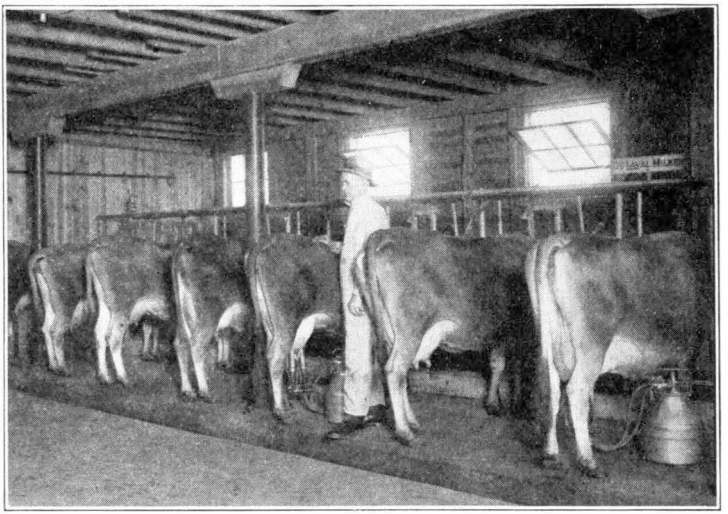
# Producing High-Quality Milk



By M. J. Prucha



University of Illinois
College of Agriculture and Agricultural
Experiment Station

Circular 341

THE three most essential points in producing milk of low bacterial count are these:

1. The animal must be clean and free from dirt.

2. The utensils that come in contact with milk must be properly sterilized.

3. The milk must be promptly cooled to 60° F. or lower and held at that temperature until delivered.

# Producing High-Quality Milk

By M. J. PRUCHA, Chief in Dairy Bacteriology

Milk occupies a unique place in man's diet in that it is the principal food and at times the only food that infants and children can take. It is largely on this account that the public is so concerned about the quality of its milk supply. A healthy cow, having a sound udder and being properly fed, will give milk of high quality. Whether or not the milk will retain that quality until it is delivered to the consumer depends entirely on the manner in which the milk is handled and on the care it receives.

The production of milk of high quality need not involve undue expenditure of money, but it does require a certain knowledge and effort at the right time. In the past the dairyman has not always received a sufficient financial inducement to make him eager to produce milk of high quality. Usually the benefit he has reaped has been the assurance of steady market for his milk and the freedom from loss due to spoilage. The demand for milk of high quality is steadily increasing, however, and the dairyman who learns to produce milk of high quality economically is bound to profit by it.

## WHAT IS HIGH-QUALITY MILK?

There is a wide variation in the definitions of high-quality milk in different communities. In all cases, however, there are recognized a few essential qualities which the milk must have in order to be classed as high-quality milk.

### High-Quality Milk Must Be Safe

It has been established beyond any doubt, both by experiments and by experience, that milk sometimes carries disease bacteria. Tuberculosis, typhoid fever, septic sore throat, diphtheria, scarlet fever, and a few other diseases of minor importance have been known to be carried by milk. The safety of the public milk supply is therefore a serious public question about which consumers are concerning themselves more and more.

It is a good business practice on the part of dairymen and dealers to satisfy this demand for safe milk. The dairyman's duty in this matter is not difficult. There is only one thing for him to do; namely, to comply conscientiously with the legal requirements concerning the health of animals and attendants, purity of the water, and sanitary surroundings of the barn.

One especially annoying problem in keeping milk free from disease bacteria is the control of flies. Milk should be well protected from

these pests, for they are a serious source of contamination. A good dairyman usually works out some scheme to do this. One man who has a reputation for clean milk uses a large tin cover for the milk strainer. The cover is suspended on a pulley and is operated by foot so that the milker can pour the milk into the strainer without inconvenience. Another dairyman keeps his milk cans in a dark cupboard during milking, and still another uses an electric fan so set that the air current keeps the flies from crawling over either strainer or can.

### High-Quality Milk Must Have Proper Food Value

The law requiring certain minimum amounts of solids in milk was passed mainly to prevent the watering of milk. This practice, which was always confined to a few unscrupulous individuals and companies, has practically gone out of existence. As there is no special difficulty in the matter of complying with the law, there need be no further discussion of it.

### High-Quality Milk Must Have Good Flavor

Undesirable flavors in milk may be derived from three sources:

1. They may be absorbed from the air.
2. They may be the result of the cows having eaten certain weeds and feeds.
3. They may be produced by bacteria.

The "cowy" smell in fresh milk usually comes from stale air in the barn or from dirt in the milk. As the streams of milk pass thru the air during milking, or when the milk is left in the barn, it absorbs odors. The remedy is simple; remove the milk from the barn as soon as it is drawn, and keep the barn free from bad odors.

Certain weeds, such as wild onion, turnip, etc., and some feeding materials, when eaten by a cow, will impart undesirable flavors to the milk. This is quite annoying in certain localities. The intensity of such flavors is influenced by the length of time that intervenes between the time that the cow eats the feed or weeds and milking time. The longer the interval, the less pronounced the flavor will be. There is, however, only one remedy, and that is not to let the cow eat such things.

Certain undesirable flavors are due to bacteria which are present in the milk or to stale-smelling utensils.

### High-Quality Milk Must Be Clean

The old saying that "cleanliness is next to godliness" still holds true, certainly in the dairy business. In a measure the term cleanliness is relative; what seems clean to one person may not appear clean to another. However, there is a common-sense judgment about cleanliness. Anyone can tell whether a cow is reasonably clean or whether it is dirty.

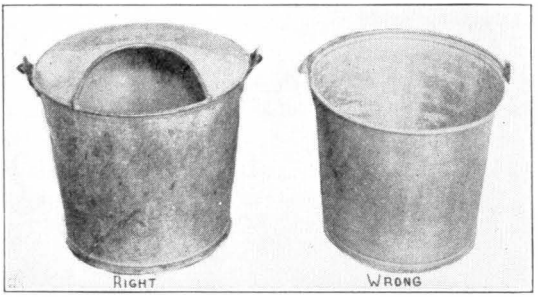



FIG. 1.—RIGHT AND WRONG KINDS OF MILK PAILS
The covered pail shown at the left helps to keep dirt and bacteria out of the milk.

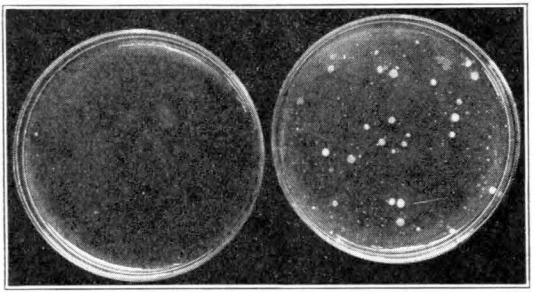


FIG. 2.—BACTERIAL COLONIES IN MILK
The white spots on these glass plates represent bacteria. The left plate was prepared from milk in a covered pail and the right plate from milk in an open pail.

In high-class dairies, covered milk pails are used extensively to prevent dirt, dust, and bacteria from falling into the milk. Such pails keep out of the milk from 30 to 70 percent of the dirt and bacteria that would otherwise fall into it. Various types of such pails are put on the market. Some of them are not practical. The pail shown in Fig. 1 is extensively used and is effective in reducing the bacteria in milk. It is low and easy to milk into, the top is soldered on and it has a rim along the opening in the cover, thus keeping the dirt that falls on the top from sliding into the milk at pouring.

Barn, stalls, and floor should be kept reasonably clean. The picture on the cover of this circular shows a barn that is well cared for, and Fig. 3 shows a barn where high-quality milk cannot be produced.

The milker must observe certain rules of cleanliness. His hands should be well cleaned when he starts milking, he should not wet his hands with the milk, his clothes should be clean, and he should handle the milk as any public food should be handled.

Dirt that has fallen into milk may be removed by straining the milk carefully thru cotton pads. It is far better, however, to keep dirt out of milk than to allow it to fall in and then try to remove it. Dirty milk cleaned is not high-quality milk.

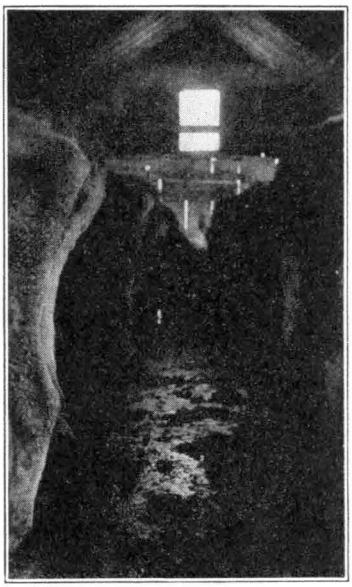


FIG. 3.—VERY POOR BARN CONDITIONS

The insufficient light and ventilation and the muddy floor make it impossible to produce clean milk. The picture on the cover shows a commercial dairy barn where cleanliness is given prime consideration.

### High-Quality Milk Must Have Good Keeping Quality

If a large number of samples of milk from different sources are taken and kept at the same temperature, some will spoil sooner than others. Different samples may develop different off-flavors. The milk that will remain sweet and without any off-flavors the longest will have the best keeping quality. The spoiling of milk and the development of off-flavors in it is due to the growth of bacteria. The larger the number of bacteria the sooner will the milk become stale and spoil.

Since bacteria are the cause of the deterioration of milk, it is the aim in high-grade milk production to control the bacteria; that is, to keep them out of the milk so far as possible and then to prevent those that get into it from multiplying. The number of bacteria in milk is of very great importance in determining its quality. This has led to the practice of grading milk largely on the basis of the number of bacteria in it.

## HOW TO KEEP BACTERIA OUT OF MILK

As the milk passes on its journey from the cow's udder to the final container in which it is delivered to the consumer, it is exposed to bacterial contamination at almost every step. It is really impossible to produce milk commercially which will be free from bacteria. Bits of feeding material, dust in the air, milkers' hands and clothing, dirt from the cow's coat and the utensils—all these contribute some bacteria to the milk.

### Keep the Cows Clean

Bacteria and dirt are not the same thing, but dirt usually harbors large numbers of bacteria, especially the kind of dirt that is found on

the cow's coat. In one case it was discovered that such dirt contained 4 billion bacteria per gram. If the cow is dirty, some of the dirt will fall into the milk during the milking operations. A thoro straining will remove what can be seen but it will not remove the bacteria. A small-top milk pail will reduce this contamination to some extent. There is,

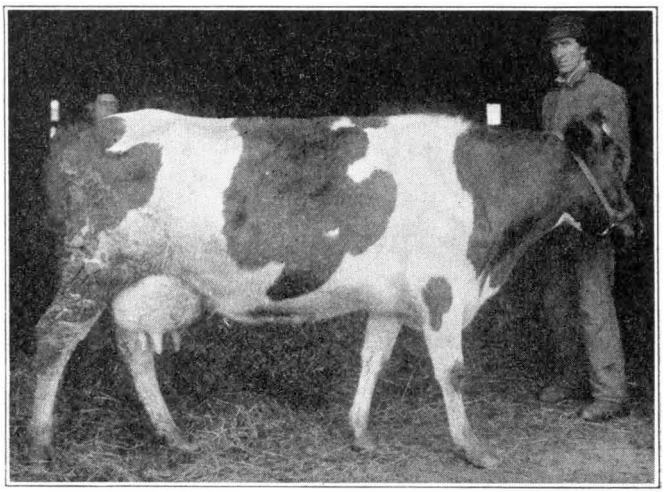


FIG. 4.—A DIRTY COW MAKES THE PRODUCTION OF HIGH-QUALITY MILK IMPOSSIBLE

Some of the dried mud and manure caked on the legs, flanks, and udder is sure to drop into the milk, carrying with it billions of bacteria.

however, only one way to guard against such contamination—that is, by keeping the cows as clean as possible. In Fig. 4 the cow is not fit to produce milk for human consumption; the cows in the picture on the cover are clean enough to produce high-grade milk.

## Wash All Utensils Thoroly

Many dairymen fail to realize the great importance of clean utensils in high-grade milk production. As dairy utensils are handled today they are by far the most important source of bacteria in milk. Dirty cows add many bacteria, dirty barns will also add some, but these sources are quite small in comparison with the utensils. Every utensil that has a stale smell, no matter how well it was once cleaned and sterilized, may add millions of bacteria.

Of the different utensils the shipping cans, the cloth strainers, and the milking machines are the greatest contributors of bacteria to the milk. The cans are supposed to be washed and sterilized at the milk plant or receiving station. No matter how well the washing and steril-

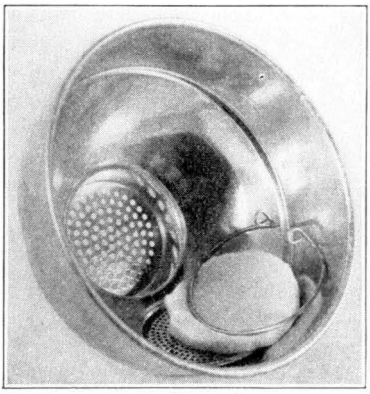


FIG. 5.—A GOOD STRAINER

This strainer has no seams, and the cotton pads as purchased are sterile and are used only once.

izing is done, however, by the time the cans are used for milk on the farm, from twelve to forty hours later, the bacteria may have increased in them to such an extent as to make the cans unfit for use. They may add as many as 500,000 bacteria to a cubic centimeter of milk. It is advisable that the dairyman sterilize the cans regardless of what is done to them at the milk plant.

Under ideal conditions of milk production, straining of milk would not be necessary. Such conditions do not exist yet. An excellent strainer is shown in Fig. 5. Only a small pad of cloth or cotton is needed and this is discarded after each milking. Such pads are not expensive and are sterile when bought. Large cloth strainers, as shown in Figs. 6 and 7, are, as a rule, a source of many bacteria, are hard to keep clean, and difficult to sterilize. Such strainers may harbor as many as 4,000,000 bacteria to a square inch.

The milking machine with which the milk comes in contact during the process of milking, may add many millions of bacteria. In one case the milking machine added 15 billion bacteria to the milk of five cows at one milking. The machine requires special treatment, directions for which are given on pages 12 and 13.

The first step in effective control of bacteria in the utensils is cleanliness. No method of sterilization and no amount of sterilizing will make the utensils that are not washed clean, fit to hold milk. There is no difficulty in the matter of washing the utensils clean. Anyone can tell whether the surface of the utensil has a film of grease or whether the seams and crevices have traces of old milk dried on them. The only thing necessary for proper washing is plenty of warm water with enough washing powder in it, thoro scrubbing, and thoro rinsing. There is one good rule to follow—wash the utensils as soon as possible after they are emptied. If they are permitted to

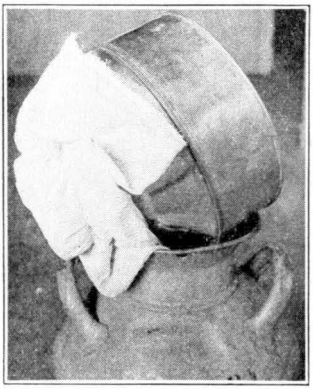


FIG. 6.—WRONG KIND OF STRAINER

A cloth strainer of this type is difficult to sterilize and invariably is a source of many bacteria.

stand for several hours before they are washed, the dirt and milk dries on them.

## Subject Utensils to Some Sterilizing Process

Anyone can tell whether a utensil is clean or not, but it is very difficult to tell whether it has been sterilized properly. For this reason sterilization of utensils has not as a rule been done effectively. There are several different schemes that the dairyman has at his disposal.

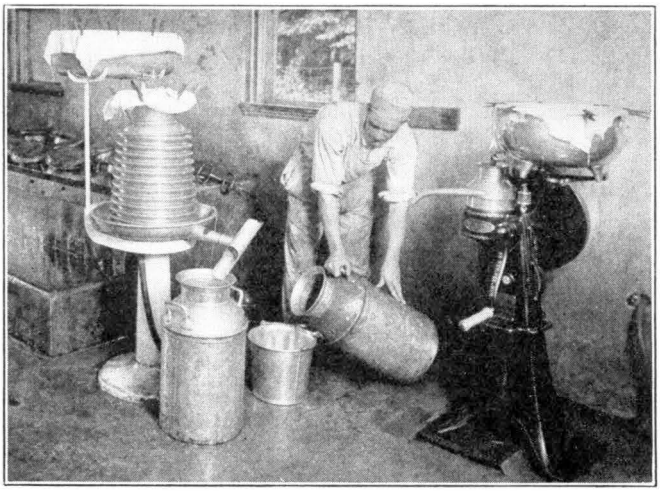


FIG. 7.—TOO MANY CLOTH STRAINERS ARE USED IN THIS DAIRY

### Sterilizing With Steam

Steam is available on very few farms. The steaming of utensils is usually done either by jet steaming or in a steam chamber. Both methods are effective if done correctly. When jet steaming is used, each can and pail should be steamed about 30 seconds at least. When the steam chamber is used, no definite directions can be given. The amount of steam necessary for proper steaming must be determined by actual tests.

### Sterilizing With Hot Water

Hot water is used quite extensively on farms for sterilizing utensils. A thoro rinsing of each can with 2 quarts of boiling water is as effective as thoro steaming. Smaller amounts do some good but will not give thoro sterilization. At the rate of 2 quarts of boiling water per can and 1 quart per pail, about 3 gallons of boiling water will be required to sterilize 4 cans, 2 pails, and 1 strainer.

**Chemical Sterilization**

Since on most dairy farms steam is not available and even hot water is difficult to get in sufficient amounts, chemical sterilization offers dairymen a very practical method of treating utensils.

Not all chemical sterilizers are suitable for dairy utensils; some have undesirable odors, and some are highly poisonous and must not be used in connection with food handling. The chlorin sterilizers, however, have none of these objectionable qualities. Following are some that are being used for sterilizing utensils:

1. Calcium hypochlorite, commercially known as bleaching powder or chlorid of lime.
2. Sodium hypochlorite, sold in liquid form under various trade names, such as B. K., Germ X, Hypochlor, Belle Disinfectant, etc.
3. Diversol, sold in granular form; it is sodium hypochlorite combined with alkaline phosphate in crystals.
4. Chloramine-T, sold in powder form or in tablet under various trade names, such as Santamine, Sterilac, Chloron, Hoover 40, Chlorazene, Alklorine, etc.

The method of applying these sterilizers is simple; a certain amount of the sterilizer is put into the wash water or rinse water, or both, and the utensils are washed and rinsed in the usual way. As a rule the directions given by reliable manufacturers are essentially correct.

Some of these chemical sterilizers tend to lose their strength; others have been stabilized and standardized. For best results on farms it is advisable to use the stabilized products. In case of doubt as to the proper way in which to apply these sterilizers a dairyman can get information by writing the Experiment Station.

## Dry Utensils in Air and Sun

The inverting of utensils on a rack to air, as shown in Figs. 8 and 9, is an old dairy practice and a good one. No matter how well the utensils, particularly the milk cans, may be washed, and even if they are steamed or scalded with hot water, they soon develop a stale smell when they are covered in such a way that they cannot dry. In other words, a utensil may be properly washed and steamed and be in an excellent condition to receive milk, but if it is not used until some 12 to 40 hours later, it usually becomes stale and not fit for milk. Such utensils become literally alive with bacteria, the moisture in them making conditions right for their rapid growth.

Drying of the utensils does two things—it kills some bacteria and prevents others from increasing. A screened rack is highly desirable. It keeps the flies and birds away from the utensils.

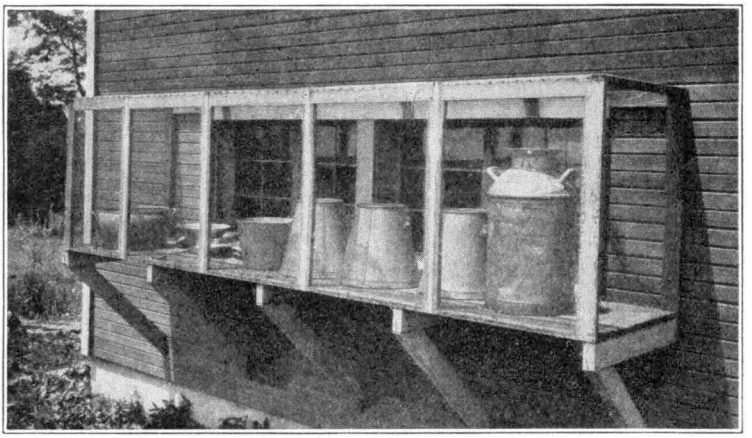


FIG. 8.—A SIMPLE, INEXPENSIVE, AND CONVENIENT SCREENED PLATFORM FOR DAIRY UTENSILS

Inverting utensils for sunning and drying is a good practice. It would be better, however, to tilt them so the air can enter. The finely meshed screen protects them from flies and birds.

### Rinse Utensils Immediately Before Using

In view of the tendency for the utensils to get stale smelling, it is advisable that the dairyman sterilize his utensils just before using them. When neither steam nor hot water is available, he can use a chemical

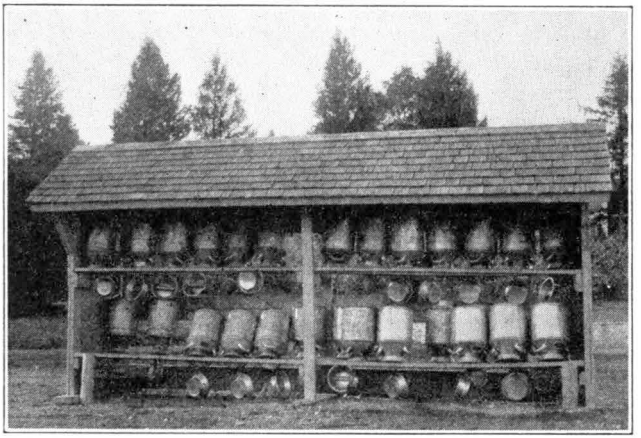


FIG. 9.—UTENSILS PROPERLY AIRED AND DRIED DO NOT DEVELOP A STALE SMELL

Screening of this rack would be an added improvement (see Fig. 8).

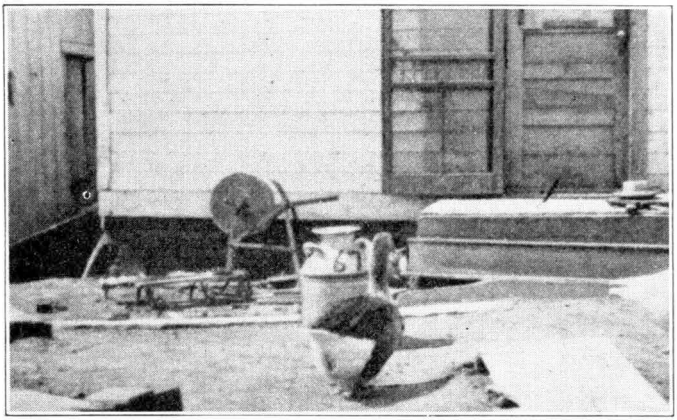


FIG. 10.—HIGH-QUALITY MILK IS OUT OF THE QUESTION WHEN MILK CANS ARE NEGLECTED

Milk cans allowed to stand around cluttered yards are bound to result in dirty milk. If the covers are left off, dust and dirt blow into the can. If they are kept on, the moist conditions encourage the growth of bacteria.

sterilizer. When none of these is available, a thoro rinsing with plenty of pure water will materially reduce the bacteria in the utensils about 50 to 70 percent.

### Give Milking Machine Careful Attention

Many milking machines have been discarded because the dairyman could not produce milk with as low bacterial count as he did by hand milking. There is no need, however, of discarding a milking machine on this account, for high-grade and even certified milk can be produced with a milking machine. The following method has been used in one dairy for several years where Grade A milk is produced regularly.

1. Immediately after milking, while the machine is still attached to the vacuum, rinse the teat cups and the milk hose by drawing thru each unit at least 2 gallons of water, lukewarm or cold. *It is important to do this immediately after milking, so that no milk will dry on the machine parts.*
2. Prepare at least 1 gallon of washing-powder solution, hot if possible, using 2 heaping tablespoonfuls of powder to a gallon. Draw this solution thru each unit.
3. Brush out the tubes and especially the teat cups, and wash the outside of these parts.
4. Then place them in some disinfecting solution until the next milking. Be sure that no air bubbles are caught in the rubber tubes, and see that all parts are completely submerged.

5. Once a week take the machine apart and scrub every part inside and outside. After assembling, put in the disinfectant solution.
6. Flush out the air line occasionally, using a hot solution of washing powder and disinfectant. In case some milk is drawn into the air line during milking, wash it out immediately after milking.

## Cool Milk Quickly and Thoroly

The cooling of milk is done mainly for one reason—to hinder bacterial growth. Bacteria are like any other vegetation; they grow

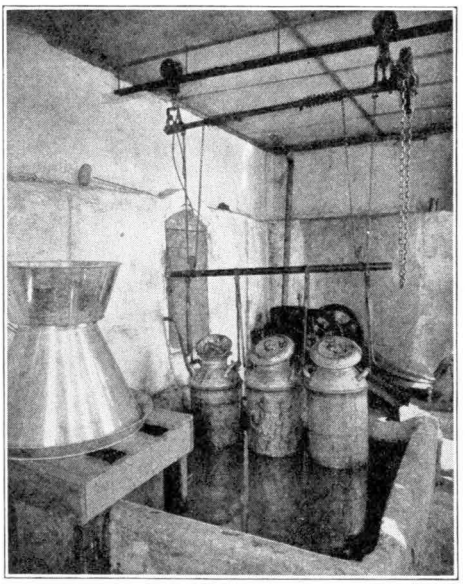


FIG. 11.—DEVICE FOR LOWERING CANS INTO AND LIFTING THEM FROM THE COOLING TANK

Cooling of milk on the farm is one of the necessary steps in high-quality production. Concrete tanks, such as the one shown here, are used extensively.

rapidly in a warm temperature and slowly in a cold temperature. To what temperature the milk should be cooled on the farm is shown by a test made at this Station. Samples of the same milk were placed at

varying temperatures, and at the end of 12 hours tests showed the following conditions:

At 40° F. there was no increase of bacteria.
At 50° F. the increase was very slight.
At 60° F. each bacteria produced 15 new ones.
At 70° F. each bacteria produced 700 new ones.
At 80° F. each bacteria produced 3,000 new ones.

The above results mean that if milk of high quality is not promptly cooled to below 60° F., it will not be of high quality at the end of 12 hours.

Among the different schemes used for cooling milk on the farm the most common practice is to put the cans of milk in a tank of cold water. Fig. 11 shows a tank of concrete construction. There are also

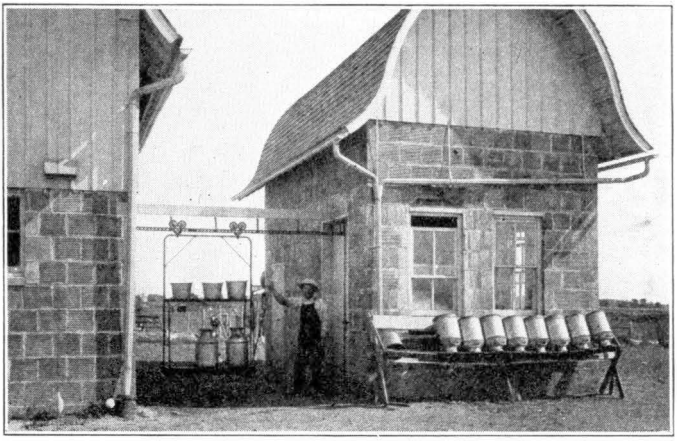


FIG. 12.—CONTRIVANCE FOR CARRYING CANS OF MILK FROM BARN TO MILK HOUSE

A concrete water storage tank in the top of the milk house furnishes water under pressure.

galvanized iron tanks on the market. One dairy expert suggests that the capacity of a tank be at least three times the volume of the milk to be cooled. After the cans of milk are placed in the tank, the well water is pumped in and then allow to run to the stock watering tank.

Probably most dairymen cool their milk, but too many do not take full advantage of the facilities they have to cool it quickly and well. Observing the following practices will give good results:

1. Cool the milk immediately after it is drawn. Allowing a can of milk to stand until all the chores are done before placing it in the cooling tank is a poor practice.

2. During the first hour of cooling, stir the milk three or four times to hasten the process. This operation is usually neglected.
3. After the milk is cooled with well water, place a few pieces of ice in the tank to help keep it below 60° F.

The lack of proper cooling of milk causes very great financial losses to the dairy business. It is impossible to produce high-quality milk without proper cooling.

## CARE AND VIGILANCE OF DAIRYMAN COUNT MOST IN PRODUCING HIGH-QUALITY MILK

It is not difficult to find dairy farms with beautiful buildings and the latest types of equipment that are not producing high-grade milk, nor to find dairymen of education who, for one reason or another, are not doing so. Proper equipment and good education are valuable and helpful, but back of it all the dairyman himself is the most important factor. There are many dairymen who produce high-quality milk uniformly altho they have simple equipment. It is the will to do the necessary things well and at the proper time that counts. The essential factors that underlie the production of high-quality milk may be summarized as follows: (1) Clean barns, clean milk house, clean milker, and clean and healthy cows. (2) Proper washing and effective sterilization of all utensils. (3) Prompt cooling of the milk to 60° F. or lower and keeping it at that temperature until delivered.