QUALITY OF GENEVA MILK SUPPLY, 1915-1919.

NEGLECT OF DETAILS IN CARE OF MILKING MACHINES RESULTS IN LOW GRADE MILK.

SUMMARIZED BY
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FROM BULLETIN BY
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Station.
NEGLECT OF DETAILS IN CARE OF MILKING MACHINES RESULTS IN LOW GRADE MILK.

J. D. LUCKETT.

The use of the milking machine with its rubber tubes, pail lid with milk spigots and valves, more or less complicated pulsator, and heavy pail, requires much greater care than the simple milk pails used in hand milking to insure the production of clean, pure milk of good keeping quality. While, in a sense, milk drawn by machines under proper conditions is cleaner than hand-drawn milk in that it is free from sediment and dust, if the accumulation of bacteria in the milky substance left in the poorly cleaned tubes is regarded as dirt (as it should be) the average machine-drawn milk is not as clean as hand-drawn milk. Since it is a simple matter to protect machine-drawn milk from outside dirt, the investigations described in the complete bulletin have to do with the difficulties actually met with by farmers in keeping milk drawn thru the milking machine free from excessive numbers of bacteria.

As a result of the ease with which milking machines become seeded with bacteria the Station has developed a method of caring for the machines which is essentially as follows: A rapid but careful washing of the machine by drawing thru it immediately after each milking successive pails of cold water, hot alkali water, and clear hot water; immersion of the teat-cups and all rubber parts in a good sterilizing solution between milkings, supplemented by a very thorough weekly overhauling of the teat-cups and tubes; and the daily scalding and thorough drying of all metal parts that come in contact with the milk.

*This is a brief review of Bulletin No. 472 of this Station on Milking Machines: The Production of High Grade Milk with Milking Machines under Farm Conditions, by John W. Bright. Anyone specially interested in the detailed account of the investigations will be furnished, on request, with a copy of the complete bulletin. The names of those who so request will be placed on the Station mailing list to receive future bulletins as issued, either popular or complete edition, as desired. Bulletins are issued at irregular intervals as investigations are completed.
except those parts kept in the sterilizing solution. Parts kept in the sterilizing solution are rinsed in water before using them for milking. Good results have been secured with this method at the Station for more than ten years, but farmers in the vicinity of Geneva who have attempted to use similar methods of cleaning and caring for their machines have generally failed to obtain equally good results. An inspection of the dairies usually showed, however, that a lack of attention to details was responsible for the production of milk having excessive numbers of bacteria.

The difficulty

**The hot water** of obtaining supply. an adequate supply of hot water in the barn or milk house frequently appears as a serious obstacle to milking machine users and prospective buyers. It has been found at the Station, however, that an abundance of hot water, *i.e.*, more than a tea kettle full, is necessary if the utensils are to be kept clean and essentially sterile. If the barn is equipped with running water, a hot water tank and heating coil can be installed, and the coil heated by means of a wood or coal stove, or a gas or kerosene burner. If running water is not available, the water may be heated in a large boiler on a wood, gas, or kerosene stove located in some safe place where the risk of fire is reduced to a minimum. Outfits for heating water are illustrated in Figs. 1, 2, and 3.

**Drying the utensils.** Equal in importance to the use of plenty of hot water is the proper drying of all pails and pulsators. For this purpose it is suggested that drying racks be erected either in the open where the utensils may be inverted and exposed to a maximum of sunlight and fresh air with a minimum of dust, or that the racks be so arranged as to expose their contents to the heat of the fire used in heating the water.
Quality of Geneva milk as affected by machines.

Since 1915 the Station has directed the milk control work for the city of Geneva and during that time 22,134 cans of milk have been examined in an estimation of the quality of the milk.\(^1\) The milk is delivered by about sixty-five dairymen at two central receiving plants where it is pasteurized and bottled. Samples for bacteriological analysis and sediment tests are collected from the individual cans as received. Of the total number of cans received, 5,351 were known to have been produced with the aid of milking machines, and 16,231 by hand milking. Based on

\[^1\] The grading of this milk has been made by direct microscopic examination. The term "excellent" has been applied to milk that would meet the bacteriological requirements for a Grade A raw milk under both the New York State and the New York City Codes. The terms "excellent" and "good" have been applied to milk that would satisfy the requirements for pasteurization as Grade A milk. The term "medium" has been applied to milk not acceptable for Grade A pasteurized but which would be accepted for Grade B pasteurized. Milk not fit for pasteurization as Grade B has been termed "poor."
the bacteriological content of the samples, 14,608 cans of the hand-drawn milk were graded as excellent or good, 1,396 as medium, and 227 as poor. Of the machine-drawn samples, 3,955 cans graded as excellent or good, 1,153 as medium, and 243 as poor. These differences are graphically illustrated on a percentage basis in Chart I.

It is quite evident that the elimination of the milk brought from farms where milking machines were used would have materially improved the quality of the milk brought to the city.

The amount of low grade milk brought from farms using machines was somewhat less than it otherwise would have been due to the fact that pressure was brought to bear on the men supplying this milk.

In one instance the dairyman was forbidden to bring milk into the city because of his continued failure to keep his machine in a sanitary condition, while the premium paid for high-grade milk was frequently withheld from men using milking machines owing to the poor quality of their milk. The hand milker will continue to be a severe competitor of the milking machine until those who use machines secure as good quality milk as those who practice hand milking.

Experience has shown that mechanically, the milking machine is reasonably successful, but from the standpoint of the control official the manufacturers have not yet given sufficient attention to the sanitary construction of their machines. Features which should receive special consideration include the elimination of all possible seams or crevices which serve to gather dirt, and the construction of leak-proof valves at the point which guards against possible leakage into the milk from the main vacuum line. This line cannot be cleaned satisfactorily with methods ordinarily available, and may become foul with milky vapor, condensation water, and like material, even a drop of which produces a detectable contamination in a pail of milk. Further study could also profitably be given to the selection of suitable metal alloys for use in teat-cups and pulsators which would not be corroded by common washing compounds and sterilizing solutions. It is also considered desirable that a standard grade of rubber be used for tubes and inflations which would withstand the action of animal fats and hot water, and which would have fairly uniform wearing qualities.

Practical experience with milking machines.

Because of the failure of some nearby dairies to produce high-grade milk two farms were visited in order to make close observations of the methods followed in caring for the milking machines, and then to introduce such changes in the operation and cleaning of the machines as would guarantee the continuous production of good milk. A detailed account of the conditions found on the two farms is given in the complete bulletin,
together with a discussion of the satisfactory results obtained with milking machines on a third farm.

**Inferior milk produced on Farm A.** Considerable trouble had been experienced on this farm in producing milk with a low number of bacteria. Of the 175 cans of milk produced on the farm and examined prior to the beginning of the investigation, 94 had been graded as excellent, 26 as good, 38 as medium, and 17 as poor. When compared with the milk coming from all farms regardless of the method of production, as shown in Chart II, it will be seen that the milk from Farm A was decidedly below the average in quality, and that it was also much poorer than the average machine-drawn milk.

**Improper care given machines.** The dairy barn (Fig. 4) on Farm A was found to be fairly clean, large, light, and well ventilated, but the care given the milking machines was unsatisfactory. Two Empire units had been in use for some time. The tubes and cups were kept in a twenty-five gallon crock (Fig. 5) filled with a saturated brine solution plus a stock solution of chloride of lime. The solution was kept in good condition. As the tubes were placed in the solution, however, air was imprisoned in them with the result that the solution did not reach all the surface over which the milk passed, allowing bacteria which cause sour or
tainted milk to multiply and produce a bad odor in the tubes. Immediately after the morning milking a pail of cold water was drawn thru the tubes and pails, the one pail of water being used for both double units employed. The tubes and cups were then placed in the solution jar without further treatment. After breakfast the machine pails, pail lids, and stripplings pails were taken to the house where they were washed with water that was sometimes nearly cold and then placed outside to dry. Following the afternoon milking a pail of cold water was drawn thru the machines and was generally followed by half a pail of fairly hot soda water and half a pail of clear warm water when the cups and tubes were again put into the solution, and the pails and lids turned upside down on a bench in the barn until milking time the next morning. Examination in the morning showed them still to be wet and greasy. Twice a week the machines were taken to the house for a thorough cleaning when they were taken entirely apart and washed.

Various modifications of the method of caring for the milking machines on Farm A were tried out during the first few days of the investigation in order to determine whether any one step was essential to the production of high-grade milk. The first corrective step taken was the removal of the screw cap at the end of the claw of the teat-cups before putting the cups into the sterilizing solution after each milking in order to allow the air to escape from the milk tubes and to insure the free passage of the solution thru the tubes. In other respects the care of the machines and utensils remained as usual. The quality of the milk varied considerably under these conditions.

The next procedure was to draw two pails of very hot water thru the milk tubes into the machine pails, thus thoroughly scalding both the tubes and pails. The results were gratifying in that the four cans of milk produced under these conditions graded as excellent.

The use of a combined cooler and aerator served to produce a good quality of milk the first time it was used, but a gradual lowering in quality accompanied each successive cooling by this means probably due to the cooler being inefficiently cleaned. In other words, cooling alone is not sufficient to produce first-class milk if the utensils are not clean as the low temperature simply checks the growth of bacteria and does not reduce their numbers.

It was finally decided to follow in detail the methods so successfully used at the Station, the treatment methods prove also including the milk cans and aerator. All of the twenty cans of milk produced under these conditions graded as excellent. From tests made during the course of the work it was evident that the chief source of

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2Circular No. 54 (Revised), Milking Machines. 1918.
Fig. 2.—Outfits for Heating Running Water with Kerosene and Coal.

Fig. 3.—Outfit for Heating Running Water with Gas.
Fig. 4.—Farm A. Interior Dairy Barn.

Fig. 5.—Farm A. Solution Jar.
Fig. 6.—Farm B. Solution Jar.

Fig. 7.—Farm B. Interior Dairy Barn.
trouble on Farm A at that time was the metal utensils, and that scalding and drying these utensils resulted in the disappearance of excessive numbers of bacteria. It was noticed in the examination of milk from dairies using milking machines that often a higher number of bacteria was found in the milk of one out of a number of cans containing milk from the same milking. The frequent recurrence of this fact led to the idea that the can with the large number of bacteria was probably the first can filled and that the milk had been contaminated by the first milk drawn thru the tubes and pails of improperly cleaned milking machines. In order to verify this assumption a record was kept of the order in which the cans were filled for several days at Farm A. The first one or two cans filled were found to have a higher number of bacteria than did the rest of the cans of the same milking, indicating that the first milk from the poorly cleaned milking machines and other utensils contaminated the first can or two.

Age of milk affects quality. During the course of the work at this farm the dairyman raised the question as to why the morning milk usually graded higher than the afternoon milk when received at the milk plant despite the fact that the milking machines actually received less care previous to the morning milking than they did for the afternoon milking. It was pointed out that the afternoon milk was not sent to the receiving station until it was about sixteen hours old while the morning milk was received and graded when only about four hours old. The difference in time made a marked difference in the number of bacteria as the milk was not held at a temperature low enough to prevent the growth of bacteria. Samples of morning milk were held for sixteen hours and the grade determined at the end of that time, while samples of evening milk were graded when four hours old. When compared with evening milk of the same age, the morning milk was found to be of inferior quality.

Quality of Farm A milk improved. With the introduction of improved methods of caring for the milking machines and utensils, and so long as the dairy remained under observation, all the milk sent to Geneva was found to have a low germ content. During the next seven months (June to December) after the visit was made the quality of the milk from Farm A, while still variable, was better than that of the milk received previous to the visit.

It was concluded that the fluctuations in the quality of the milk produced on this farm were due to the failure on the part of the dairyman to attend to all of the essential details of the cleaning process.
Since the milk from Farm B began coming into Geneva in November, 1918, 113 cans had been examined up to June 1, 1919, and of this number 45 graded as excellent, 18 as good, 37 as medium, and 13 as poor. As illustrated in Chart III these percentages compare very unfavorably with the average quality of the entire milk supply during the same time, or even with the average quality of all the machine-drawn milk, while the hand-drawn milk was decidedly superior.

An eight-day visit was made to Farm B in order to study the conditions prevailing there, and while a general inspection of the dairy barn and equipment showed them to be of standard construction (Fig. 7), they were poorly kept. Manure had been allowed to accumulate on the cement platform behind the stanchions making it difficult to keep the milker pails and other utensils clean. While there was a good supply of running water (temperature 62° F.) in the barn and milk room, no provision was made for hot water except that it could always be obtained at the house nearby. A large concrete vat in the milk room was filled with water at each milking, and the cans set in it up to their necks. Later a drain was provided so that a stream

**Chart III.—Quality of Milk from Farm B as Compared with the Quality of the General Milk Supply, November, 1918 to June, 1919.**
of water was constantly supplied. The cows were kept fairly clean, but little attention was paid to the condition of the udders when the teat-cups were put on and they were often dirty. The sterilizing solution used for the teat-cups and tubes was kept in a twenty-five gallon crock (Fig. 6), and altho it was mechanically clean, the solution contained no hypochlorite and insufficient salt, so that it was not effective as a sterilizer.

The vacuum pipe line contained a few drops of moisture after each milking, and a milky spray drained out of the vacuum tank trap and the compressed air tank when the stop cocks were opened after milking. Three units of a Sharples machine had been used on this farm for some time. Altho the dairymen had supposedly cleaned the milking machines the day before the investigation started, a casual examination showed them to be dirty. It was found that the nipples were practically never removed from the bottom of the teat-cups and that the short milk tubes were scarcely ever taken off the cups, the cups and tubes simply being put in warm water, a brush run thru them a few times, and then rinsed in hot water. A coating of fat and dried milk was left on the inflations and in the tubes, worn inflations were not removed promptly, and much dried milk was found on the strainers in the check valve chamber, on the valve seats, and on the valves themselves. After the morning milking the machine pails and large milk cans were rinsed out with about a kettleful of hot water and turned upside down to dry, while at night the pails and tubes were simply rinsed out by sucking a pail of cold water thru them. When the tubes were placed in the sterilizing solution the caps were left on the milk claws, thus imprisoning air in the tubes and preventing the solution from acting upon all the inside surface of the tubes.

Proper cleaning improved the quality of the milk. Previous to the third milking after the investigation began the teat-cups were completely taken apart and all the metal and rubber parts of the machines were thoroly cleaned with hot alkali water and rinsed with clear hot water, while the machine pails, strippings pails, and large milk cans were scalded and dried. The rubber parts were also soaked for about an hour in a strong hypochlorite solution. After the evening milking the tubes and pails were washed by drawing thru them, successively, a pail of cold water, a pail of hot soda water, and a pail of clear hot water, while the cups and tubes (with the screw caps removed) were placed in a brine solution to which had been added a stock solution of hypochlorite. Excellent results were secured under these conditions until the third milking when one can of milk graded as excellent and two cans as good.
Altho the usual precautions had been taken previous to this third milking and an aerator had been added to the equipment already in use, it was found that the running water did not cool the milk below 64° F., so that in the case of the evening milk, which stood for about sixteen hours before delivery, any organisms present in the milk had ample opportunity to multiply. At the next milking a change in the water supply was made which resulted in cooling the milk below 60° F., and from that time to the end of the investigation all the milk graded as excellent.

The final results show that the trouble at this farm was caused by failure to clean the machine properly combined with inadequate facilities for cooling.

In contrast to the farms described above, the history of Farm C is briefly reviewed as the dairymen had adapted the Station methods for cleaning milking machines to his own conditions so successfully that he had maintained an almost perfect record for producing milk with a low germ content. This record also corresponded with the high record maintained by Farmer C when he practised hand milking. The dairy barn, altho not strictly modern (Fig. 8), was kept reasonably clean and had a plentiful supply of light and air. Since the cows frequently came thru a muddy yard to get to the barn, their udders were carefully washed with warm water.

A double unit Empire machine was used on this farm and of the 274 cans of milk examined, 266 graded as excellent or good, 7 as medium, and one as poor. All utensils were thoroly scalded after each milking and everything that in any way came in contact with the milk was kept scrupulously clean, but the cups and tubes were never taken apart for a thoro overhauling oftener than once a week. The cups and tubes were kept in a strong chloride of lime solution (Fig. 9) except in the winter when brine was added to keep the solution from freezing.

During the summer of 1919 trouble was experienced in maintaining the excellent record made up to that time, and a microscopic examination of the milk showed that a yeast was commonly present. The dairymen was instructed to add brine to the sterilizing solution and since then his milk has graded as excellent or good, 32 cans excellent and 2 good.

The important factors which contribute to the excellent record made on Farm C are as follows: (1) All the utensils with which the milk comes in contact are kept very clean, and as a rule, the dairyman and his wife care for the dairy themselves, not leaving it to incompetent or indifferent hired help. (2) The sterilizing solution is always sweet and clean, and in this connection it is
pointed out that it does not matter so much where the solution is kept as how it is kept. On Farm C the solution crock is kept in the dairy barn (Fig. 8). (3) The cows are always kept clean. (4) The dairyman himself is clean. (5) The barn is kept in good condition. (6) The milk is adequately cooled. Taken together these factors have resulted in the establishment of an excellent record which is proof that, with proper care, and attention, milk of good quality can be produced with a milking machine under practical farm conditions.

The chief conclusions to be drawn from the observations made on the three farms are as follows:

(1). The methods of cleaning are more important than the type of milking machine in determining the germ content of the milk.

(2). The essential requirements for the successful care of the milking machine are plenty of hot water, a good washing compound, a rack for drying the utensils, a good sterilizing solution in a large crock, and a willingness to use care twice a day for 365 days in the year.

(3). The neglect of any one of several important details in the cleaning process may make the difference between success and failure, while if attention is given to the details of the cleaning process, no trouble will be experienced from the contamination of the milk by the milking machine.