THE YIELD AND COMPOSITION OF MILK FROM MERINO SHEEP

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SUMMARY

The milk production of a flock of *27* Merino ewes of two different *genotypes* and four different age groups was measured for 13 weeks after lambing. Seventeen of the sheep received 1 kg lupin/head/day in the last week of pregnancy. Samples of the milk were collected and analysed for fat, protein, lactose and total solids. At the fifth week of lactation a measure of the udder volume was taken. The ewes produced a raw mean of 1.23±0.04 l/day of milk during th *13* weeks of lactation, with a peak of *1.75* ± 0.1 l/day in the third week. The two genotypes did not differ in either milk quantity or composition. Ewes fed lupins produced significantly more milk than the controls (1.50±0.07 l/day and 1.25±0.06 l/day respectively; least squares mean). The analysis of the milk was as follows: fat: 8.48±0.23%; proteins: 4.85±0.07%; lactose: 5.46±0.03%; total solids: 19.70±0.30%. There was a positive correlation between fat and total solids (r=0.89). Protein content was positively related with fat and total solids (r=0.26; r=0.45). The protein content of the milk was affected by ewe live weight ($P<0.01$) and lamb birth weight ($P<0.05$). Milk production was negatively related with protein and total solids contents (r=-0.27; r=-0.15), but unrelated to fat percentage (r=-0.09). Udder volume and total milk produced were positively correlated (r=0.71).

INTRODUCTION

Australia imports annually some *$8* million worth of sheep cheese and the estimated potential market for all sheep dairy products is *$60* million (Dawe and Langford 1987). This situation has prompted an increasing interest in sheep dairy farming. In Australia there are no specialised dairy sheep breeds. Therefore it is of interest to test the existing breeds to determine their potential as dairy animals. Because the Merino is the most widespread breed in Australia the present study was designed to determine the milking potential of Merino ewes and to analyse the milk components that influence cheese quality and quantity.

MATERIALS AND METHODS

Twenty-seven *Merino* ewes that had given birth to single lambs during a two day period were milked weekly from parturition to nine weeks, and then again at 13 weeks after lambing. Eighteen ewes were AMS (Australian Merino Society) Merino, while the remainder were Meridales. The latter breed was developed by crossing the Merino with a variety of non-Merino breeds and then back crossing to the AMS Merino. The flock included four different age groups (2, 3, 4 and 6 years old), with no maiden ewes. The animals all grazed pasture, but 17 of them received 1 kg of lupins per head *per* day in the last week of pregnancy. During lactation the sheep grazed green winter pasture and were fed lupins *ad lib.* at milking.

Production was evaluated using the oxytocin technique of McCance (1959) by first machine milking and hand stripping the ewes to extract their milk, and then repeating this process four hours later. The milk produced at the second milking was multiplied by six to determine the daily production. The ejection of milk was stimulated by an intra-jugular injection of 1 i.u. of synthetic oxytocin (Ilium Syntocyn) which in a previous experiment (Bencini, unpublished

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1988) proved to be the most suitable method of inducing a milk ejection reflect in Merino sheep.

During the fifth week of lactation the lateral (Ul) and longitudinal (U2) semi-circumferences of the udder were measured and udder volume *(W)* was calculated using the formula:

$$UV\ (cc) = (4/3\ pi\ r^3)/2$$

where: r(cm) = average udder radius = (U1 + U2)/2 pi

At each milking a 50 ml sample was taken and stored at 1-4° for 14 to 20 hours prior to carrying out an analysis of the milk components. Fat, protein, lactose and total solids were determined with a single-beam Infra-red instrument, ("Milko Scan", Foss Electric, Denmark) at the laboratories of a commercial dairy manufacturing plant.

Statistical analysis of the milk production and composition was carried out by least squares ANOVA. The model included effects due to genotype, late pregnancy lupin supplementation, ewe age, ewe live weight and lamb birth weight. Least squares means (±s.e.) are quoted, unless otherwise indicated.

RESULTS

The 27 sheep produced an average of 1.23±0.04 l/day of milk (raw mean) during the 13 weeks of lactation. A peak production of 1.75±0.1 l/day occurred during the third week (Fig. 1).

The two Merino genotypes did not differ significantly in quantity and composition of milk produced. Age and live weight of the ewes likewise did not affect milk production.

The pre-lambing supplementation with lupins increased milk production ($P<0.01$), with ewes fed lupins producing 1.50±0.07 l/day compared with 1.25±0.06 l/day produced by the non-supplemented sheep. Daily milk production increased by 15 ml of milk for each extra kg of lamb birth weight ($P<0.01$).

The composition of the ewes' milk is shown in Table 1. The fat showed high variability while lactose had a low coefficient of variation and proteins and total solids had intermediate coefficient of variation.

Table 1 Composition of the milk from experimental Merino ewes (raw data) - average over 9 weeks of lactation

	Mean ± s.e.	c.v. (%)	Min	Max
Fat (%)	8.48 ± 0.23	13.93	4.67	20.17
Protein (%)	4.85 ± 0.07	7.22	3.79	6.75
Lactose (%)	5.46 ± 0.03	2.92	3.70	6.04
Total solids (%)	19.70 ± 0.30	7.88	12.33	27.74

Examination of the relationships existing between the different milk components showed that fat and total solids were highly correlated ($r=0.89$; $P<0.01$). Protein content was positively related with both the percentages of fat ($r=0.26$; $P<0.05$) and total solids ($r=0.45$; $P<0.01$).

Examination of *sources* of variation in the milk components revealed that age of the ewe affected the percentage of fat and total solids of the milk ($P<0.05$). However, there was not a consistent effect with increasing age. Lamb birth weight and ewe live weight affected ($P<0.05$ and $P<0.01$ respectively) the protein percentage of the milk, which was increased by 0.024% for each extra kg of ewe live weight, and decreased by 0.002% for each extra kg of lamb birth weight. There was an interaction ($P<0.01$) between genotype and ewe live weight. In contrast the interaction between lupin supplementation and ewe live weight was not significant. Milk production was negatively correlated with the percentage of protein and total solids in the milk ($r=-0.27$; $P<0.01$ and $r=-0.15$; $P<0.05$ respectively), but the correlation with the percentage of fat was not different from zero ($r=-0.09$).

The average udder volume of the sheep was 958 ± 36 cc, and it was strongly correlated ($r=0.71$) with the total milk produced in the first 9 weeks of lactation. The relationship between udder volume and milk production is illustrated in Fig. 2.

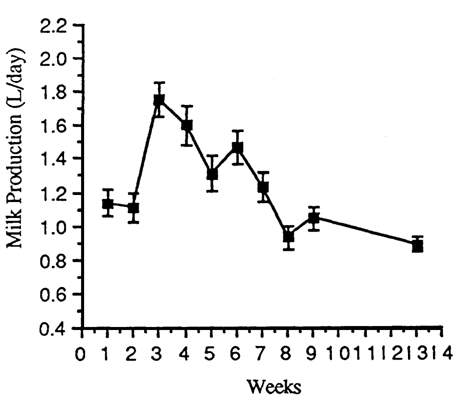

Fig. 1. Lactation curve of the 27 ewes

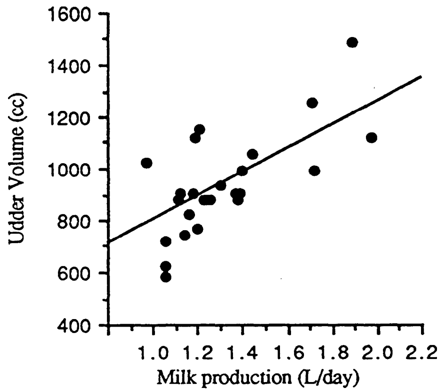

Fig. 2. Relationship between udder volume and milk produced ($Y=344.4+457.8x$; $r=0.71$)

DISCUSSION

The milk production of the Merino ewes in this study was lower than that recorded for overseas dairy sheep breeds, but higher than daily yields quoted by Dawe and Langford (1987) for crossbred ewes. In a similar study Corbett (1968) used the oxytocin technique to evaluate milk production of grazing Merino ewes and found lower average daily yields (926 g, 996 g and 1196 g in three experiments carried out in 1963 and 1964) than the ones observed in the present research.

Milk yield of the two genotypes studied did not differ significantly. This is surprising as Meridales were developed by cross-breeding the AMS Merino with a variety *of* British breeds such as Border Leicester, Dorset Horn and Poll Dorset, which are high milk producers. There has been, however, an intensive programme of back-crossing to the AMS Merino.

Also the milk composition did not differ between the two genotypes. This is in accordance with Moore (1966a) who found no difference between the milk quality of *two* strains of Merino and between Merino and Corriedale ewes; the comparison was however restricted to fat and solids-non-fat.

According to Epstein (1985) age of the ewes affects milk production, with highest yields reached only at the third or fourth lactation. In this study the age of the ewes did not affect milk production, but there were no maiden ewes in the flock. In contrast, age of the ewes affected the fat and total solids content of the milk. This is in accordance with the finding of Nitsan and Volcani (1960) that older Awassi ewes produced a milk richer in fat than that of younger ewes. However, in the present study it was not possible to establish a clear relationship of fat and total solids content with age.

Ewe live weight did not affect milk production even though Epstein (1985) stated that larger ewes produce more milk. However, heavier ewes produced a milk with a higher protein content. The examination of the ineractions between late pregnancy lupin supplementation, genotype, and ewe live weight suggests that greater live weights were due to the genotype rather than to the lupin treatment.

The lupin supplementation in the last week of pregnancy significantly increased milk production. This result has important implications for the management of ewes during late pregnancy.

Ewes which gave birth to heavier lambs produced more milk, as also reported by Owen (1957) and Epstein (1985), and can be explained by the fact that milk synthesis is stimulated by suckling. Bigger lambs require a larger amount of milk and therefore exert a greater suckling stimulus. The *cross* fostering studies of Moore (1966b) also support this finding.

Lamb birth weight had a negative effect on the protein content of the milk which could be explained by the negative correlation observed between milk production and protein content of the milk.

The positive relationship between udder volume and milk production, which has also been found in several other breeds (Laboussiere 1988), shows that udder volume accounts for about 50% of the variation in milk production.

A negative correlation between fat content and milk production is stated to be "well established" by Epstein (1985). However it was not significant in this study. There was instead a significant negative correlation between milk production and the protein and total solids content of the milk. This confirms the existence of a negative relationship between quantity an quality of the milk, already quoted by Barillet *et al.* (1986) which has implications for programmes of genetic improvement of milk production in sheep. The milk production of the ewes in the present study was quite low when compared with other breeds, but the fat content of the milk was higher than that quoted by several authors for a number of overseas breeds of dairy sheep (Ramos and Juarez 1981). On this basis basis Merino sheep milk appears to have potential for the production of special high quality cheeses.

REFERENCES

BARILLET, F., ELSEN J.M. and ROUSSELY M. (1986). Proc. 3rd World Congress Applied to Livestock Production 658.

CORBETT, J.L. (1968). Aust. J. Agric. Res. 19: 283.

DAWE, S.T. and LANGFORD, C.M. (1987). In "Proceedings of the Sheep and Wool Seminar and Refreshers Course", NSW Department of Agriculture, Goulburn, April 1987, 32: 1.

EPSTEIN, H. (1985). "The Awassi Sheep with Special Reference to the Improved Dairy Type". FAO Animal Production and Health Paper 57, FAO: Rome.

LABOUSSIERE, J. (1988). Livestock Prod. Sci. 18: 253.

McCANCE, I. (1959). Aust. J. Agric. Res. 10: 839.

MOORE, R.W. (1966a). Aust. J. Agric. Res. 17:201.

MOORE, R.W. (1966b). Aust. J. Agric. Res. 17:191.

NITSAN, Z. and VOLCANI, R. (1960). Cited by Epstein, H. (1985).

OWEN, J.B. (1957). J. Agric Sci. (Camb.) 48: 387.

RAMOS, M. and JUAREZ, M. (1981). Federation Internationale de Laiterie - International Dairy Federation Bulletin, Document 140.