

DOUBLE CUPPING AND MACHINE STRIPPING OPTIMISE THE YIELD AND THE COMPOSITION OF SHEEP MILK

R. BENCINI^A and T.W. KNIGHT^B

^AAnimal Science, Faculty of Agriculture, University of Western Australia, Nedlands, W.A. 6009

^BAgResearch, Flock House Agricultural Centre, Private Bag 1900, Bulls 5452, New Zealand

SUMMARY

Two experiments were conducted to compare techniques to maximise the amount of milk harvested mechanically from Poll Dorset ewes. The treatments were double cupping, machine stripping, Sagi hook, a negative control (no extra stripping applied) and a positive control (residual milk withdrawn after injecting 5 IU of oxytocin). In the first experiment it was shown that the amount of milk collected did not differ between treatments, but the fat content in milk was higher for all treatments compared to the control ($P < 0.01$). A second experiment was conducted in which the fractions of milk were kept separate and residual milk was measured after each of the treatments by injecting oxytocin and hand stripping the ewes. The total amount of milk harvested was the same for all treatments, but there was a significant difference in the amount of milk obtained by machine milking and hand stripping after the different treatments. The amount of milk obtained by machine milking after double cupping or mechanical stripping was 13% and 12% more than that obtained after the control. Ewes machine milked with a Sagi hook yielded slightly, but not significantly, more milk than the controls. The residual milk obtained after double cupping and mechanical stripping was about 60-70 g, but after the Sagi hook and the control it was about 200 g. The concentrations of fat and total solids in the milk were significantly higher after the mechanical stripping and double cupping treatments. The residual milk was higher in total solids after the mechanical stripping and Sagi hook treatments. It was concluded that double cupping or machine stripping are necessary to optimise the quantity and quality of milk harvested from sheep.

Keywords: Sheep milking, machine stripping, double cupping, residual milk.

INTRODUCTION

In commercial sheep dairies the milkers practise some form of stripping (manual or mechanical) or massage in the belief that such practices increase the amount of milk harvested. Labussiere (1969) found that some sheep have only 1 milk ejection and retain considerable amounts of milk in the alveolar tissue of the mammary gland. Others have, instead, a double ejection pattern, do not retain large amounts of alveolar milk and their milk is richer in fat. For those ewes that have only 1 ejection some hand or machine stripping is necessary, and failure to do so results in a considerable loss of milk. Within each breed, both types of ejection patterns are present, but the more specialised dairy breeds have a larger proportion of ewes with double milk ejections (Purroy Unanua 1986; Labussiere 1988). Incomplete milking of dairy ewes results in lower total lactation yields and shorter lactations (Purroy Unanua 1986; Labussiere 1988).

The breeds of sheep milked in Australia and New Zealand have never been selected as dairy animals, so they may retain part of the alveolar milk. At least 4 methods are adopted to increase the level of emptying of the udders. These are:

- i) machine stripping: mechanical stimulation of the udders (massage) while the cups are in position, often accompanied by pulling the cups down to allow draining of milk from the cisterns;
- ii) hand stripping: the milk is removed by hand milking the sheep after mechanical milking;
- iii) double cupping: the cups are re-attached after a few minutes while the udders are massaged; or
- iv) Sagi hook: a mechanical device that lifts the udder and moves the position of the teats to vertical to facilitate the draining of the milk into the cups.

Since the alveolar milk is rich in fat (Labussiere 1985), the amount of alveolar milk removed with these strategies could affect the composition and therefore the suitability of the milk for processing.

An experiment was conducted to determine the most appropriate method of harvesting milk from machine milked ewes and to determine the effects on the composition of the milk. Since it has been shown that some form of stripping is required in traditional dairy sheep, it was expected that, in unselected breeds, some stripping technique would be of even greater importance.

In a second experiment the residual milk after each stripping method was measured to test the hypothesis that the various stripping methods lead to an increase in the amount of alveolar milk

harvested, thereby reducing the amount of residual milk left in the udder after milking.

MATERIALS AND METHODS

Both experiments were conducted with Poll Dorset ewes of the Flock House (MAF Technology, Bulls, New Zealand) milking herd. The ewes were in mid-lactation, had been milked for several lactations, were trained to the milking routine and behaved like dairy animals.

Experiment 1

Ten ewes were milked daily at 0700 and 1600 hours. The milking cups were attached until the milk flow stopped and then the following treatments were applied:

- i) intramuscular injection of 5 IU of synthetic oxytocin (Oxytocin-EA, Ethical Agents Ltd, Auckland, New Zealand) (assumed to represent the maximum amount of milk that could be harvested);
- ii) machine stripping by massaging the udder and pulling down the cups until milk flow stopped;
- iii) double cupping by detaching and re-attaching the cups after 1 or 2 minutes and the udder was massaged;
- iv) application of a Sagi hook; or
- v) the cups were left on, with no further attempt to increase the amount of milk collected (control).

At each milking the amount of milk produced was measured with milk measurers (Tru Test Distributors, Auckland, New Zealand) and samples were collected for the determination of milk composition. The experimental procedures were carried out every second day (to avoid carry over effects of oxytocin) for 10 days. On each day of the experiment the treatments were allocated randomly to each ewe according to a double Latin square experimental design.

Experiment 2

Eight ewes were milked daily as for experiment 1, and the following treatments were applied:

- i) machine stripping;
- ii) double cupping;
- iii) application of a Sagi hook; or
- iv) no stripping method applied (control).

After each milking the ewes were injected with 5 IU of oxytocin and hand stripped to harvest the residual milk. The milk obtained after machine milking and hand stripping (residual) was weighed and samples were collected for the determination of milk composition. The milking procedure was carried out every second day for 8 days according to a double Latin square design.

For both experiments the milk samples were analysed with a Milko Scan (Foss Electric, Denmark) at the Hillcrest Test Centre of the Livestock Improvement Corporation Ltd (Hamilton, New Zealand). Least squares analysis of variance was used for statistical analysis of the milk production and composition. Effects were assumed to be significant when the level of probability was 5% or less. The effects of the different treatments were examined using Least Significant Differences tests.

RESULTS

Experiment 1

The total amount of milk collected did not differ between treatments (Table 1), but milk composition was affected. The concentration of fat was higher for the oxytocin, double cupping and machine stripping ($P < 0.01$) and also for the Sagi hook compared to the control ($P < 0.05$).

The concentration of total solids was significantly higher ($P < 0.01$) in the milk after the oxytocin treatment or the double cupping than after the control, machine stripping and Sagi hook. The concentration of protein in the milk, however, was not affected by any of the treatments.

Experiment 2

There were significant treatment effects for the amount of milk obtained after machine milking and hand stripping (Table 2). The milk harvested after double cupping and machine stripping was respectively 13% and 12% greater than that harvested after the control. Ewes milked with a Sagi hook yielded slightly, but not significantly, more milk than the controls. The residual milk obtained by hand stripping following double cupping and machine stripping was about 60-70 g, but the amount stripped after the Sagi hook and the control was about 200 g. The total amount of milk produced, calculated by adding the milk obtained by machine milking to that obtained by hand stripping was the same for all treatments.

The concentrations of fat and total solids but not protein in the milk were significantly higher following machine stripping and double cupping treatments (Table 3). The residual milk obtained by hand stripping after injecting oxytocin did not differ in fat and protein concentrations, but it had a higher concentration of total solids after machine stripping and Sagi hook (Table 3).

Table 1. Mean daily milk production (L/day) and composition (%) as affected by different stripping techniques in experiment 1

Stripping method	Milk produced	Fat	Protein	Total solids
Oxytocin	0.82 (0.08)	8.1 (0.23)	6.6 (0.14)	20.2 (0.26)
Double cup	0.87 (0.10)	8.0 (0.33)	6.8 (0.17)	20.4 (0.41)
Machine stripping	0.89 (0.05)	7.8 (0.24)	6.6 (0.15)	20.0 (0.28)
Sagi hook	0.88 (0.06)	7.7 (0.22)	6.8 (0.18)	19.9 (0.31)
Control	0.85 (0.07)	7.5 (0.22)	6.8 (0.20)	19.9 (0.39)
LSD (5%)	0.4	0.14	0.08	0.15
LSD (1%)	0.7	0.25	0.14	0.26
Values in parentheses are standard errors of the mean.				

DISCUSSION

In the first experiment the milk had a higher concentration of fat and total solids following the oxytocin treatment compared to the control. This suggests that there was an increase in removal of alveolar milk which has a higher fat concentration (Labussiere 1985). Fat content was also significantly higher than the control following double cupping, machine stripping and Sagi hook, suggesting that these methods promote removal of larger proportions of alveolar milk. However, the increased removal of

Table 2. Mean quantities of milk obtained (g/day) by machine milking using different stripping techniques (machine milk) and by re-milking the ewes after oxytocin treatment (residual milk) in experiment 2

Stripping method	Machine milk	Residual milk	Total
Double cup	1327.2 (86.2)	57.0 (7.2)	1384.2 (84.3)
Machine stripping	1308.6 (130.2)	72.0 (10.0)	1380.6 (131.8)
Sagi hook	1239.7 (153.6)	167.0 (35.6)	1406.7 (141.8)
Control	1170.7 (110.1)	218.6 (57.6)	1389.3 (129.6)
LSD (5%)	80.98	61.40	102.04
LSD (1%)	144.35	109.62	182.19
Values in parentheses are standard errors of the mean.			

alveolar milk was not accompanied by an increase in milk yield. Thus, the expectation that in unselected breeds stripping would be necessary to increase the amount of milk harvested was not confirmed by the results of this experiment. The lack of a significant difference in milk yield between treatments in this first experiment could be due to the low daily yields of the sheep used in this trial (about 0.8 L) compared to those of the sheep used in the second experiment (about 1.3 L).

In the second experiment the different milk fractions were collected separately to determine what proportion of the milk yield was additional milk obtained by applying the different stripping methods. This experiment showed that machine stripping and double cupping led to a higher yield of milk which was also richer in fat and total solids. This is in agreement Labussiere (1985, 1988), Purroy Unanua (1986) and Papachristoforou (1990) for European dairy sheep. These authors reported that failure to apply a stripping method resulted in short lactations and lower lactation yields. Only a long-term trial could establish whether this effect is present also in unselected Poll Dorset ewes.

The total amount of milk harvested, obtained by adding the machine milked and hand stripped milk,

Table 3. Mean composition (%) of milk harvested by machine milking (MM) and after oxytocin administration (RM) for each stripping method in experiment 2

Stripping method	Fat		Protein		Total Solids	
	MM	RM	MM	RM	MM	RM
Double cup	6.2 (0.27)	11.5 (0.44)	5.7 (0.24)	4.9 (0.23)	17.9 (0.40)	21.9 (0.37)
Machine strip.	6.6 (0.23)	12.5 (0.54)	5.9 (0.24)	5.0 (0.25)	18.4 (0.28)	22.5 (0.49)
Sagi hook	6.3 (0.42)	12.2 (0.86)	5.7 (0.23)	4.8 (0.29)	18.1 (0.51)	22.5 (0.77)
Control	5.6 (0.47)	10.6 (0.62)	5.4 (0.06)	4.8 (0.07)	17.4 (0.23)	21.0 (0.48)
LSD (5%)	0.31	1.69	0.49	0.31	0.17	1.31
LSD (1%)	0.55	3.02	0.88	0.56	0.31	2.34
Values in parentheses are standard errors of the mean.						

was not different for any of the treatments. This clearly shows that these stripping methods do not affect the amount of milk produced, but they may change the milk ejection physiology. If no stripping is applied, the ejection of milk is not complete and some alveolar milk is retained. The alveolar milk is richer in fat, so when stripping methods are applied the milk also has a higher concentration of fat and total solids. This hypothesis is supported by the finding that fat concentration in the milk removed from machine milked ewes is higher if hand stripping follows the mechanical milking (Papachristoforou 1990).

The present findings conform with results of similar studies on European dairy sheep (Labussiere 1985, 1988; Purroy Unanua 1986; Papachristoforou 1990), so even in specialised dairy breeds, some alveolar milk is retained unless the ewes are stripped.

In contrast to the hypothesis that, in local breeds, stripping would be indispensable to maximise the amount of milk extracted, it appears that, instead, our unselected sheep had a physiology of milk ejection similar to that of specialised dairy sheep, suggesting that our sheep are as suitable for milking as the European dairy sheep. Selection for suitability for machine milking was started only recently in the Mediterranean countries where traditionally sheep have been hand milked for centuries (Bencini 1993), and this could explain the lack of a difference between European and local sheep milked in Australia and New Zealand.

The composition of the residual milk was similar to that reported by Labussiere (1985), who showed that the alveolar milk contains a higher proportion of fat than normal milk. However, the residual milk had also a lower protein concentration compared to normal milk, a fact which has not been previously reported. The fat and protein concentrations of the residual milk were not affected by the stripping method applied prior to its removal. However, the concentration of total solids was higher after machine stripping or application of the Sagi hook. It is possible that these 2 treatments had an effect on the composition of the residual milk that was subsequently withdrawn.

The experiments described in this paper have enabled us to evaluate milking techniques to harvest milk from machine milked ewes. Some form of stripping is necessary to maximise milk yield from these ewes and failure to adopt such methods would lead to the production of less milk with lower concentrations of fat and total solids.

REFERENCES

- BENCINI, R. (1993). Ph.D. Thesis, The University of Western Australia.
 LABUSSIÈRE, J. (1969). *Ann. Zootech.* **18**: 185-96.
 LABUSSIÈRE, J. (1985). *Bull. Tech. C.R.Z.V. Theix, I.N.R.A.* **61**: 49-58.
 LABUSSIÈRE, J. (1988). *Livest. Prod. Sci.* **18**: 253-74.
 PAPACHRISTOFOROU, C. (1990). *Ann. Zootech.* **39**: 1-8.
 PURROY UNANUA, A. (1986). Proceedings of the International Dairy Federation Seminar on Production and Utilization of Ewe's and Goat's Milk, Athens, 1985, pp. 28-41 (I.D.F.-F.I.L. Bull. **20211986**).