs spent more time grazing than did singles. The increase in grazing time and decrease in suckling time as lactation proceeds agrees with previous studies (Spedding *et al.*, 1963; Hodge, 1966; Joyce & Rattray, 1970; Domingo *et al.*, 1972) in which herbage intake generally increases as milk intake decreased, and although Hinch (1989) reported that lambs in larger litters suckled more frequently but for a shorter time, such behaviour was not consistently observed in this trial.

There was no difference in milk composition between the ewes with triplets and those with twins, therefore there is no ability for the ewe to compensate for the difference in milk volume available to twin and triplet lambs. The apparent increase in total milk solids in week 10 is consistent with changes in milk composition in dairy cows late in lactation and similar to values reported for Merino and Corriedale ewes (Moore, 1966) but cannot be explained in the current trial since protein and lactose concentration decreased and MF% did not increase at that time. MF% at four weeks is the same, protein levels are about 2% lower, and lactose about 0.9% lower than the equivalent values reported by Peterson (1992). The MF% values are similar to values in Romney ewes (Perren, 1958), in Merinos (Moore, 1966) and in Cheviots (Noble *et al.*, 1970).

The milk yields estimated in the ewes with twins were very high compared to those reported by Peterson *et al.* (2005; 2006) at equivalent stages of lactation on a nearby farm. Whilst this probably reflects the fact that they were different sheep on a different farm it is possibly an artefact due to the low number of milkings (three) carried out in this trial compared to the high number (twelve) in that trial. Muir *et al.* (1998) reported milk yields in ewes with twins approximately 300 g/d higher at three milking times each one week earlier in lactation than those reported in the present study. In future studies, milking needs to be started earlier in lactation to determine if early and/or peak milk yields differ between ewes with twins and those with triplets. Nevertheless, it is most likely that in conditions in which MY is lower, triplets will be at an even greater disadvantage compared to twins. It

is likely that the early lactation potential milk yield of ewes is determined during pregnancy by the size of the placenta but that nutrition during lactation can alter yield, so improved nutrition should increase the milk yield of ewes. However, since triplet-bearing ewes grazing pasture are unable to eat more than ewes with twins (Morris & Kenyon, 2004) it is unlikely that providing more pasture to a flock will substantially improve the growth of triplets compared to twins. To achieve that it is likely that ewes with triplets would need to be preferentially fed a higher-quality diet.

In conclusion, this trial has shown that triplets do not grow as fast as twins because they have less milk available, they did graze more to compensate for the lower amount of milk, and that the composition of milk produced by ewes with triplets did not differ from that of ewes with twins.

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