SOME UNESSENTIAL DAIRY REFINEMENTS.

SUMMARIZED BY
F. H. HALL
FROM BULLETIN BY
H. A. HARDING, G. L. RUEHLE, J. K. WILSON AND G. A. SMITH.

PUBLISHED BY THE DEPARTMENT OF AGRICULTURE.
Economy essential in dairying

Strict economy is necessary at every point if present-day milk production is to show profits. Advances in the price of purchased feeds and of labor have been accompanied in New York State, during several recent years, by short pastures and lessened yields of home-grown feeds due to droughts and other unfavorable weather conditions. At the same time, those having oversight of the large milk markets have demanded improvement in the sanitary quality of the milk that can only be secured by direct expenditure of money and by added labor in stable and milk room.

We must bear as best we may the calamitous vicissitudes of the weather, for we can usually do little to prevent or to replace the losses due to severe drought or untimely frost, but we may meet the demands for clean milk with much less labor than at first seemed possible. In large dairies, use of the milking machine may reduce the labor cost of milking while the germ content of machine-drawn milk—the measure of cleanliness in its production—may be held at a low point if a few simple, inexpensive precautions are observed. In smaller dairies where use of the machine is not practicable, the substitution of the small-top pail for the type in common use will shut out one-half or more of the dirt and germs that make milk impure without noticeably increasing outlay or labor.

Care in handling the milking machine and use of the small-top pail are practical sanitary measures which return marked results for the money and time expended.

Some resultless requirements

But boards of health and similar inspection officials include many other features in the requirements or recommendations for securing milk of good sanitary quality. These requirements have been based on general principles rather than actual measurements, for when the need for some regulation of the

* This is a brief review of Bulletin No. 365 of this Station on The Effect of Certain Dairy Operations upon the Germ Content of Milk, by H. A. Harding, G. L. Ruehle, J. K. Wilson and G. A. Smith. Anyone interested in the details of the investigation will be furnished, on application, with a copy of the complete bulletin. The names of those who so request will be placed on our Station mailing list to receive future bulletins issued, popular or complete edition as desired. Bulletins are published at irregular intervals, not monthly.
sanitary quality of milk arose, careful studies of the effect of various barn and milk-house conditions and of the various operations involved in getting milk from the cow to the consumer had not been made. Several of these recommendations or requirements, when tested at this Station and measured by their actual effect on the germs in the milk, prove of surprisingly little or no value. To secure some of the conditions in question, or to perform the operations involved, requires considerable expenditure of money or time; and proof that these conditions or operations are useless in improving the sanitary quality of the milk should result in the abandonment of demands for them by milk dealers and sanitary inspectors and remove them from dairy scorecards or greatly lessen their weight thereon. The milk producer can then devote to more profitable uses the money and time expended on these unessential refinements.

The tests discussed in this bulletin were made in the cattle barn of this Station, in which milk of good sanitary quality has been quite easily produced in recent years. The conditions are probably better than those in most farm-dairy stables, though there is no considerable difference between our stable and its equipment and those of other dairymen in the vicinity and throughout the State who are producing milk of the better grades. Whether the changes in the stable and its management, found without value here, would be equally valueless in stables of lower grade could only be determined by actual test, but in stables of such character other fundamental improvements should first be made if sanitary milk is to be produced; which would bring these stables out of the lower class.

The dairy operations found in our tests to have no value in keeping down germ content of milk were: (1) Ceiling the stable with lath and cement, and white-washing the interior and painting the woodwork; so that it may be said that the cleanliness of the interior of the stable, within a fairly wide range, had no measurable effect upon the milk. (2) Clipping the udder, flank and adjoining portions of the cow led to a slight increase in the germ content of the milk when the cow was cleaned either by hand or with a vacuum cleaning machine. (3) Cleaning the cows with a vacuum cleaner, at the rate of one cow per minute, resulted in practically the same germ content of the milk as cleaning with a brush and comb at the rate of two cows per minute.

Study of some of the points here discussed began about five years ago and each test was continued long enough to obtain accurate results independent of accidental variations. In all the tests, small-top pails were used. In each case where only one cow was milked into a pail, the pail was thoroughly cleansed and sterilized in the dairy room about twenty rods from the barn and was
protected with a cloth over the top during the sterilization, this cloth not being removed until the pail was handed to the milker. In this way considerable contamination of the milk was avoided. In a preliminary test, we compared, for three milkings of each of four cows, pails thus protected by cloth and other pails similarly cleansed and sterilized, but not protected by the cloth while being taken from the milk room to the barn. The protected and unprotected pails were used alternately on the same cow by the same milker and all other necessary precautions were adopted to make the comparison show only the effect of the cloth protector. The average germ content shown in the protected pail was about 900 germs per unit,\(^1\) while that in the unprotected pails was 160 per ct. greater, being about 2,400. This protection of the pails seemed of decided advantage in eliminating a source of error in the experiment and might be a wise precaution in practical dairy work. However, the influence of the protection would rapidly decrease with successive milkings into the same pail.

In taking samples, the milk from each cow was thoroughly stirred with a sterile spoon and the necessary amount taken by means of the same spoon. Before adopting this method of sampling careful tests were made of various other methods and this one was proven most reliable. Several duplicate bacterial cultures were made from the samples, which were developed under conditions providing both for the growth of the bacteria that thrive in ordinary room temperature and those coming from the udder of the cow where the temperature is considerable higher. In every case, at least three plates were counted to secure the average germ content, and, in many instances, twice this number.

**Plastering and white-washing stable**

When the Station barn was constructed in 1904, the cow stable was ceiled at the top and sides with planed, beaded, matched southern pine, which was finished with a coat of oil and shellac in accordance with accepted dairy construction at the time. Modern sanitarians find fault with this finishing of the stable since the joints and beading of the wood allow considerable accumulation of dust, and they usually recommend the use of lath and cement. This gives a tight ceiling and a smooth finish to which little dust can cling. In our stables, also, the stanchions are not of the type now most highly recommended, as they lack a little in simplicity and afford many places for the lodgment of dust. In order to contrast the effect of this older construction under unfavorable conditions with the newer construction at its best, dust was allowed to accumulate on walls, ledges and stanchions until these were in as bad a condition as would be tolerated under reasonably good barn management. The germ content of the milk of six cows,

\(^1\)The unit was 1 cubic centimeter of milk, equal to 18 to 20 drops.
well distributed about the stable, was now determined at each of six milkings, three cows being milked by two men, each milker using the same pail. The interior of the stable was then thoroughly renovated, the ceiling and walls down to within three feet of the floor were covered with wire lath with two coats of cement and the area between the cement and the floor was covered with zinc. After the plastering had been finished, the stanchions, floors and mangers were thoroughly cleaned, thus putting the stable in excellent sanitary condition. As soon as the barn was in order, the germ content of the milk from the same six cows was again ascertained on six days. During this test, every effort was made to conduct all the operations connected with the barn management and the examination of the milk under conditions identical with those of the earlier test, except for the renovation of the stable which had taken place. Soon after this test was completed, the wood work and iron work of the stable were painted. When the stable was again ready for use, the germ content of the milk of the same cows was again determined. The results from the 212 milk samples show no measurable effect from the change in barn conditions. Taking as a basis the results obtained in the dirty barn before plastering, the milk obtained after the barn had been freshly plastered and cleaned showed an increase in germ content of 114 germs per unit, while later, when the wood work and stanchions had received a coat of paint, the germ content was 119 per unit less than when the barn was at its worst.

In previous studies made at the Station, it was found that the udders of different cows normally contained quite widely varying numbers of bacteria and that the number of bacteria found in the strippings, or last milking drawn from each cow, gives a very fair measure of these bacteria in the udder. In these three tests, samples were taken from the strippings as well as from the whole milk so that correction could be applied for the bacteria of the udder. If the figures as obtained from the whole milk are thus corrected to account for the udder content of bacteria, which could not have been directly influenced by the barn conditions, the results show that the increase in the germ content of the milk during milking was greater by 44 per unit after plastering and less by 137 after painting. What these results really show is that in the last two sets of tests when the barn conditions were essentially alike and unusually clean, the observed difference in germ content is much greater than the difference between the results when the barn was clean and when it was dirty. That is, the influence of the barn conditions was so slight that it was not measurable even when care was exercised to balance all of the other factors as closely as possible.

A little more than a year after this renovation of the stable, samples were again taken as before and their germ content carefully determined. The plaster, wall and ceiling of the stable were then white-washed and the wood work freshly painted, after which other samples were collected from cows milked under these supposedly improved
conditions. As before, the two groups of samples showed little
difference in the bacterial content of the milk examined. The average
results differed by only 240 germs per unit, with the advantage, if
any, in favor of the milk produced before the whitewashing and
repainting. These results were so close that no one would be justi-
fied in assuming that the data show whitewashing to be an unsani-
tary practice and calculated to increase the germ content; on the
other hand, they offer no support for the common notion that white-
washing of the stable is an important sanitary practice with a strong
influence upon the quality of the milk.

The results from this whole series of tests upon the effect of barn
conditions suggest that the importance of barn construction has
been considerably overestimated and that within rather wide limits
the condition of the stable exerts no measurable influence upon
the germ content of the milk produced within it.

Another dairy practice strongly recommended

Clipping cows where clean milk is desired is the clipping of the
flanks, udders and part of the tails of the cows. Theoretically, this seems a most excellent practice, well adapted to
facilitate easy and thorough cleaning of the cow before milking,
and the results from the tests of the practice made in our stable were
decidedly surprising to the investigators. There are some difficul-
ties in making a test of this kind since it is impossible to alternate the
cow on both sides of the experiment in short periods as it requires
considerable time for the animal to return to an unclipped condition
after she has been clipped. Care was taken, however, to make the
test under conditions as nearly alike as possible except for the factor
of clipping and it is believed that the results are reliable. In a
preliminary experiment, the germ content of the milk from two cows
was determined for six days, after which the udders and flanks of the
cows were clipped and bacterial counts again made of their milk for
a similar period. In this test the general averages appear to show
that clipping increased the germ content of the milk, but as the major-
ity of the germs on this side of the test came from one cow on one
particular day, too much weight can not be placed on the results.
If this particular observation be omitted, the results incline slightly
to the other side of the test, that is, in favor of clipping.

In a later test, 22 samples were collected in the regular way from
the milk of each of four cows from which bacterial cultures were
made and plates counted as in the other tests. The udder, the flank
up to the hip joint, and the tail above the brush were then clipped
on each of the cows and a few days later, 24 samples from each cow
were collected and tested as before. The average germ content of
the 88 samples of milk from the unclipped cows was 204 per unit,
or, excluding the normal udder content as determined by the stripp-
ings, 133 germs per unit. After clipping, the general average was
320 germs per unit from the clipped cows, or excluding the aver-
age udder content, 208 germs. These quite extensive measure-
ments give an average of about 75 more germs in the milk of the cows after they had been clipped than before. This would seem to indicate that clipping cows increases, rather than decreases, the probability of germs finding their way into the milk during the milking process. The data certainly do not support the prevailing idea that clipping the udders and flanks of cows is a valuable aid in the production of sanitary milk.

**Hand and machine milking of cows**

Reasoning on general principles, it is quite logical to assume that the vacuum cleaner would prove as effective when applied to the coats of cows as it is in the household and many departments of business. The use of such an apparatus is quite feasible where the milking machine is installed since a vacuum pump is used in connection with the milker. Such a method of cleaning has been recommended by the American Association of Medical Milk Commissions. In a careful series of tests made in our stable, the germ content of the milk was not reduced by the use of the vacuum cleaner and more time was needed to go over the cows than when currycomb and brush were used. Some difficulty was met with at first in securing what seemed to be an effective vacuum and comparative tests made under these conditions showed a disadvantage, even in the germ content, in the use of the vacuum cleaner. When arrangements were made, by which the vacuum of approximately one-half an atmosphere could be regularly maintained, the differences in germ content between hand cleaning and machine cleaning practically disappeared, but, as stated before, the time required for each animal was greater with the machine than when cleaning by hand. Our results, as a whole, do not seem to justify the purchase of a vacuum cleaner for use in the cow stable.

In all of these tests the bacterial counts of the milk as drawn were very low and changes in stable conditions seemed to exert no measurable influence upon the number of these organisms present. This raised the question as to what are the important sources of bacteria in milk.

Accordingly, on 17 days the germ content of a pail of milk was followed from the cow through the various operations in preparing it for the consumer. At the Station, the milk is taken to a small milk room, separated from the stable by a single door, poured over an aerating cooler, collected in a second pail and taken in this to the dairy. Here it is passed through a cloth strainer into a third pail in which it is placed in cold water until needed. All these utensils are cleaned with hot water and sal soda and treated for ten to fifteen minutes in a steam box. The cooler was not protected in any special manner during use, though the milk room was kept moderately clean.

Samples were taken which represent the stripplings, and the milk in the pail, after leaving the cooler, after arriving at the dairy, and
after straining into the final can. On all of these days except two, the germ content of the milk at every stage was very low, the averages for the entire period showing 57 bacteria per unit in the strippings, 161 for the milk in the pail, 426 after cooling, 443 when it reached the dairy, and 474 after it had been strained. On two days there was apparently some slight contamination of the milk during cooling, but even then it had a germ content which was surprisingly low. These figures were obtained when the dairy operations were all conducted in the ordinary way and show that with reasonably careful handling in a moderately clean stable and clean dairy room, the germ content of the milk can be kept low without special elaborate precautions. The small count throughout in this particular case was due to the fact that the milk was furnished by one cow which had a rather low udder content.

Conclusions of milk to use, as a general standard, a germ content of 10,000 germs per unit as insuring a milk which is above suspicion of uncleanness. In obtaining milk which shall be safely below this 10,000 limit, it is the custom to spend much labor in washing the cows and in keeping the interior of the barn scrupulously clean. In all of the tests discussed in this bulletin, the germ content has been very low, seldom exceeding 1,000 germs per unit of which number about one-half are germs normally present in the udders of the cows.

This milk was produced under general conditions which appear to be no better than those surrounding a considerable number of ordinary city dairies, conditions which probably would not be acceptable to any certified milk commission. Notwithstanding these facts the extended study of the product indicates that in bacterial content at least it is of the very highest quality. That milk of this quality is not uniformly produced under such general conditions is illustrated by the fact that a local commercial dairy in which the methods and equipment resemble those at the Experiment Station, except that steam is not available for treating the utensils, quite uniformly turns out a product with a content approximating 1,000,000 germs per unit.

What, then, is the difference between these two dairies? At the Station the stable is kept cleaner, the cows are much cleaner, the milkers are cleaner, and the utensils are thoroughly steamed. Apparently the wide difference in the germ of the product from the two dairies lies in the influence of one or more of these factors. The important fact, which is being gradually recognized through these and similar observations is that the production of a reasonably clean milk with a low germ content will be a far simpler and less expensive undertaking when the factors that really govern its production are actually understood.