THE TEMPERATURE OF MILK IMMEDIATELY AFTER MILKING AND STRAINER CAPACITY

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ABSTRACT

The temperature of milk at the conclusion of the milking of each cow was found to be directly related to the temperature of the barn and to the amount of milk given per milking. It was not materially affected by the time required for milking.

Hand milking produced the warmest milk which varied only slightly in temperature from winter to summer, while milk drawn by machines varied to the greatest extent. Milk drawn by hand from heavy-producing cows in warm barns was the warmest and gave the greatest capacity in straining.

These variations in temperature of milk were sufficient to account for marked variations in the capacity of strainers using cotton discs or heavy straining cloths and to explain the irregularities in the capacity of the same type of strainer on the same farm at different seasons of the year or on different farms at the same season.
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INTRODUCTION

At the time of publication of Bulletin No. 585 of this Station on straining milk on the farm, it was recognized that the same type of strainers and cotton pads did not always give uniform results on different farms. For example, in the winter of 1929, a manufacturer of cotton pads reported a very large capacity for his strainer cotton. The results could not be duplicated in the Station dairy barn, but they were readily verified by the senior author in the barn in which the manufacturer had made his original tests. It was observed that the temperature of the milk produced in these two barns at the same season of the year varied considerably, and it was suspected that this was the cause of the discrepancy secured in the experiments with the strainers.

As a result of this observation experiments on the temperature of milk immediately following milking were planned with the hope that information might be secured regarding the factors affecting the temperature of milk. These tests were commenced in January 1931 and were continued throughout the winter and spring of that year. No experiments were conducted in the summer since milk strainers give little difficulty from the standpoint of capacity in the summer months. The experiments were again continued in the fall and winter of 1931 and 1932. By taking temperatures during various seasons it was possible to secure a wide range of temperatures within the barn.

Data were also secured on the length of time required to milk each cow and on the total milk produced per milking.

Preliminary observations indicated that the temperature of milk drawn from the cow by hand was very much warmer than that drawn by a milking machine which was designated as machine No. 1. For this reason data were secured on cows milked by hand and by
machine No. 1, and to secure additional variations cows were also milked by a machine designated as No. 2. It should be stated that at each milking cows were milked by the three different methods so that the results would be entirely comparable. Machine No. 2 was selected for comparative purposes as it was assumed that it would milk more rapidly and would use less vacuum pump capacity than machine No. 1. If such proved to be the case, the two machines might give a milk of different temperature. In all cases the machines and pails were rinsed with luke warm water just before milking so that the milk from the first cows would not be chilled excessively.

RELATION OF TEMPERATURE OF BARN TO TEMPERATURE OF MILK

It was found that throughout most of the winter months the temperature of the barn was 10° to 25°F above the outside temperature. The outside temperature rarely dropped below 20° above 0 so that

![Graph showing the relationship between temperature of milk and temperature of the barn.](image)

**Fig. 1.—The Relation of Temperature of Milk Immediately After Milking to the Temperature of the Barn.**
it was not possible to secure sufficient data on temperatures within
the barn below 40° to show any relationship to these cold tempera-
tures. At the other extreme the collection of data was stopped
when the temperature of the barn was 80° to 85° as this was suf-
ficiently high to produce milk of a relatively warm temperature
which strained readily. The data are represented graphically in
Fig. 1.

In considering all data, it should be borne in mind that tempera-
tures of individual milkings varied considerably and that each dot
in Fig. 1 is an average of a large number of determinations.
Several thousand temperature recordings were made during the
course of these experiments. The results show that milk drawn
from the cow by hand varied in average temperature from 94.5° to
97.7°. The coldest milk drawn by hand in these experiments had a
temperature of 90° as it was weighed in the pail at the scales in the
barn. Obviously milk produced by hand chills very little during
the milking process and is not materially affected by the temperature
of the barn in which it is milked.

Milk drawn from the cow by machine No. 2 varied in its average
temperature from 90.3° to 96.1°. The temperature of the milk
increased as the temperature of the barn increased, but in all cases
the milk produced by this machine was relatively warm. The coldest
milk drawn from any individual cow by machine No. 2 was 84° at
the completion of milking.

Machine No. 1 produced milk which was considerably colder than
that drawn by the other two procedures. This milk varied in average
temperature from 81.2° to 91.1°. The milk drawn by machine No. 1
increased in temperature rather strikingly with a rise in temperature
of the air in the barn, and at a barn temperature of 80°, milk drawn
by all three procedures was above 90°. The coldest milk from any
individual cow in the milk pail of machine No. 1 was 66°. An
appreciable number of samples were below 70°, while much of the
milk produced at a barn temperature of 55° or less was below 80°.

RELATION OF WEIGHT OF MILK PER MILKING TO
TEMPERATURE OF THE MILK

Since the milk drawn by machine No. 1 was so markedly affected
by the temperature of the air in the barn, all data presented to
show the relationship of the temperature of the milk immediately
after milking to the weight of milk per milking are limited to milk
produced when the barn temperature varied from 50° to 60°. The relationship of the weight of milk per milking and the temperature of the milk is shown in Fig. 2.

It is apparent that the temperature of the milk drawn by each of the three procedures was noticeably affected by the amount of milk given by the cow. Milk drawn by hand showed a slight but notice-

![Graph showing the relation of temperature of milk immediately after milking to the weight of milk per milking. Barn temperatures 50° to 60° F.](image-url)
able relationship between the weight of milk given and its temperature. For milk drawn by hand the average temperature varied from a minimum of 92° to a maximum of 96.8° as the amount of milk given by each cow varied from 5 to 20 pounds per milking. In the case of milk drawn by machine No. 2 the relationship of the temperature of the milk to the amount given by the cow was approximately the same as that for hand milking, but the temperature of the milk itself was lower, ranging from an average of 89.2° to 94.5°. The most striking relationship was that shown by milk drawn by machine No. 1. This milk varied in average temperature from 78.5° to 88.7° and the amount of milk given by each cow varied from 5 to 25 pounds per milking.

It would have been interesting to have included in these data results of cows producing in excess of 25 pounds of milk per milking, but such cows are not common in the Jersey breed. On the other hand, the data for all methods of milking show that when cows gave 20 to 25 pounds of milk per milking in a barn at 50° to 60°, the milk varied from 88.7° to 96.8°. Such warm temperatures will be shown subsequently to have little effect upon straining capacity and it is evident, therefore, that cold milk and slow straining are problems when cows give less than 20 pounds per milking and are machine milked.

RELATION OF TIME REQUIRED TO MILK A COW TO TEMPERATURE OF THE MILK

It has always been assumed that one of the most important factors affecting the temperature of milk, aside from the temperature of the barn, is the time required to milk a cow. Data on this relationship are given in Fig. 3. Since it has already been shown that the barn temperature and the weight of milk produced by the cow are factors affecting its temperature, it was necessary to limit these data to results which would be comparable. The data on the temperature of milk included that milk drawn when the barn temperature varied from 50° to 60° and from those cows that gave from 7.5 to 12.5 pounds of milk per milking.

Within the limits of 5 to 10 minutes per cow, the time required to milk a cow had little or no effect upon the temperature of the milk. This was true for the three methods of milking. As previously shown, the temperature of the milk drawn by machine No. 2 was
colder than that drawn by hand, while that drawn by machine No. 1 was the coldest of all. It should be stated in this connection that when the time of milking a cow was extended to excessively long periods, the temperature of the milk decreased slightly. In the case of milk drawn by machine No. 1, there were 26 milkings which required from 11 to 15 minutes. The temperature of this milk was 82.3° which is approximately 2.5° lower than that given in Fig. 3.

![Graph showing the temperature of milk over time](image-url)

**Fig. 3.—Relation of Temperature of Milk Immediately After Milking to Time Required to Milk the Cow.**

Barn temperature 50° to 60° F; weight of milk 7.5 to 12.5 pounds.
RELATION OF TEMPERATURE OF MILK TO STRAINER CAPACITY

Milk produced in the summer months was held warm until the completion of milking at which time it was quickly chilled to 90°, 85°, 80°, or 75°. This milk was then poured thru cotton pads in a milk strainer recently studied at this Station. The strainer had a 6¾ inch foot and required a cotton disc of 7½ or 8 inches in diameter. The cotton was supported on a wire grid and the upper disc was conical to prevent packing of the cotton; both of these conditions increase strainer capacity.

The amount of Jersey milk which could be poured thru one cotton pad before the pad clogged is shown in Fig. 4. It will be noted that one of these large cotton pads would strain only one full 10-gallon can of milk at 80°. The capacity of the cotton pad increased as the temperature of the milk increased until at 90° or above one cotton pad strained three 10-gallon cans of milk. Slightly more Holstein milk could have been strained than that shown in Fig. 4. These results have been checked on many farms and are typical of those secured under practical conditions.

DISCUSSION OF RESULTS

The results of this experiment clearly indicate that the temperature of milk produced in a given barn may be affected by the temperature of the barn, by the total weight of milk given by each cow, and by

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the method used for milking. Since the temperature of the milk is so important in determining the capacity of a milk strainer, it is evident that variations in strainer capacity must be expected from farm to farm at the same season of the year and with the same identical straining equipment. Most uniform strainer capacity will be secured from farm to farm and for all seasons of the year when the milk is drawn by hand.

The difficulty often experienced with straining milk in the winter is due to two factors, namely, the low temperature of the barn and the smaller amount of milk given by each individual cow.

It is difficult to understand all of the various reasons for the marked difference in the temperature of milk drawn by the two machines. This is due in part to one important factor which has been observed in these experiments. Machine No. 1 required much more vacuum capacity than machine No. 2, even tho both operate on a 15-inch vacuum, due to the drawing of air directly into the milk tube. This cold air, in turn, undoubtedly helped in cooling the milk.

Previous work at this Station on straining milk has shown that the temperature of the milk was of the greatest importance in determining the capacity of a given strainer. The effect of temperature was much greater than that of the sediment or the fat content of the milk. It was also shown that the design of the strainer and the character of the cotton pad were of major importance; but in tests regarding the effect of these other factors, the same strainer and cotton from the same batch were used. The present work shows that the temperature of the milk and strainer capacity are dependent upon the method of milking as well as upon the temperature of the barn and the yield of milk.

If a strainer using cotton or special filtering cloth is of proper design and size but fails to give proper capacity with chilled milk, then the dairyman is practically forced to use a more open straining medium, such as more porous filter cloths especially designed for straining milk.

CONCLUSIONS

Milk drawn by hand was warmer and more uniform in temperature than that drawn by machine, as shown by averages of several thousand temperatures. In a barn at 50°F, hand-drawn milk was 94.5°, that drawn by one milking machine was 90.5°, and that drawn by another machine was 81°.
The temperature of milk in the milk pail immediately after milking decreased as the barn became colder. For hand milking the decrease in milk temperature was only 3.2° when the barn temperature dropped from 80° to 50°. For one milking machine the decrease in temperature of the milk was 5.8° and for the other 9.9°.

The milk was warmer from heavy-producing than from low-producing cows, but the difference in temperature was small with hand milking, varying from 92° to 96.8° when milk production varied from 5 to 20 pounds per milking. For the milking machine yielding the coldest milk, when the barn was 50° to 60° the milk varied from 78.5° to 88.7° as the weight of milk per milking increased from 5 to 25 pounds.

The time required to milk a cow did not affect the temperature of the milk when normal rates of milking were used. Cows milked in 11 to 15 minutes per cow showed a drop of only 2.5° in the temperature of the milk as compared with those milked in less than 10 minutes.

One cotton pad, 7½ inches in diameter used in a strainer previously described in Bulletin No. 585 of this Station strained one 10-gallon can of milk at 80° and three 10-gallon cans of milk at 90°.

In view of the fact that one of the milking machines regularly produced milk at 80° to 82° when the barn was 55° or lower, it is evident that the variations in the temperature of milk in the milker pail is of great importance in affecting strainer capacity, and readily explains the difficulties often encountered in straining milk during cold weather.