EFFECT OF DIFFERENT PREMILKING METHODS ON THE MILKING CHARACTERISTICS OF AUSTRALIAN ILLAWARRA SHORTHORN COWS

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SUMMARY

Washing for 5 sec as compared with no premilking treatment significantly increased the overall milking rate, reduced the time for the first flow of milk and shortened the milking time. Increasing the amount of premilking stimulus to 30 sec and 60 sec further increased the overall milking rate, and decreased the milking time.

Taking foremilk had the same effect in stimulating milk let-down as massaging the udder for the same length of time.

A short delay of 30 sec after stimulation increased the milking rate. However, a delay of 5 or 8 min after preparation before milking adversely affected the milking response. Rewashing at the end of the waiting period before putting the cups on overcame the adverse effects of this delay.

The milk-flow curve was not always characteristic for each cow but varied with different methods of premilking preparation. With insufficient or no stimulation there was a slow initial milking rate before the maximum was reached later in the milking. If milking was not started until 5 or 8 min after stimulation the initial rate was fast but the milking rate became slower later in the milking and there was sometimes a "second let-down."

I. INTRODUCTION

Various workers (Smith and Petersen 1948; Knoop and Monroe 1950; Roark, Beck, and Fryer 1952; Phillips 1960) have shown that massage of the udder before milking increases the rate of milk flow and shortens the milking time as compared with milking without any premilking stimulation. However, the importance of variation in the amount of stimulation and of different methods of cow preparation has not been determined definitely. Dodd and Foot (1947, 1949) and Dodd, Foot, and Henriques (1949) conducted a series of experiments in which they investigated the effect of different milking techniques and concluded that even severe changes in management caused little alteration to the rate of milking. Roark, Beck, and Fryer (1952) reported that variation in the length of time spent in cow preparation between 10 sec and 60 sec affected the milking response only slightly. These authors also emphasized the importance of fore-milking in stimulating milk let-down; this was not in agreement with the results of Knoop and Monroe (1950).

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The results of Miller and Petersen (1941) and Ward and Smith (1949) showed that a delay in beginning milking after stimulation reduced the milk yield. On the other hand, Knodt *et al.* (1949) found no significant differences in milk yields for periods up to 90 days when cows were milked from 2 min to 20 min after stimulation. Delayed milking has been shown to reduce the milking rate. Dodd, Foot, and Henriques (1949) found that a delay of 3 min after stimulation had no effect but that a 6 min delay had a marked effect on the rate of milking. Roark, Beck, and Fryer (1952) found that a delay of 5 min or 8 min after preparation decreased the rate of milk flow and that the 8 min delay decreased the yield.

The experiments reported here were made to determine the effect of various amounts of stimulation on the milking of Australian Illawarra Shorthorn (A.I.S.) cows, the relative effectiveness of massage and fore-milking, and the importance of delay after stimulation. In these experiments the effects of sudden changes only have been considered and no investigations have been made of the possibility of the cows becoming adjusted to the changed methods if they were continued for a longer period of time. In other work, which will be reported separately, the influence of more extended application of some of these treatments has been determined.

II. EXPERIMENTAL PROCEDURES

(a) Cows Selected

The first experiment in the present series was conducted at Peak Crossing in south-eastern Queensland, using A.I.S. cows from a commercial dairy herd. The remaining experiments were made under similar environmental conditions at the Queensland Agricultural College at Gatton, using cows from the College A.I.S. herd. The cows selected in all trials were giving over 10 lb of milk at the afternoon milking. The stage of lactation of the cows varied from the 2nd to the 7th month, but the majority were in the 3rd or 4th month at the time of the recordings.

(b) Milking Equipment

Experiment 1 at Peak Crossing was carried out using one unit of a 4-unit Alfa Laval Speedway milking machine, and in the remaining experiments at Gatton, one unit of a 10-unit Alfa Laval Speedmaster milking machine was used. The same Alfa Laval teat-cup assembly, comprising cluster claw and Swedish monobloc milker inflations, was used in all investigations. The inflations were new at the beginning of the trials and were used only at experimental milkings. The weight of the assembly was 7 lb.

The vacuum level during recordings was maintained at 15 in. In addition to the vacuum control valve fitted to the 10-unit milker, a Ruakura valve was fitted to the connected milk and airline systems of the test unit to stabilize the vacuum level at this unit.

Pulsations were activated by an Alfa pneumatic pulsator, at a constant speed of 55 pulsations per min. The squeeze-to-release ratio at this speed was 40:60 measured along the 5 in. vacuum ordinate of the Ruakura vacuum recorder graph.

(c) Milking Methods

Treatments were applied to cows only at afternoon milkings. At the morning milking they were milked with the rest of the herd, with a normal premilking treatment, comprising washing for 30 sec, taking 4 streams of foremilk, and cups put on 30 sec after the completion of fore-milking. Trial cows were allowed to run with the rest of the herd. At Peak Crossing, they were taken direct from the holding yard during milking. At Gatton, they were segregated from the main herd and yarded close to the test bails prior to milking time. This ensured the quiet handling of cows during milking. Other handling procedures to which the cows were accustomed before the trials were continued. The cows were milked without back chains or leg ropes, but at Gatton they were restrained in the bails by a neck yoke. They were not fed during milking.

In all treatments, washing of udders and teats was carried out with udder cloths wetted with chlorinated water at atmospheric temperature. Stimulation was continued for the experimental period by vigorously rubbing the udder with the cloth wrung free of excess water. Foremilk, when taken, was removed into a strip cup by taking four large streams from each teat. The cow contact time when removing the foremilk was 20 sec. Machine stripping of cows was carried out when the sight glass of the Ruakura milk flow indicator was half-full. The cups were removed when the milk level in the indicator fell to ¼ glass during machine stripping. Machine stripping was carried out by bearing down on the cups and massaging the udder with the hands.

(d) Design of Experiments

In Experiment 1, milking without preparation was compared with a 5 sec wash, a 5 sec wash and taking foremilk, a 30 sec wash, and a 30 sec wash and taking foremilk. In the last four treatments the cups were put on 1 min after the start of washing. The treatments were applied to 10 cows for a period of 10 days according to a latin square design.

In Experiment 2, the effects of stimulation for 5 sec, 30 sec and 60 sec and putting the cups on immediately after washing were compared. The 3 treatments were applied to 12 cows for a period of six days according to a latin square design balanced for carryover effects. It was found that there were no carryover effects, and in later experiments in which 3 treatments were compared a switchback design was used.

In Experiment 3, the effect of washing for 15 sec and then taking foremilk for 15 sec was compared with washing for 30 sec. The 2 treatments were applied to 12 cows for 3 days in a switchback design.

Experiment 4 was planned to determine the effect of waiting for 1 min, 5 min and 8 min after a 5 sec wash and taking foremilk as compared with putting the cups on immediately after a 5 sec wash and after a 5 sec wash and taking foremilk. The treatments were applied to 10 cows for 10 days according to a latin square design.

Experiment 5 was conducted to investigate the effect of rewashing for 30 sec following an 8 min delay after the initial premilking preparation. Three treatments were applied to 12 cows for 3 days in a switchback design.

(e) Recording

Cow graph records at each experimental milking were obtained using the apparatus designed by Murray (1960). Data concerning the milking were obtained from the graphs as previously described. The times for the first 0·2 lb milk to be recorded on the graphs were obtained using a stop-watch.

TABLE 1

EXPERIMENT 1: EFFECT OF FIVE METHODS OF PREMILKING PREPARATION WITH INCREASING AMOUNT OF STIMULATION

(Average Results for 10 Cows)

Method No.	Treatment	Total Yield (lb)	Total Milking Time (min)	Time for 1st 0·2 lb (sec)	Strippings (%)	Maximum Milking Rate (lb/min)	Overall Rate (lb/min)
1	No washing, cups straight on	13·2	5·22	37·1	8·3	4·14	2·28
2	5 sec wash, cups on 1 min after start of wash ..	13·1	4·29	27·4	10·3	4·36	2·52
3	5 sec wash, fore-milk, cups on 1 min after start of wash	13·1	4·00	22·6	7·9	4·81	2·78
4	30 sec wash, cups on 1 min after start of wash ..	13·2	3·95	22·0	9·4	4·80	2·77
5	30 sec wash, fore-milk, cups on 1 min after start of wash	13·4	3·69	19·3	8·4	5·04	3·01
Standard error of mean ..		1·3	0·08	2·1	1·0	0·10	0·05
Significance tests		..	1>2, 3, 4, 5 at 1% level 2>4, 5 at 1% level 2>3 at 5% level 3>5 at 1% level 4>5 at 5% level	1>2, 3, 4, 5 at 1% level 2>5 at 5% level	..	5, 4, 3>2, 1 at 1% level	5>3, 4>2>1 at 1% level

II. RESULTS

(a) Effect of Increasing the Amount of Stimulation

The results of Experiment 1 are given in Table 1. The differences between treatments did not significantly affect the total yield of milk or the amount of machine strippings. Milking was significantly slower if the cups were put on the cows without premilking preparation. For this treatment, both the maximum and the overall rates were slower, the total milking time longer and the time to the first increment longer than for any of the other four treatments. Increasing the time spent in cow preparation decreased the total milking time and increased the overall milking rate. There were no differences between Treatments 3 and 4, in which premilking preparation took almost the same length of time, although in Treatment 3 most of the time was spent in taking the foremilk rather than washing the udder.

The results of Experiment 2 are shown in Table 2. There was a slightly increased yield with the 60 sec wash treatment, this being significant at the 5 per cent. level. The overall milking rate tended to increase with increasing stimulation and was significantly greater with the 60 sec wash than with the 5 sec wash.

TABLE 2

EXPERIMENT 2: EFFECT OF INCREASING THE DURATION OF WASHING

(Average Results for 12 Cows)

Method No.	Treatment	Total Yield (lb)	Total Milking Time (min)	Time for 1st 0·2 lb (sec)	Strippings (%)	Maximum Milking Rate (lb/min)	Overall Rate (lb/min)
1	5 sec wash, cups on immediately	13·1	4·65	22·4	7·6	5·62	2·97
2	30 sec wash, cups on immediately	13·3	4·30	19·9	6·2	5·53	3·17
3	60 sec wash, cups on immediately	14·5	4·53	21·2	6·5	5·76	3·38
Standard error of treatment mean		0·3	0·07	1·6	0·4	0·45	0·07
Significance		3>1, 2 at 5% level	..	..	..	..	3>1 at 5% level

(b) Effect of Fore-milking as Compared with Udder Massage

There was no significant difference between a 5 sec wash followed by taking the foremilk for 20 sec (i.e. udder manipulation for 25 sec) and a 30 sec wash (Table 1). Both gave faster milking rates than a 5 sec wash. This suggested that taking the foremilk was just as effective as udder massage for approximately the same length of time, and this is confirmed by the results given in Table 3.

TABLE 3

EXPERIMENT 4: EFFECT OF WASHING AND TAKING FOREMILK AS COMPARED WITH WASHING FOR THE SAME LENGTH OF TIME

(Average Results for 12 Cows)

Method No.	Treatment	Total Yield (lb)	Total Milking Time (min)	Time for 1st 0·2 lb (sec)	Strippings (%)	Maximum Milking Rate (lb/min)	Overall Rate (lb/min)
1	15 sec wash, 15 sec taking foremilk, cups on ..	14·3	4·41	21·6	6·8	5·83	3·32
2	30 sec wash, cups on ..	14·0	4·55	24·9	7·2	5·57	3·23
Standard error of treatment mean		0·6	0·12	3·1	1·0	0·10	0·14
Significance		..	..	..	..	..	..

(c) Effect of a Delay in Starting Milking After Cow Preparation

Table 4 shows that taking the foremilk after a 5 sec wash (Treatment 2) did not significantly alter the milking rate as compared with Treatment 1. It can also be seen that when the cups were not put on until 1 min after the start

TABLE 4

EXPERIMENT 3: EFFECT OF A DELAY AFTER PREPARATION BEFORE MILKING

(Average Results for 10 Cows)

Method No.	Treatment	Total Yield (lb)	Total Milking Time (min)	Time for 1st 0·2 lb (sec)	Strippings (%)	Maximum Milking Rate (lb/min)	Overall Rate (lb/min)
1	5 sec wash, cups on immediately	14·0	4·76	24·4	5·4	5·47	3·08
2	5 sec wash, fore-milk, cups on immediately	13·4	4·62	24·4	7·3	5·50	3·02
3	5 sec wash, fore-milk, cups on 1 min after start of wash	15·5	4·47	20·5	3·9	5·95	3·56
4	5 sec wash, fore-milk, cups on 5 min after start of wash	12·9	4·81	23·0	6·3	4·98	2·80
5	5 sec wash, fore-milk, cups on 8 min after start of wash	12·4	4·90	19·5	6·9	5·04	2·68
Standard error of mean ..		0·6	0·19	1·7	1·4	0·17	0·14
Significance tests		3>4, 5 at 1% level 3>2 at 5% level	..	..	..	3>5, 4 at 0·1% level	3>4, 5 at 0·1% level 3>2 at 1% level 3>1 at 5% level

of cow preparation, the overall milking rate was significantly faster than when the cups were put on immediately after the same preparation, and that delays of 5 min and 8 min markedly reduced both the maximum and overall milking rates and also significantly lowered the total milk yield. Because of the reduction in yield the total milking time was not affected.

The long delay before milking after stimulation made noticeable alterations to the shape of the milk flow curves. Typical curves are shown in Figure 1. The rate of milking in the first minute was approximately the same as in a normal milking, but later the rate became much slower than normal. Four

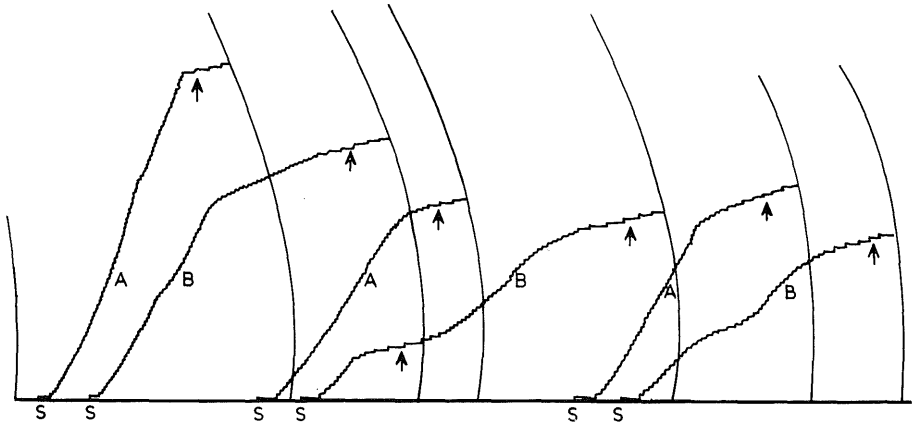

Fig. 1.—Milking curves showing effect of premilking waiting time on the milking characteristics of three cows. A, milking 1 min after the start of washing; B, milking 8 min after the start of washing. S indicates the start of milking and the vertical arrow the start of machine stripping.

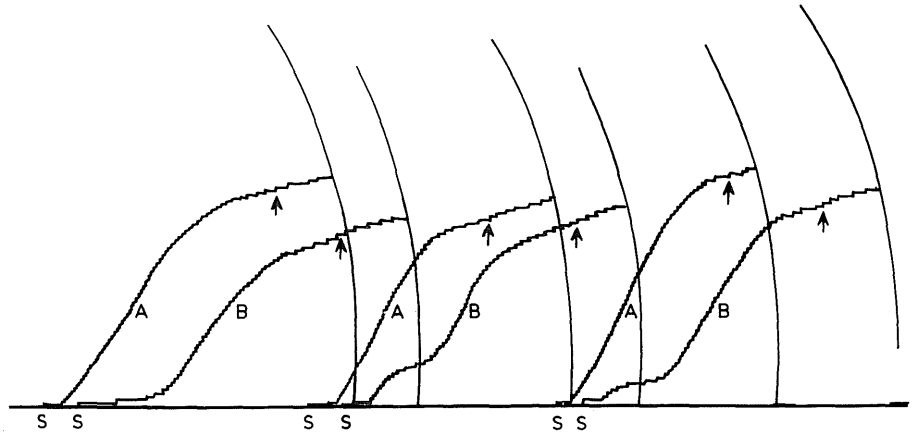

Fig. 2.—Milking curves showing effect of premilking stimulation on the milking characteristics of three cows. A, cows given adequate stimulation; B, cows given insufficient stimulation. S indicates the start of milking and the vertical arrow the start of machine stripping.

cows regularly showed the phenomenon of second let-down after a 5 min or an 8 min wait, and one of these cows usually required the stimulus of machine stripping to initiate the second flow of milk. All of these cows were fast milkers. The other 6 cows in this trial, which included 1 fast milker, 3 medium milkers and 2 slow milkers, did not show any evidence of second let-down although milking was much slower.

The shape of the milk-flow curves was altered also when the cups were put on immediately after only a short wash, or without any premilking preparation. The initial milking rate was slower than usual and the maximum rate was not reached until later in the milking. Typical curves are shown in Figure 2.

Table 5 shows that in Experiment 5, as in Experiment 4, a delay of 8 min significantly reduced both the maximum and the overall milking rates. However, rewashing the cows just before milking stimulated let-down again, so that there were no significant differences between this milking and milking after normal preparation of a 5 sec wash, fore-milking and putting cups on 1 min after the beginning of washing.

TABLE 5

EXPERIMENT 5: EFFECT OF REWASHING JUST BEFORE MILKING AFTER A LONG DELAY AFTER COW PREPARATION

(Average Results for 12 Cows)

Method No.	Treatment	Total Yield (lb)	Total Milking Time (min)	Time for 1st 0·2 lb (sec)	Strippings (%)	Maximum Milking Rate (lb/min)	Overall Rate (lb/min)
1	5 sec wash, fore-milk, cups on 8 min after start of wash	15·6	4·73	14·2	4·6	5·93	3·35
2	5 sec wash, fore-milk, rewash for 30 sec 8 min after start of 1st wash, cups on ..	16·7	4·26	15·0	4·0	6·52	4·03
3	5 sec wash, fore-milk, cups on 1 min after start of wash	16·7	4·09	15·9	3·0	6·71	4·21
Standard error of treatment mean		0·6	0·23	0·7	0·6	0·09	0·11
Significance		..	..	..	..	3, 2>1 at 0·1% level	3, 2>1 at 0·1% level

IV. DISCUSSION

Previous workers have reported that massaging the udder and fore-milking (Knoop and Monroe 1950; Roark, Beck, and Fryer 1952) or massaging for 20-30 sec (Miller and Petersen 1941; Phillips 1960) increased the milking rate when compared with no premilking treatment. This was confirmed in the present experiments, where it was also shown that even a short wash lasting 5 sec

gave sufficient stimulation to cause a significant improvement in the overall milking rate. Greater amounts of stimulation further increased the overall milking rate and decreased the milking time.

Washing and taking foremilk (4 streams per teat) was found to be just as effective as a let-down stimulus as washing for the same total length of time. This appears contrary to the results of Roark, Beck, and Fryer (1952), who found that massage and fore-milking gave faster milking than massage only or fore-milking only. However, the differences found by these workers may have been due to the amount of time spent in stimulation rather than to the treatment used. Knoop and Monroe (1950) found that taking the foremilk after cleaning the udder with a heavy towel wrung from warm water was no more effective than the same treatment without fore-milking. In this instance the relatively short time which would have been spent in taking 1 or 2 streams of milk from each teat after a good washing stimulus was probably insufficient to alter the milking response.

In order to maintain satisfactory milk quality it is recommended that a strip cup be used to detect mastitis. In the present investigations it was shown that the time spent in taking foremilk was also effective as stimulation for let-down. This is therefore an additional reason for the regular inclusion of fore-milking in cow preparation.

Waiting for approximately 30 sec after washing before starting to milk gave faster overall milking than putting the cups on immediately after washing. It was noted that with very few exceptions milk did not actually let-down into the teat cistern until shortly after washing had ceased. Washing had the effect of causing the teats to contract. It was not until this nervous reaction had disappeared that peak internal udder pressure was obtained and this may be the reason for faster milking rates following a short delay between stimulation and milking.

The effect on milking rate of a longer delay of some minutes after preparation before milking was similar to that reported by previous workers (Dodd and Foot 1949; Dodd, Foot, and Henriques 1949; Roark, Beck, and Fryer 1952). In the experiments reported here such delays of 5 and 8 min also caused a significant reduction in milk yield. Delays of similar time occur in commercial dairies whenever cows waiting to be milked are washed before or immediately after the cups are put on the other cow in the unit. Although these results showed that cows should be milked soon after the premilking preparation, it was found that a second stimulation just before milking overcame the effect of this delay. Therefore, if a cow was inadvertently prepared for milking too soon this could be remedied by rewashing. There appeared to be a greater incidence of air-leaks at the cups at stripping or prior to a second let-down when milking was delayed 5 or 8 min after washing. This could have been caused by the teats becoming drier because of the long wait before milking.

Some cows tended to leak milk from the teats in the yard or standing in the bails prior to preparation for milking. This "self let-down" did not appear to have any influence on the milking response to the preparation given later. When such cows were given treatment involving insufficient stimulation or a long delay after stimulation they milked slowly. When they were given good stimulation they milked normally.

It can be seen from these experiments that the shape of the milk-flow curve was not characteristic for any particular cow but varied considerably with different methods of cow preparation. With insufficient or no stimulation the let-down was slow, so the initial milking rate was slower than normal and the maximum rate was reached late in the milk-flow curve. When a good stimulus was given but there was a long delay before milking, the initial rate of milking was fairly fast (often the maximum for that milking) but there was marked slowing later, sometimes with the phenomenon of second let-down. This would be due to the first stimulus wearing off before the cow was properly milked out. Foot (1935) and Beck, Fryer, and Roark (1951) reported that each cow had a characteristic milk-flow curve which was found to be highly repeatable. However, such results were obtained when a constant method of premilking treatment was used. Alterations to the shape of the milk-flow curve were not noticed in previous experiments concerning the effect of vacuum level on milking rate (Lightbody and Murray 1960) or in other experiments in which the effects of alteration of the pulsation rate on milking were investigated. In such experiments milking rates were markedly altered but the shape of the milk-flow curve of each cow was similar for all treatments. Alteration of vacuum level or pulsation rate with a constant method of cow preparation primarily affected the maximum milking rate. On the other hand, variation of the method of premilking preparation seemed to affect mainly the duration of the let-down stimulus as related to the time of milking, and except with the more extreme procedures had little effect on the maximum milking rate.

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