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THE PRODUCTION OF DAIRY COWS AS AFFECTED BY FREQUENCY AND REGULARITY OF MILKING AND FEEDING

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INTRODUCTION

In the management of the dairy herd, milking requires more time and labor than any other phase of the work. The application of recent findings regarding the secretion of milk and the development of milking machines may be expected to produce important changes in the frequency and also in the manner of milking. At the United States Dairy Experiment Station at Beltsville, Md., the Bureau of Dairy Industry has carried on experiments¹ on the effects of the frequency of milking, change of milkers, and regularity and irregularity in the hours of milking and feeding on the cows' production of milk and butterfat. The results of these experiments are reported and discussed in this publication.

FREQUENCY OF MILKING

MILKING THREE TIMES A DAY AS COMPARED WITH TWICE A DAY

It is generally known that cows produce more milk if milked three or four times a day than if milked twice a day. Just how much more milk will be produced, however, is a matter upon which investigators differ. Some of the results obtained in comparing three with two milkings a day are as follows:

At the Agricultural Experiment Station of the University of Vermont (6)² two cows milked three times a day, in trial periods of 3 to 14 days, gave less milk than when they were milked twice a day.

Walker (14, p. 29), after carrying on an experiment at Offerton Hall, England, in which he used two groups of five cows each, reported as follows:

¹ The services of H. T. Converse, Associate Dairy Husbandman, Bureau of Dairy Industry, in directing certain phases of this work, are gratefully acknowledged.
² Italic numbers in parentheses refer to Literature Cited, p. 15.

So far as milking three times a day is concerned, the results obtained in these experiments show no advantage whatever. On the contrary, the extra driving and other undue interference with the treatment of the cows has produced results of a negative character.

At the Ontario Agricultural College, Canada, (3) two cows milked three times a day for two weeks gave more milk, but only one of these cows gave more butterfat, than when milked twice a day.

At the New York State Agricultural Experiment Station, (2) cows producing about 400 pounds of butterfat a year when milked twice a day gave only about 22 pounds more when milked three times a day.

Fleischmann (4, p. 177-178) estimated the increase in yield to be about 6 or 7 per cent for milking three times a day as compared with twice.

According to Huynen (8), the milk yield when cows were milked twice a day as compared with three times was about 1 per cent less for cows yielding 10 liters and 10 per cent less for cows yielding 30 liters or more, with an average for the herd of about 6 or 7 per cent less. The milkings were 12 hours apart when made twice a day; and 5½, 6½, and 12 hours apart when made three times daily.

At the Agricultural Experiment Station of the University of New Hampshire (10) two cows milked three times a day for three days gave slightly more milk and somewhat more butterfat than when milked twice a day.

Riford (11) reported that a herd of 50 cows which averaged 45 pounds of milk a day when milked twice daily, gave 4 pounds more per cow when milked three times a day for two weeks.

Smeyers (12) found that 34 cows which yielded 8.5 to 17 kilograms (18.7 to 37.5 pounds) of milk daily when milked twice a day, averaged 8 per cent more milk and 13 per cent more butterfat when they were milked three times a day for seven days.

At the Agricultural Experiment Station of the University of Idaho (7) three cows milked two, three, and four times a day gave relative yields of 60, 75, and 100 pounds of milk. Thirteen cows milked three and four times a day gave one-fourth more milk when milked four times a day than when milked three times. With twice-a-day milking the peak of production was reached in about three weeks; with the other two methods of milking the peak was reached in about six weeks.

In the work referred to above, milking three times a day generally resulted in greater milk production per cow than milking twice. However, the increase in the amount of milk that might be expected over long periods was not determined, as only one or two of the trials exceed a few weeks in length.

In order that he can decide whether it would pay him to milk his cows more than twice a day, the farmer should know how much extra milk he may expect to get from his herd by milking oftener than twice a day for both long and short periods. It was for the purpose of getting such definite information that the Bureau of Dairy Industry conducted the experimental work reported herein.

SHORT-PERIOD EXPERIMENT

Four Holstein cows (three registered and one grade), soon after freshening, were milked two and three times a day in alternate periods of 40 days. The experiment was continued for 360 days, making

nine periods for each cow. In this experiment, three of the cows were started on a period of twice-a-day milking and therefore ended with a period of twice-a-day milking, and one was started and ended with three-times-a-day milking. These four cows were good producers, their average daily yield when milked twice a day varying from 27 pounds for the lowest producing cow to 55 pounds for the best. The average for the four cows was 42 pounds.

The cows were kept in box stalls, were fed three times a day, and were given approximately the same quantity of feed regardless of the number of times milked.

The results of this experiment are given in Table 1, which shows that milking three times a day resulted in a production of about 11 per cent more milk and 10 per cent more butterfat, on the average. In this table the results of the first 10 days of each 40-day period were not included, as this time was allowed for the cows to become accustomed to the change in order of milking. The experimental results therefore cover only the last 30 days of each 40-day period.

TABLE 1.—Comparison of three-times-a-day milking with twice-a-day milking over short periods

Cow No.	Times a day milked	30-day periods	Average production for each period		Average increase				Average gain in weight for each period
			Milk	Butterfat	Milk		Butterfat		
		Number	Pounds	Pounds	Pounds	Per cent	Pounds	Per cent	Pounds
226	3	4	1,246.4	41.91	110.6	9.74	3.87	10.18	2
	2	5	1,135.8	38.04					19
230	3	4	1,827.8	64.95	175.9	10.65	5.41	9.09	23
	2	5	1,651.9	59.54					23
232	3	5	1,620.6	57.20	134.0	9.01	3.39	6.29	10
	2	4	1,496.6	53.81					36
82	3	4	947.2	34.08	139.7	17.30	5.22	18.08	13
	2	5	807.5	28.86					17
Average	3					11.02		9.93	12
	2								24

¹ True or weighted average.

The chart in Figure 1 shows the production of cow No. 230 in alternate 40-day periods. In this chart, each 40-day period is subdivided into 10-day intervals, including the first 10 days of each period. In the first period the milking was twice a day. The production of this cow is characteristic of the production for the group. The chart shows that every change from milking twice a day to milking three times a day resulted in an increase in production, whereas every change from three times to twice a day resulted in a decrease. Furthermore these changes were immediate.

The smaller gains in body weight made by the cows when milked three times a day, as shown in Table 1, were to be expected. As has already been stated, the cows received the same amount of feed during the entire experiment. Since milking three times a day resulted in a greater production of milk, less nutriment was available for making body fat.

LONG-PERIOD EXPERIMENT

Although Table 1 furnishes fairly reliable information on the increase to be expected from milking three times a day for short periods, it was thought that longer periods might show greater differ-

ences, for the reason that the good effects of milking three times a day in the experiment just reported were no doubt carried over into the twice-a-day periods, and vice versa.

The results of a second experiment, conducted for longer periods, are shown in Table 2. Eight Holstein cows (five registered and three grades) were used in this experiment. Five cows were milked three times a day for a period ranging from 217 to 365 days, and twice a day for the same length of time. Three of the cows (Nos. 269, 273, and 275) were milked three times a day during two periods, with one intervening period of twice-a-day milking; the others were milked three times a day for only one period and twice a day for one

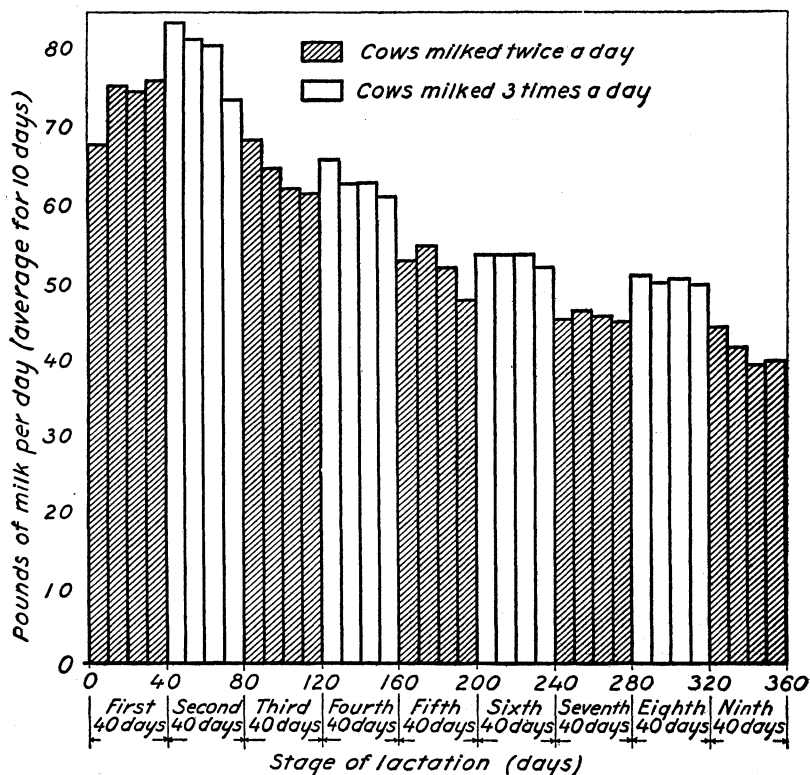


FIGURE 1.—Production of milk by dairy cow No. 230 when milked three times a day as compared with milking twice a day, in alternate periods of 40 days for one year

period. All the animals were good producers, the average daily milk yield when milked twice a day varying from 36 pounds for the poorest cow to 53 pounds for the best.

These eight cows were kept in box stalls. They were fed grain three times a day, regardless of whether they were milked twice or three times. The same grain mixture was used throughout the experiment, the quantity fed being based on the requirements according to the Savage standard, with an extra allowance for advance in stage of lactation. The cows received alfalfa hay and corn silage twice a day. They were given no pasture or green feed.

TABLE 2.—Comparison of three-times-a-day milking with twice-a-day milking over long periods

Cow No.	Times ^a a day milked	Length of period	Age at beginning of test		Time pregnant during experiment	Production						Gain in weight	
						Actual			Figured to maturity				
						Milk	Butterfat	Lbs.	Milk	Butterfat	Increase		
											P. ct.		P. ct.
88	3	360	3	2	43	13,907.0	587.79	16,549.3	699.47	27.1	24.5	124	
	2	360	5	11½	195	13,023.5	561.90	13,023.5	561.90	-----	-----	223	
97	3	360	4	3½	0	15,541.9	480.36	16,785.3	518.79	9.1	12.8	41	
	2	360	2	10	89	12,398.7	371.00	15,374.4	460.04	-----	-----	66	
214	3	360	6	0	200	16,179.7	546.66	16,179.7	546.66	24.2	25.1	182	
	2	360	7	2½	141	13,024.5	437.12	13,024.5	437.12	-----	-----	196	
253	3	360	2	6	40	13,103.6	488.86	16,903.6	630.63	8.0	10.7	120	
	2	360	4	2	56	14,361.4	522.74	15,653.9	569.79	-----	-----	128	
269	3	217	3	10	69	10,041.6	373.00	11,967.0	446.75	38.9	43.7	71	
	2	217	4	5	131	8,051.4	290.47	8,615.0	310.80	-----	-----	3—47	
273	3	298	4	3	55	13,027.8	473.22	14,379.6	521.73	9.6	7.1	62	
	2	298	4	1½	26	12,036.3	447.02	13,119.6	487.25	-----	-----	3—55	
275	3	240	3	11½	51	12,380.4	411.19	14,439.2	479.68	7.8	11.3	91	
	2	240	4	7½	155	12,632.1	406.59	13,390.0	430.99	-----	-----	37	
A.2	3	365	4	0	171	17,850.5	622.41	19,635.5	684.65	42.8	38.5	42	
	2	365	5	4	43	13,352.0	479.84	13,752.6	494.24	-----	-----	121	
Average	3	-----	4	0	79	-----	-----	15,854.9	566.04	19.7	20.7	91	
	2	-----	4	10	104	-----	-----	13,244.2	469.01	-----	-----	84	

¹ Record for three-times-a-day milking is average of two periods.

² True or weighted average.

³ Loss.

Figuring the records to maturity was necessary because the average age of the cows when being milked three times a day was 4 years, whereas the average age of the cows when milked twice a day was 4 years and 10 months. In figuring to maturity factors prepared in the Bureau of Dairy Industry from a study of advanced-registry records were used. These factors are 1.40, 1.21, 1.10, and 1.04, respectively, for cows exactly 2, 3, 4, and 5 years of age, with monthly gradations for intermediate ages.

During the time when they were milked twice a day the cows were pregnant an average of 25 days longer than during the time when they were milked three times a day, but it is not evident that this made any material difference in the results of the experiment.

The increase in milk production as a result of milking three times a day varied greatly for different cows, ranging from 7.8 to 42.8 per cent. The average increase of all these cows, however, 20 per cent for milk and 21 per cent for butterfat over a period of 7 to 12 months, should be a fairly reliable index of what might be expected in a herd of eight or more cows. The slight increase of butterfat over that of milk production indicates that more frequent milking resulted in slightly richer milk. This is not in accord with the findings of short-period experiments, either when the animals were milked three or four times a day.

Previous work (13) in the Bureau of Dairy Industry has shown that the secretion of milk is a continuous process. As the udder fills with milk the pressure exerted by the milk tends to check secretion, and the greater the pressure the more completely is secretion checked. These facts provide a reasonable explanation for the fact

that the cows yielded greater quantities of milk when they were milked oftener than twice a day. The same line of reasoning indicates that the extent of the increased yield secured by more frequent milking depends upon the degree to which the udder was distended. In a herd of cows yielding about the same quantities of milk but having different udder capacities the increase in yield produced by more frequent milking should be more pronounced in animals of small udder capacity.

The average gain in weight of the cows in the second experiment (Table 2) was 91 pounds for animals milked three times a day and 84 pounds for those milked twice a day. The similarity of these gains indicates that the feeding was comparable and that the rations were sufficient in quantity.

The increases obtained in this long-period experiment were approximately twice those obtained in the short-period experiment. These increases may in large part be attributed to the greater persistency of the milk flow when cows were milked three times a day, as shown by Table 3 and Figure 2.

TABLE 3.—Decline in production when milking was twice a day as compared with the decline when the milking was three times a day, for eight cows

Cow No.	Milking per day	Milk production			
		First 30 days	Last 30 days	Decline	
	Number	Pounds	Pounds	Pounds	Per cent
88	Three	1,415.1	940.8	474.3	33.5
97	do	1,380.9	1,045.5	335.4	24.3
214	do	1,680.0	840.5	839.5	50.0
253	do	1,060.0	995.7	64.3	6.1
269	do	1,500.0	1,285.2	214.8	14.3
273	do	1,456.7	980.4	476.0	32.7
275	do	1,796.6	1,534.8	261.8	14.6
A2	do	1,600.5	1,000.4	600.1	37.5
Average					26.6
88	Two	1,320.6	598.2	722.4	54.7
97	do	1,360.1	835.6	524.5	38.6
214	do	1,420.3	750.4	669.9	47.2
253	do	1,370.5	990.4	380.1	27.7
269	do	1,500.3	796.5	703.8	46.9
273	do	1,705.9	720.1	985.8	57.8
275	do	2,160.2	1,370.4	789.8	36.6
A2	do	1,380.6	845.5	535.1	38.8
Average					42.5

Table 3 shows that the decrease in milk yields from the first 30 days to the last 30 days of the second experiment was much greater when the animals were milked twice a day than when they were milked three times a day. A part of this difference must be ascribed to the fact that the cows were a little younger when milked three times a day than when milked twice a day, and for this reason they sustained their milk flow better. The age factor, however, does not account for all of the difference found.

The difference in persistency of the milk flow is better illustrated by Figure 2, which represents the average production of the entire group of cows under both systems of milking.

It will be observed that the cows milked twice a day seemed to reach the peak of their production a little sooner after calving than did those milked three times a day. The initial and maximum productions were about the same for each.

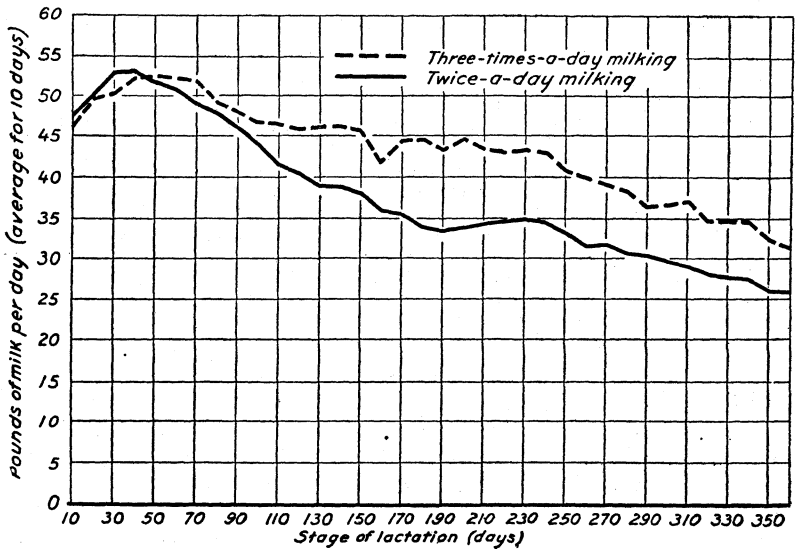


FIGURE 2.—Comparison of persistency of milk production in twice-a-day and three-times-a-day milking. Average for 8 cows, 210 days; 7 cows, 235 days; 6 cows, 290 days; and 5 cows, 365 days.

An experiment in which a grade Holstein cow was milked twice a day for a period of one year, and then once a day for another year, furnished further information on the persistency of the milk flow. (Table 4.)

TABLE 4.—Decline in milk yield of a cow milked twice a day and once a day for two 1-year periods

Times a day milked	Production for 365 days		Milk production for first 30 days	Milk production for last 30 days	Decline in production of milk	Gain in weight for 365 days
	Milk	Butterfat				
	Pounds	Pounds	Pounds	Pounds	Per cent	Pounds
2	12, 078. 4	434. 24	1, 202. 4	682. 7	43	18
1	5, 291. 9	207. 06	1, 040. 4	240. 3	77	29

The decline in production of this cow when milked twice a day was about the same as that of the eight cows reported in Table 3. When she was milked but once a day the decline was much greater than when milked twice a day. Apparently, the oftener a cow is milked the more persistent is the milk flow. The similarity of the gains in weight show that the greater decrease in milk production when the milking was once a day was not due to inadequacy of the ration.

ECONOMY OF MILKING THREE TIMES A DAY

In deciding whether it is profitable to milk three times a day instead of twice the dairyman should take into consideration not only the average increase in production that may be expected from a given

number of cows but also the cost of the extra milking and the extra grain to be fed and the value of the extra milk produced. As these factors vary in different sections of the United States, as well as with the individual farmer, a statement that will cover all cases can not be made. Each farmer must figure it out for himself. The following method is suggested:

EXAMPLE: A Holstein cow giving 30 pounds of milk a day on twice-a-day milking is to be milked three times a day for the entire lactation period.

A 20 per cent increase in production is 6 pounds.	
Value of 6 pounds milk at \$2.40 per 100 pounds.....	\$0. 144
Cost of extra milking, estimating rate of milking at 6 cows an hour and wages at 30 cents an hour.....	0. 05
Cost of extra grain, at 2 cents a pound, estimating 0.4 pound for each extra pound of milk.....	0. 048
Total cost of producing 6 pounds of milk.....	0. 098
Net cash advantage from milking three times a day as compared with twice, over cost of feed and labor.....	0. 046

It would appear, therefore, that high-producing cows might profitably be milked three times a day, if the product could be sold at the prices which ordinarily prevail for market milk. On the other hand, and generally speaking, if the product goes for butter making or cheese making, it is doubtful whether it would pay to milk cows more than twice a day.

MILKING FOUR TIMES A DAY AS COMPARED WITH THREE TIMES

Four Holstein cows (three registered and one grade) at the bureau's experiment station at Beltsville, Md., were milked three and four times a day in alternate periods of 40 days for 360 days, the same plan being followed as when comparing two milkings a day with three a day. In this experiment also the results during the first 10 days of each period are not included in Table 5. These cows were good producers; their average daily milk yield when they were milked three times a day ranged from 38 pounds for the lowest producer to 58 pounds for the best producer.

TABLE 5.—Comparison of four-times-a-day with three-times-a-day milking

Cow No.	Times a day milked	30-day periods	Average production for each period		Average increase for four times over three times a day				Average gain in weight for each period
			Milk	Butterfat	Milk		Butterfat		
		Number	Pounds	Pounds	Pounds	Per cent	Pounds	Per cent	Pounds
224	4	4	1,806.1	67.51	91.0	5.3	1.55	2.3	7
	3	5	1,715.1	65.96					1—17
240	4	4	1,820.4	71.02	148.0	8.8	4.81	7.3	39
	3	5	1,672.4	66.21					25
248	4	4	1,882.9	62.49	149.8	8.6	5.22	9.1	26
	3	5	1,733.1	57.27					2
67	4	4	1,192.1	45.49	47.3 ¹	4.1	2.33	5.4	23
	3	5	1,144.8	43.16		² 7.0		² 6.0	24

¹ Loss.

² True (or weighted) average.

Table 5 and Figure 3 show the average production of the four cows when milked three and four times a day. In starting this experiment the cows were milked three times a day during the first period. In

the similar experiment comparing two and three milkings a day, every cow when changed from two milkings a day to three increased in production, and when changed back again decreased in production. This was not uniformly the case with each of the cows milked three and four times a day. The average results for all four cows, however, were similar to those for each of the cows milked two and three times a day.

Table 5 shows that the cows gave, on the average, 7 per cent more milk and 6 per cent more butterfat when milked four times a day than when milked three times. In view of the fact that cows milked

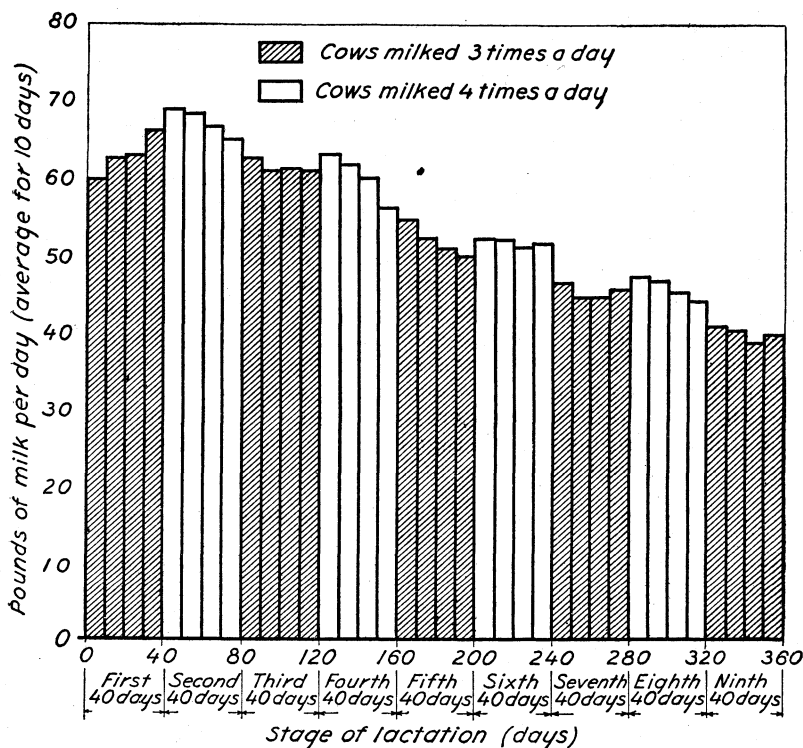


FIGURE 3.—Average production of four cows milked three times a day, as compared with that of the same cows when milked four times a day

two and three times a day showed about twice as much increase when the experiment was carried on over long periods as when the periods were short (Table 1 and 2), it seems reasonable to suppose the same thing would hold true, in a general way, in the case of cows milked three and four times a day.

This table also shows that the cows gained more in weight when they were milked four times a day than when milked three times. Ordinarily this would indicate that the cows so milked were fed more, but they were actually fed slightly less than when milked three times. The differences in the feed intake were so small, however, that they probably did not have any material effect on the results.

CHANGE OF MILKERS

Farmers commonly believe that cows produce best if they are always milked by the same person. On most farms this practice may be followed without much difficulty. In some of the larger dairies, however, the work appears to be expedited, and also equalized, by milking the cows just as they come. Previous investigations on the effect of changing milkers upon milk production show the following results:

Carlyle (1) reports a slight increase in production with a change of milkers. In his experiment he used 8 cows for 5 periods of 4 days each. The cows were milked by three men, the same milkers being used throughout the experiment. During alternate periods each man milked the same cows; during the other periods, the cows were not milked twice in succession by the same man.

Linfield (9, p. 222-223, 307) notes an immediate increase in milk yield when the change is made from a poor to a good milker, even though the good milker is a stranger.

In the writer's present work an experiment was made to determine the effect of a change of milkers upon production. Twelve cows (9 Jerseys and 3 Holsteins) on semiofficial test were divided into 3 groups of 4 cows each. Three men, all of them good milkers, were used in the experiment. Each group of cows was milked by the same man for 30 days. Then the 12 cows were milked by the three men for 30 days in such a way that no cow was milked twice in succession by the same man. Each group was again milked for 30 days by the same man, making two periods in which the same milker was used and one period in which different milkers were used. The amount of feed for the first and third periods averaged exactly the same as for the second period. The results are given in Table 6.

TABLE 6.—Production of cows when milked by the same milker and by different milkers

Cow No.	Same milker (first period)		Different milkers (second period)		Same milker (third period)		Increase or decrease (-) ¹ when milking was done by same milker	
	Milk	Butterfat	Milk	Butterfat	Milk	Butterfat	Milk	Butterfat
214.....	<i>Pounds</i> 1,260.7	<i>Pounds</i> 40.33	<i>Pounds</i> 1,142.2	<i>Pounds</i> 38.45	<i>Pounds</i> 1,623.8	<i>Pounds</i> 34.30	<i>Pounds</i> 0	<i>Pounds</i> -1.14
226.....	1,255.4	46.51	1,064.4	35.50	948.6	34.15	37.6	4.83
256.....	1,043.0	37.91	986.4	35.85	855.7	31.66	-37.1	-1.07
410.....	771.6	54.19	719.1	52.97	673.4	48.82	3.4	-1.47
420.....	575.0	36.03	501.9	31.95	474.6	29.90	22.9	1.01
424.....	952.0	57.80	907.1	52.61	900.7	52.24	19.2	2.41
427.....	671.7	43.23	634.2	41.44	601.3	38.78	2.3	-4.44
435.....	676.4	42.40	627.3	39.31	599.6	36.88	10.7	.33
436.....	701.3	40.21	567.7	33.61	378.1	24.20	-28.0	-1.41
437.....	920.7	53.39	876.1	54.02	847.0	53.36	7.7	-.65
464.....	864.1	49.41	763.2	48.32	678.5	43.42	8.1	-1.91
467.....	620.1	38.51	514.5	31.86	431.1	27.81	11.1	1.30
Total.....	10,312.0	539.92	9,304.1	495.89	8,412.4	455.52	² 58.1	³ 1.83

¹ Obtained by subtracting production of second period from average of first and third periods.

² Equal to 0.6 per cent.

³ Equal to 0.4 per cent.

When the cows were milked by the same man, 9 of them gave a little more milk, and 2 gave less than when milked by different men, and 1 cow gave the same under both methods of milking. Milking by

one man resulted in less butterfat from seven cows and more from five. The two methods of milking used have very little effect upon the total production of both milk and butterfat.

The popular opinion that cows should always be milked by the same man probably rests upon the assumption either that a strange milker is likely to be less efficient than the regular milker or that the cows are excited by a strange person. When cows are accustomed to having different men care for them, it appears that milking by a strange person will result in no material decrease in production, provided he is as efficient as the regular milker.

These results are not greatly different from the findings of the Agricultural Experiment Station of the University of Wisconsin already reported (1).

**MILKING AND FEEDING AT REGULAR AND IRREGULAR HOURS
COWS MILKED TWICE A DAY**

Experiments were carried on at Beltsville to compare the results of regular and irregular hours of milking and feeding when cows were milked twice a day. In the first experiment 6 cows were used (1 registered Guernsey, 2 grade Guernseys, 2 registered Holsteins, and 1 grade Holstein), varying in milk production from 15 to 28 pounds per cow per day and averaging nearly 20 pounds of milk and 0.7 pound of butterfat. They were milked at 4 a. m. and 4 p. m. for 30 days, but the results of the first five days were not considered, as this time was allowed for the cows to become accustomed to the procedure. The cows were then milked at irregular hours for 30 days, the first five days again not being considered. Another 30-day period like the first followed, making three experimental periods of 25 days each. Table 7 shows the hours at which the cows were milked in the second period.

TABLE 7.—Hours at which cows were milked in the second period of experiment on irregular milking

Day	Milking hour		Day	Milking hour		Day	Milking hour		Day	Milking hour	
	A. m.	P. m.		A. m.	P. m.		A. m.	P. m.		A. m.	P. m.
1	4	6	9	6	7	17	8	6	24	4	6
2	6	4	10	6	5	18	4	5	25	6	4
3	6	8	11	7	9	19	6	8	26	4	6
4	4	4	12	7	6	20	6	6	27	7	9
5	4	6	13	7	6	21	4	5	28	7	8
6	5	7	14	6	4	22	7	7	29	6	4
7	7	6	15	4	4	23	5	3	30	6	8
8	4	5	16	5	7						

The cows were fed all the clover hay and corn silage they would eat, and grain at the rate of about 10 pounds for each pound of butterfat produced. The same grain mixture was used in the entire experiment. It consisted of linseed meal, 1 part; dried distillers' grain, 4 parts; hominy chop, 2 parts; and dried beet pulp, 2 parts. It was fed regularly, regardless of the time of milking. Body weights were taken for three consecutive days at the beginning and end of each experimental period. Table 8 shows the results of this experiment.

TABLE 8.—*Influence upon production of milking at regular and irregular hours*
COWS OF AVERAGE PRODUCTION

Cow No.	Regular milking, ¹ period 1 (25 days)			Irregular milking, period 2 (25 days)			Regular milking, ¹ period 3 (25 days)		
	Milk	Butterfat	Gain or loss (—) in body weight	Milk	Butterfat	Gain or loss (—) in body weight	Milk	Butterfat	Gain or loss (—) in body weight.
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
33.....	432.1	19.72	24	432.0	20.44	49	425.6	22.47	-21
51.....	489.1	16.38	31	539.7	19.53	63	563.4	19.64	29
54.....	431.2	16.52	24	440.5	17.54	72	424.8	17.82	-7
114.....	368.7	16.04	17	344.6	16.50	46	345.1	16.71	12
223.....	506.8	15.62	36	499.2	15.38	29	453.4	13.92	18
243.....	704.4	20.80	21	612.4	19.11	47	614.8	18.71	-27
Total.....	2,962.3	105.08	153	2,868.4	108.50	306	2,827.1	109.27	4

GOOD PRODUCING COWS

17.....	618.3	27.96	-3	562.3	24.99	1	512.3	23.21	-20
21.....	933.2	39.68	10	858.0	37.07	-21	801.3	35.17	-6
50.....	743.4	27.10	9	679.6	26.85	18	701.5	22.72	-42
71.....	465.5	19.15	29	443.7	18.62	10	431.4	17.00	-8
402.....	512.0	27.61	1	506.7	28.72	7	475.7	25.71	21
Total.....	3,272.4	141.50	46	3,050.3	136.25	15	2,922.2	123.81	-55

¹ The production of the 6 cows for periods 1 and 3 averaged 2,894.7 pounds of milk and 107.17 pounds of butterfat; of the 5 cows, 3,097.3 pounds of milk and 132.65 pounds of butterfat.

When the 6 cows were milked at irregular hours, 3 of them gave more milk and 4 gave more butterfat than when they were milked at regular hours. When the milking was done regularly there was a slight increase in total milk but a slight decrease in total butterfat. Milking at regular instead of irregular hours resulted in 0.92 per cent more milk and 1.23 per cent less butterfat in one experiment, and 1.54 per cent more milk and 2.64 per cent less butterfat in the other, for cows of average to good production. One method of milking seems to be no more favorable than the other. When the cows were milked at irregular hours, they gained considerably more in body weight than when they were milked regularly. The reason for this was not determined; it could not be attributed either to the feed or to the weather.

Because it proved impossible to determine the reason for the difference in body gains, and because the cows used were only average producers, it was thought best to carry on a second experiment using higher-producing cows. Five cows were selected (1 registered Jersey, 2 grade Jerseys, 1 grade Holstein, and 1 grade Guernsey), producing from 19 to 37 pounds of milk each per day and averaging about 26 pounds of milk and 1.1 pounds of butterfat. The experiment was carried on in the same way as the foregoing experiment. The results are shown in the second part of Table 8.

The results of the second experiment agree with those of the first, in that slightly more milk and slightly less butterfat were produced with regular milking than with irregular milking. The gains in body weight in the second experiment were about the same for both methods of milking.

for regular milking, and for regular milking and feeding, for the three experiments given in Tables 7, 8, and 9, is summarized as follows:

PERCENTAGE OF INCREASE OR DECREASE

	Milk	Butterfat
Regular milking (cows of average production)-----	0. 92	-1. 23
Regular milking (cows of good production)-----	1. 54	-2. 64
Regular milking and feeding (cows of average production)-----	3. 90	5. 25

It would seem from these experiments that cows of average production can be milked at very irregular hours without disadvantage if they are fed regularly.

However, since irregularity in the hours of both milking and feeding resulted in the production of approximately 4 per cent less milk and 5 per cent less butterfat, this practice should not be carried on for any considerable length of time; but the loss is not so great as to preclude an occasional irregularity when other work is pressing.

COWS MILKED THREE TIMES A DAY

When a person milks cows three times a day at regular intervals of eight hours each, his periods of rest are materially shortened, and if it were not for this fact no doubt many more cows would be milked oftener than twice a day.

Although Grisdale (5) states that very considerable inequalities in the intervals between milkings appear slightly to reduce both the quantity and quality of the milk, Walker (14, p. 11) says: "It can not be said that the total quantity of milk is influenced by the equal or unequal periods of milking."

The experiment reported below was conducted at Beltsville with 4 cows (3 grade Holsteins and 1 registered Holstein) to show how much milk would be produced by milking cows at intervals of 6, 7, and 11 hours, as compared with intervals of 8 hours. Two of the cows were milked at 7 a. m., 1 p. m., and 8 p. m., and the other two at 5 a. m., 1 p. m., and 9 p. m. At the end of 40 days the two groups were reversed and the experiment was continued for another 40 days. The results of the first 10 days of each period are not included, as this time was allowed for the cows to become fully accustomed to the change in time of milking. Consequently, the length of each experimental period as reported is 30 days.

The average yield of milk was about 43 pounds per cow per day. The feed was exactly the same in kind and quality for the two groups. Hay, silage, grain, and beet pulp were fed. The hay and silage were fed at regular intervals and the grain and beet pulp at the time of milking.

When milked for 30 days at 8-hour intervals, the cows yielded 5,195.6 pounds of milk and 194.56 pounds of butterfat, and when milked at unequal intervals they gave 5,044.7 pounds of milk and 189.08 pounds of butterfat, or 150.9 pounds of milk (or 2.9 per cent) and 5.48 pounds of butterfat (or 2.82 per cent) less. When a fair allowance was made for the cows that were off feed for several days, the difference was a little less than 2 per cent. These results indicate that milking at equal intervals is preferable, but that there is no great loss by milking at unequal intervals for short periods of time.

SUMMARY

Cows milked twice a day and three times a day in alternate periods of 30 days, following 10-day transitional periods, gave 11 per cent more milk and nearly 10 per cent more butterfat when milked three times a day.

Cows milked twice a day and three times a day for long periods, 217 to 365 days, gave nearly 20 per cent more milk and nearly 21 per cent more butterfat when milked three times a day.

The decline in milk yield in the long periods was much greater when the cows were milked twice a day than when they were milked three times a day.

The production of milk by a cow milked once a day declined 1.8 times as fast as when she was milked twice a day.

Cows milked four times and three times a day, in alternate periods of 30 days, following 10-day transitional periods, gave 7 per cent more milk and 6 per cent more butterfat when milked four times a day.

The explanation offered for the greater yield following the more frequent milking is that relief from the pressure of milk within the udder allows secretion to proceed more freely.

Changing milkers resulted in an almost negligible decrease in milk production.

Milking at regular instead of irregular hours resulted in 0.9 per cent more milk and 1.2 per cent less butterfat in one experiment, and 1.5 per cent more milk, and 2.6 per cent less butterfat in the other, when cows of average to good production were used.

Regular milking and feeding resulted in the production of 3.9 per cent more milk and 5.2 per cent more butterfat than did irregular milking and feeding.

An experiment during which cows were first milked three times a day at equal intervals of 8 hours, and then at unequal intervals of 6, 7, and 11 hours for 30-day periods, following 10-day transitional periods, demonstrated that there was a decrease of 2.9 per cent in milk yield and 2.8 per cent in butterfat when the milking was done at unequal intervals.

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