CARE OF MILK ON THE FARM

—By—

JAMES N. PRICE
Dairy and Live Stock Specialist

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Milk—Its Composition and Characteristics

A general knowledge of the character and composition of milk is necessary to the proper understanding of its production and care. Milk is one of the most valuable of human foods; yet, as it is commonly handled, it may become one of the most dangerous. Its composition makes it a most suitable medium for the reproduction and growth of nearly all species of bacteria.

Milk is composed of water and a number of solids containing all the elements of food necessary for the nourishment of the young, growing animal. The proportions of water and the different solids vary with the different breeds and with individuals of the same breed. The relative percentages of the different constituents of milk vary also from day to day and at different stages of lactation with the same cow.

The average composition of milk is as follows:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>87.17%</td>
</tr>
<tr>
<td>Fat</td>
<td>3.69%</td>
</tr>
<tr>
<td>Casein</td>
<td>3.02%</td>
</tr>
<tr>
<td>Albumen</td>
<td>.53%</td>
</tr>
<tr>
<td>Sugar</td>
<td>4.88%</td>
</tr>
<tr>
<td>Ash</td>
<td>.71%</td>
</tr>
</tbody>
</table>

Total: 100.00 per cent

If milk is drawn under the best sanitary conditions; placed in an air-tight, sterile container; and held at a low temperature, it will keep for a long time without any apparent change in its character or composition. But, when produced under ordinary conditions, so that more or less dirt (usually more) gets into the milk, its nature and composition are changed in a very few hours. These changes are recognized in the ordinary souring and curdling of milk and in the development of
various disagreeable odors and flavors. They are due to the action of various minute organisms known as bacteria.

**BACTERIA**

To understand these changes that take place in milk, it is necessary to know something of the nature and growth of bacteria. Bacteria are minute, one-celled plants; so small that they can not be seen without the aid of a microscope. All milk, unless produced under unusual conditions, contains some bacteria.

![Fig. 1—Shapes of Bacteria. a. Spirillum. b. Micrococcus. c. Micrococcus. d. Streptococcus. e—h. Rod-shaped. i., j. Divisions. (Conn)](image)

In milk we find all the food material and other conditions necessary for rapid bacterial development. The rate of increase in the number of bacteria depends very largely on the temperature of the milk. Most forms found in milk develop most rapidly at temperatures ranging from 80 to 100 degrees Fahrenheit. At a few degrees above 100, many forms develop very slowly or are checked entirely. At 125 degrees, some forms are killed, while others grow quite rapidly at this temperature. Most bacteria are killed if exposed for ten or fifteen minutes to a temperature of 150 to 160 degrees F. Some forms have the power to form spores. The spores of bacteria correspond, in a way, to the seeds of higher plants, and are able to withstand very unfavorable conditions without being killed. To destroy spores by heat, requires an exposure to a temperature of 220 to 230 degrees F.
As the temperature of milk drops below 80 degrees, the rate of bacterial growth gradually decreases. The growth is still quite rapid at 70; somewhat slower at 60; much retarded at 50; and very slow at 40 or below. Some forms continue to grow even at freezing temperature.

The effect of temperature upon the rapidity of bacterial development is shown by the following table taken from U. S. Bulletin No. 602:

<table>
<thead>
<tr>
<th>Temperature of milk</th>
<th>Number of bacteria per c.c. at beginning</th>
<th>Number at end of 6 hrs</th>
<th>Number at end of 12 hrs</th>
<th>Number at end of 24 hrs</th>
<th>Number at end of 40 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 deg. F...10</td>
<td>12</td>
<td>15</td>
<td>41</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>68 deg. F...10</td>
<td>17</td>
<td>242</td>
<td>61,280</td>
<td>3,574,990</td>
<td></td>
</tr>
</tbody>
</table>

At higher temperature the increase is still more rapid. Under the most favorable conditions for development, a single bacterium may increase to 1,000,000 or more in 24 hours. Bacteria reproduce themselves by division. That is, each individual elongates a little and then breaks in two in the middle,
leaving two where there was only one. Some forms are able to complete this division under the most favorable conditions every half hour. If they could continue this rate of increase unhindered for 24 hours, each bacterium would have 17,000,000 descendants at the end of that time.

During their growth in milk, the different forms of bacteria produce various changes in its appearance and composition. Some kinds act upon the sugar and change it to lactic acid, which causes the milk to curdle. Other forms secrete a substance which, in its action upon milk, very closely resembles rennet that is used in cheese making. This substance acts upon the casein, causing the milk to curdle without the formation of acid. This change is often spoken of as "sweet curdling."

These bacteria secrete also another substance that "digests" or liquifies the curd formed by the rennet-like secretion. These secretions are known as enzymes. The slimy or ropy condition sometimes seen in milk is caused by still another type of bacteria.

Kinds of Bacteria

As stated before, there are a great variety of bacteria found in milk. This is not surprising when we consider the great variety of sources from which they are introduced into the milk. It is not necessary that the practical dairyman go into a detailed study of the various forms of bacteria. He is more interested in their general characteristics; their effect upon milk and its products; sources of contamination and their control.

In a general way, bacteria may be classified as follows: (1) Harmless; (2) Useful; (3) Harmful.

(1) Harmless. Under this heading may be classed a great majority of all the forms found in milk. Some may be present in milk as it is drawn from the udder; but by far the greater number gain access from outside sources. They have very little effect upon the character of the milk. Their number is of importance only because a large number indicates careless
handling, which offers opportunity for harmful forms also to gain access.

(2) Useful. While all forms may be classed as harmful, or at least objectionable, from the standpoint of the retail milk business, there are forms that are essential to the successful manufacture of butter and cheese. The proper ripening of cream is very essential to the development of a desirable flavor in butter. The proper ripening of cream depends upon the development of lactic acid from the milk sugar by the action of certain lactic acid producing bacteria. We make use of the same type of bacteria in the souring of milk for cottage cheese, also to some extent in the manufacture of cheddar cheese.

Fig. 3—Varieties of Bacterium Lactis Acidii (Conn).  
This type changes part of the milk sugar into lactic acid, causing the ordinary curdling of milk.

The peculiar flavors of our various kinds of cheeses are due to the action of different forms of bacteria during the ripening process. The fact that these forms are essential to the successful manufacture of butter and cheese does not make it any less important that all forms should be excluded from milk until it reaches the factory.

(3) Harmful. This group may be divided into two classes: (a) Those forms producing changes in milk that render it unfit for use; (b) Those forms which apparently do not affect milk but are injurious to the health of the consumer.

Under the first class would be included those types that produce gas, disagreeable odors, slimy milk, abnormal colors, etc.
The second class includes the specific disease germs; and other forms which, if present in large numbers, cause digestive disorders, especially in young children. The most common disease germs found in milk are the germs of tuberculosis, scarlet fever, and typhoid fever. Other forms of bacteria produce poisonous substances in milk that are the cause of much of the digestive disorders in "bottle babies."

In milk held for a long time at a low temperature, certain forms of bacteria are apt to develop that produce toxins, or poisons, that may prove fatal to the consumer. These occur quite often in ice cream that has been held in storage for several days, especially if it has been made from unclean milk. Milk that is several days old should not be considered safe to use simply because it has been held at a low temperature and is sweet.

How Milk Becomes Contaminated With Bacteria

It is important that the practical dairyman know how and from what sources bacteria gain entrance to milk in order that he may understand how to prevent this contamination. The principal sources of contamination are:

1. Dust and filth in the barn;
2. The body of the cow;
3. The clothing and hands of the milker;
4. Unclean utensils.

It is impossible to produce clean milk in a filthy barn where filthy cows are milked by a filthy, careless milker. Dust and dirt are continually falling into the milk from the dust-laden air, and dropping from the flank and udder of the cow and the clothes of the milker. And, dripping from the hands that have been generously lubricated with foam from the pail, is a rich, brown liquid that would be excellent as a fertilizer, but should have no place in the milk pail that contains the baby's bottle of milk and the butter that goes on the children's bread. The dairyman owes it to himself and family, and to all mankind who use dairy products, to strive to handle milk under as cleanly conditions as he would have other articles of food handled and prepared for his own use. If we could bring ourselves to think of milk as an article of food, we would, no doubt, be more thoughtful of its care.
It is more important that milk be handled carefully than almost any other food. Milk is usually kept for several hours before it is used, and often under conditions that are favorable to the rapid development of bacteria. Under such conditions milk soon becomes unfit for use unless it has been produced with care. Most of our other foods, even though they have been handled carelessly in the kitchen, are rendered comparatively safe by being subjected to a high heat in cooking that will destroy a large percent of the bacteria present. This food is then placed on the table and consumed while still hot, thus preventing the occurrence of changes and decomposition that takes place in milk that is not clean.

Production and Care of Milk

The Barn. The essential qualifications of a good dairy barn are: (1) Good ventilation; (2) Plenty of light; (3) Properly constructed floors; (4) Walls and ceiling that can be kept free from dust; (5) Location on well drained site.

(1) Good ventilation is necessary in order to keep the air of the barn pure, not only for the protection of the milk, but also for the protection of the herd. This ventilation may be secured by means of windows, but it is better to have a good system of ventilating flues and intakes.

In cold weather the draft from the windows is injurious to the cows, and the open window tends to lower the temperature of the barn too much on very cold, windy days. If the windows are used for ventilation, they should be arranged to swing inward at the top, rather than to slide up and down like the ordinary window. This arrangement permits their being open on stormy days, since the air does not strike the cows directly, but is deflected toward the ceiling, where it is warmed, to some extent, before it reaches the cows. In some districts of the Inland Empire, where there is scarcely any wind during the cold weather, the use of muslin curtains over the window openings gives satisfactory ventilation.

A good ventilating system is shown in figure 4. Such a system is far superior to window ventilation, where there is sufficient wind to create an air current through the flues.
Fig. 4—Showing arrangement of ventilating flue and intakes. The foul air flues are located at end of barn.

(2) Plenty of light in the dairy barn is very important. Sunlight is nature's disinfectant. It keeps the atmosphere of the barn dry and pure, and is necessary to the health of the herd. The ordinary barn, with no windows, is always damp, mouldy, and full of foul odors. These conditions mean that bacteria are abundant, and milk produced in such a barn will most certainly possess the odors of the barn and contain many
bacetria that may render it unfit for food. There should be four square feet of window space to every cow. The dairy barn should have windows on all sides, if possible; particularly if it is wide enough for two rows of cows. The basement barn is objectionable because it is impossible to get sunlight into all parts. Such a barn is usually damp. If a basement barn is used, it should have a good ventilating system to purify the air and help keep down excessive moisture. When building a barn for two rows of cows, it is best to have the sides facing east and west, allowing the sun to reach all parts of the interior. This will, however, depend upon the building location. Some locations allow the admission of sunlight only during the middle of the day, which demands a south exposure.

(3) A properly constructed floor must be built of material that will not absorb the moisture, and must be so constructed that it is easily cleaned. The platform, from manger to gutter, must be of such length that the cow stands with her hind feet on the edge of the gutter. It is impossible to keep the cow clean if her stall is not of the proper length. If it is too long the droppings lodge on the platform, and if it is too short, the cow stands with her hind feet in the gutter part of the time, thus tracking manure onto the platform. In either case the stall becomes dirty and the cow soiled when lying down.

Fig. 5—Cross section of floor plan of dairy barn. Showing arrangement and dimensions of stalls, gutters, etc.
The manure should be removed from the barn at least twice a day when the cows are kept in the barn both day and night.

Fig. 6—Colonies of Bacteria. Developing from bacteria falling upon a plate exposed during milking in a poorly-kept barn. (Fraser)

Fig. 7—Colonies of bacteria. Developing from bacteria falling upon a plate exposed during milking in a well-kept barn. (Fraser)

If a high grade market milk is being produced it is sometimes necessary to clean more often in order to keep the barn free from odors. The barn should be scrubbed out once a day.
at least, when the cows are stabled in the barn at night. If they are stabled in the day also, the barn is scrubbed more often, especially in "certified" dairies.

(4) Walls and ceilings should be so constructed that they furnish as little space as possible for the lodgment of dust. It is best that the walls be lined on the inside with matched lumber. This makes a wall that is easily cleaned. It is an excellent plan to finish the wall with concrete to a height of three or four feet, making a wall that may be washed down if necessary. This is of particular importance if the cows stand with their heads to the center of the barn. If the barn has only a single wall, with the framing timbers exposed, the dust should be swept down frequently. Whitewashing the interior twice a year aids greatly in keeping the barn sanitary.

The ceiling should be matched lumber, so that dust or other material will not drop through. This is especially important when hay or other material is stored overhead. If the barn is only one story, it need not be ceiled for ordinary purposes, but the construction should be such that there are as few overhead timbers as possible. Some form of self-supporting roof is most satisfactory, since it does away with much of the timbers used in the ordinary construction and does not require any posts in the lower part of the barn, where they often interfere with desirable arrangement of stalls. The ceiling should be kept free from dust and other loose material that is easily dislodged, and that is liable to contaminate the milk during milking.

(5) If the barn is located on well drained ground where it is possible to have a dry yard, it is much easier to keep clean. When the cows wade through a muddy yard all day or are obliged to go through a deep mud hole at the door of the barn, their thighs, flanks and udders are always soiled, and must be washed before milking time if clean milk is to be produced. A large amount of mud is carried into the barn, which makes more work in keeping the barn clean. Unless the yard is exceptionally well drained it is a good plan to cover it with a layer of gravel or cinders. This will form a surface from
which the water drains readily. Any low places that occur from time to time should be filled with one of these materials. If the manure is kept cleaned up in such a yard, the mud will seldom get deeper than two or three inches.

In some districts the cows are allowed the run of open sheds or a covered yard during the day; and, in some cases, are housed in the same way at night. By this method it is necessary to have the cows in the barn only at milking time. This makes it easier to keep the milking barn clean and, therefore, easier to produce milk of high quality. It is often advisable to use this plan when remodeling an old barn for dairy purposes.

The Cows—One of the first considerations in the production of pure milk should be the health of the herd. Cows that are affected with any infectious or contagious disease may give milk that contains the germs of that disease. It appears that children contract disease more readily than grown people from the use of infected milk. While there is some difference of opinion regarding the relation of the tuberculosis of cattle and human tuberculosis, there is abundant proof that children often contract the disease by consuming milk from affected cows.

When a cow is suffering from any udder trouble, such as inflammation of the udder, garget, bloody milk, etc., the milk should not be used. The milk is not normal at such times and often contains germs that may cause serious digestive trouble in children. Such milk can not be made safe by heating. This indicates that the trouble is not due to any direct action of the germs within the digestive tract of the child, but rather to the presence of toxins or poisons that are developed in the milk by the action of these bacteria. There are various conditions other than disease under which the cow may produce abnormal milk. While the milk in such cases does not necessarily contain disease producing bacteria, it may be so abnormal in composition that it is injurious to the digestion of children. Any slight disorder, such as indigestion, or other digestive troubles, excitement, abuse, exposure to severe weather, the cow being in heat—or any unusual condition
affecting the care of the herd—may affect the composition of
the milk.

Care of the Cows—The dairy herd should be handled quietly
and without any undue excitement. Dogs, particularly strange
dogs, should not be allowed around the barn at milking time,
or to interfere with the herd at any time. A milker
who will strike a cow with a milking stool or other
instrument should not be employed. The amount of milk is
very much reduced and the quality affected by unkind treat-
ment. If we expect the dairy cow to give us a profitable milk
flow, we should repay her with kind treatment and an abun-
dance of wholesome food. The dairy cow must use large
amounts of food to supply the material necessary for profitable
milk production and to keep her body in good condition. A
great deal of sickness among our dairy herds is caused by im-
proper feeding. Constipation is a common result of constant
feeding on dry feed. This is especially true when hay com-
poses a large part of the ration. The dairy cow should have
silage or roots in winter, if possible, on account of their succu-
 lent nature. These succulent feeds serve, in a way, the part
of grass in a ration, and are very beneficial to the health of
the cow. The use of some laxative food, such as wheat bran
or oil meal, will serve to ward off many cases of digestive
trouble. If the digestion is kept right, there will be little
trouble with sickness in the herd unless they come in contact
with some contagious disease. Decayed or mouldy feed is in-
jurious to cattle. The idea that hay and silage that is too rot-
ten for other stock is good enough for the old cow has no place
on the up-to-date dairy farm. If fed in large amounts, mouldy
food is poisonous to live stock, and they are killed by it more
often than we think. Various digestive troubles and garget
are some of the results of feeding moulded feed.

The cow should be well bedded to keep her clean, to make
her comfortable, and to protect her udder from cold, damp
floors. Any material that is free from dust and is a good
absorbent will serve for bedding. Good clean straw, saw dust
or planings from the planing mill make suitable bedding.
Where nothing else can be secured, clean dry sand may be used. It is a very good absorbent, but is inclined to cling to the hair of the cows. It is also heavy to haul and adds greatly to the weight of the manure. Mouldy hay or straw should never be used for bedding in the dairy barn. It is well to clean the stall and re-arrange the bedding the last thing before leaving the barn at night. This will aid greatly in keeping the cows clean. The dairy cow should be curried at least once a day. Many are very careful to groom their horses each day but the cows are not touched with a curry comb once a year. Frequent grooming keeps the hair and skin in good condition, thus improving the health of the animal. Another important reason for grooming the cow is that it removes a large amount of loose dirt and hair that would otherwise fall into the milk during milking. It is, therefore, even more important that the cow be curried than the horse.

Fig 8—Dirty cows. A source of contamination
Fig. 9—Clean cows. The result of a well-kept barn and careful grooming.
Milking—It is during milking that the principal contamination of milk takes place. The amount of dirt and the number of bacteria that are introduced at this time will depend upon the condition of the barn and cow, and the care with which

Fig. 10—Colonies developing from bacteria falling upon a plate exposed in a well-kept barn previous to feeding.*

Fig. 11—Colonies developing from bacteria falling upon a plate exposed in the same barn while feeding grain.*

Fig. 12—Colonies developing from bacteria falling upon a plate in the same barn while feeding silage.*

*Exposures made by Magoon, Washington Exp. Sta.
the milker does his work. If the barn is dark and full of dust, and the cow is soiled with manure or mud, or has loose hairs and dirt hanging on her sides and udder, a large amount of dirt and numerous bacteria will be introduced during the process of milking.

The air of the barn can be kept free from dust, if the walls and ceiling are kept clean, no hay handled in the room within the hour previous to milking, and the cows groomed, or any other work that tends to stir up dust, done at least one-half hour before milking time. The udder, thigh, flank and belly of the cow should be wiped with a damp cloth before milking, to remove dust or loose hairs that might fall into the milk. Even with clean cows, this will very greatly reduce the amount of dirt and the number of bacteria in the milk. If the udder is soiled, it should be washed thoroughly and wiped with a clean cloth. In the production of "certified" milk the soiled udder should be washed twice in clean water and then dried before milking.

Not wiped.  

Wiped.  

Decrease due to wiping.  

Fig. 13—Diagram showing the effect upon the number of bacteria in milk of wiping the udder with a damp cloth. (Conn)

After the cows are prepared for milking, the milker should wash his hands and put on a clean suit, preferably white, that is used for no other purpose than milking. The clothes that are worn while feeding and caring for the cows and other stock are covered with dust, dirt and hairs that will fall into the milk during milking. The milking suit should be washed often and scalded in boiling water or sterilized with steam. The milking stool should be so made that it can be kept clean. In dairies where high grade milk is produced, the stools are washed and sterilized the same as the pails.
The milking should be done quickly and thoroughly, yet gently. If milk is left in the udder, it not only tends to reduce the milk flow, but it also leads to an increase in the number of bacteria in the udder, which, in turn, increases the number in the milk. Milk left in the udder sometimes causes inflammation of that organ. The milker should be allowed to milk only with dry hands. Milking with wet hands is not only a very filthy habit, but is liable also to cause the cow's teats to chap in cold weather. In the production of high grade milk, the hands should be washed after milking each cow. Soap, towels and clean water should be provided in a convenient place.

Fig. 14—A type of covered pail.

The small top, or covered pail, is a great aid in the production of clean milk. If the pail has the top almost entirely covered, leaving an oblique or nearly vertical opening, there is little opportunity for dust or dirt to enter.

Odors—Milk often has abnormal and disagreeable odors and flavors that render it unfit for use. These odors and flavors are from three sources: the air, the body of the cow, and changes in the milk due to bacterial action. Milk very readily absorbs odors that are present in the barn at milking time or in the refrigerator and other places where milk is handled.
It is, therefore, important that the barn be kept free from odors that may taint the milk. For this reason it is not best to handle silage, or other feeds that have a decided odor, just before milking time. Such work should be done at least an hour before milking, and the barn aired.

There are several different feeds that, when eaten by the cow, will produce their peculiar odor in the milk. This is true of turnips, rutabagas, cabbage, and, to some extent, silage. When on pasture, the cow may eat wild onions and various other weeds that impart very undesirable flavors to the milk. These troubles that occur on pasture are very difficult to control. If the pasture land is confined to a small area, these weeds can be kept down to a large extent by clipping with a mower. In the South it is often necessary to dig the wild onions out with some sharp instrument. This requires a great deal of time and labor, but in those districts where the onion is abundant, it is often necessary in order to produce milk that is marketable. On large pastures or under range conditions, about the only remedy is to take the cows off pasture during the season when the trouble occurs, or the trouble may be lessened to some extent by allowing the cows on pasture for only a few hours each day, preferably just after milking. There are mechanical contrivances for the removal of these flavors that have been used with more or less success. This is accomplished by means of heat and thorough aeration. I have found that Pasteurization and subsequent aeration will reduce these odors and flavors to some extent, but will not entirely remove them.

The odors caused by the feeding of roots and silage may be eliminated by feeding these feeds immediately after milking. The odors imparted to milk by feeds eaten by the cow are due to the presence in these feeds of certain volatile oils that have the power to pass through the tissues of the body, thus reaching the udder and the milk. In the same way the odor of onions will appear on the skin of the person a short time after they are eaten. If these feeds are given immediately after milking, so that several hours will elapse before the next
milking, the odor will have had time to escape from the body of the cow, and will not appear in the milk. Silage, if it is of good quality, does not impart the flavor to milk to any great extent. The odor of silage in milk is more often due to the fact that the odor is present in the barn at milking time. This can be prevented by feeding the silage after milking, and by being careful to keep all waste material cleaned up so that it will not lie around the barn and decay.

Some of the disagreeable odors and flavors that occur in milk are due to the action of bacteria, and are the result of certain changes that are produced in the milk by the action of these organisms. There are other off flavors that may be due to the condition of the cow. If the odor is present at the time the milk is drawn, it is due either to the condition of the cow or the food she has eaten. If the odor does not appear until some time after the milk is drawn, it is caused by the action of bacteria, or by the milk having been exposed to air in which this odor was present. If the trouble is due to the condition of the cow, the milk should not be used until the trouble has been removed. These abnormal flavors sometimes occur as a result of digestive disorders. At other times they are due to the fact that the cow is far along in the period of lactation. In case of digestive troubles, a laxative such as salts, one to one and a half pounds, or raw linseed oil, one pint, will often remove the trouble. It may be well also to change the feed. An occasional bran mash or a small amount of linseed meal daily, will help to keep the digestion in good condition.

Care of Milk After Milking

Removal From Barn—Milk should not be allowed to remain in the barn after milking. The air of the barn always contains more or less dust that may fall into the milk, and the milk will absorb any odors that may be present in the barn. There should be a milk room adjacent to the barn where the milk may be strained into cans immediately after milking. This room may be built in one corner of the barn, or it may be built outside and connected with the barn by means of a door,
or better, by a small entry or hall way. This room should be conveniently located in order to save time and labor at milking time, yet it must be so built that the air of the barn is excluded. As soon as each cow is milked, or at least between the milking of every two cows, the milk should be carried into the milk room and strained to remove any particles of dust or any hair that may have fallen into the pail. Even when the covered pail is used, a strainer should be kept on the can until full to prevent dust or flies from falling into the can while the pails are being emptied.

The straining is best done through a layer of absorbent cotton between two cloths, or through several thicknesses of cheese cloth or other like material. A supply of clean strainer cloths should be on hand at all times. These cloths must be thoroughly washed and sterilized each time they are used. This should be done according to directions for cleaning dairy utensils that will be given later.

It should be understood that straining serves only to remove the coarse material from the milk. It does not reduce the number of bacteria or remove the finer particles of dirt. Straining will not change dirty milk into sanitary milk.

Cooling—If the milk is to be sold as whole milk, it should be cooled to 50 degrees or below, not later than ten minutes after milking. If the cooling is done with a cooler or aerator, it may be done in the milk room, provided this room is thoroughly protected from dust and odors from the barn. When the milk room is used for a cooling room, the milk is strained directly into the receiving vat of the cooler; then allowed to run through a second strainer into a can. Unless it is possible to keep the milk room free from dust and barn odors, the cooling should be done in the dairy house that is located 75 to 100 feet from the barn. While the milk is running over the cooler or aerator it is exposed to the air in a thin layer and, unless this work is done in a room where the air is pure, undesirable odors and a large number of bacteria are liable to be introduced.
If a cooler is not used the cans of milk should be placed in a cooling vat as soon as possible and the milk stirred frequently until cooled. This vat should be supplied with a continuous supply of cold water, or ice should be added to the water. If the milk is to be bottled at the farm, the bottling should be done as soon as the milk leaves the cooler and the bottles immediately placed in the refrigerator or in water at a temperature of fifty degrees or lower. If no cooler is used, the milk may be bottled as soon as milked, and the bottles placed in the cooling trough. If this plan is used, it is best to have

![Fig. 15—A good cooler. The cooling is done by running cold water through the cooler while the milk runs slowly over the outside. The milk will be cooled to within about two degrees of the temperature of the water used.](image)

![Fig. 16—Another type of cooler. The cooling may be done with either running water, ice water or ice.](image)
the water at 45 degrees, or lower. Unless a low temperature is maintained in the cooling water, it requires so long for the milk to cool that the bacteria have an opportunity to develop to a considerable extent before the temperature gets low enough to check them. The milk should be kept cold until delivered to the consumer. When delivering milk in bottles, some arrangement should be made to protect the milk from the heat during delivery. This may be done by placing the bottle crates in an enclosed case in the wagon, or by icing the crates, or both.

If the milk is sold wholesale and delivered in cans, the cans may be protected from the heat by covering with a heavy blanket, preferably wet. There are on the market heavy felt or padded jackets to be put on each can that is to be hauled or shipped to a market. These serve very well to maintain the low temperature of the milk during shipment. Great care should be taken, however, when either blankets or jackets are used, to keep them in a sanitary condition. There is a jacket or insulated can on the market that is a great aid in maintaining a low temperature in milk during shipment. These are used to some extent in creameries that receive large amounts of cream by train or gather it on cream routes where the wagon is out all day. They are somewhat expensive and heavy to handle or they would, no doubt, be used more.

Separating and Care of Cream—When cream is sold or manufactured into butter on the farm, a cream separator should be used.

The separator not only gives a better grade of cream but also removes the fat more thoroughly from the milk than the gravity or natural method of creaming. It has been shown by carefully conducted tests that the cream separator will remove 25 per cent more fat from the milk than is recovered by the gravity method. To recover the most fat by the gravity method it is necessary that the milk stand at least twelve hours. If it is not properly cooled, it will require a longer time. This method requires a large storage room, if large quantities of milk are to be handled and, since the milk must
be held for several hours before skimming, bacteria will have developed to a considerable extent before the cream is removed. In the summer time the cream is often sour when skimmed. For best results in churning, the cream should test from 30 to 35 per cent. If the milk is thoroughly skimmed by hand, the cream seldom tests over 25 per cent and often less. Thin cream goes off flavor sooner and develops a more undesirable flavor than a rich cream. On account of these facts the cream separator should be used if one is milking three or more cows.

The various cold water and dilution "separators" that are on the market are not real separators, but merely patented devices to be used in the gravity system of creaming. They have little value over the ordinary long, narrow can, and do not recover any more fat on the average.

The milk should be separated as soon as possible after milking and the cream cooled to at least 50 degrees F. Each new lot of cream should be cooled before mixing with older cream. If a warm lot of cream is added to an old lot, the rise in temperature produces a rapid development of bacteria and an off-flavored cream is apt to be the result. If it is to be sold to a creamery, it is best to separate a cream testing 35 to 40 per cent fat. This gives a cream that is much less apt to go off in flavor than a thin cream. It costs less to ship the same value in fat in a rich cream, and when the starter is added to the cream to ripen it the per cent of fat will remain about right for churning.

Cleanliness and cold are just as important in the care of cream as in the care of milk. Unless the dairyman delivers a high grade of cream to the creamery, the butter-maker cannot produce a high grade of butter. Low grade butter must sell at a low price, which necessitates a low price paid to the dairyman for fat. Eastern creameries are now grading cream and paying for it according to the per cent of fat, condition and flavor. The time is not far distant when western creameries will do the same; then the man who ships low grade
cream will be cut in price as his cream falls below the standard of first grade.

The up-to-date dairyman, however, will not wait until forced to take proper care of his cream, but will consider it his duty to put out as perfect a product as it is possible for him to do.

**Care of Dairy Utensils**

The proper washing of the dairy utensils is a very important part of the dairy work. Unclean utensils are often the source of very undesirable fermentations in milk. Pails or cans which have open seams or are not soldered smoothly are constant sources of contamination. If the pails have seams around the bottom, they should be flushed with solder. It will cost only a few cents to have the tinner do this and it will save much time in washing and also insure a much cleaner pail. It is poor economy to purchase cheap utensils. A good quality of utensils, with smooth sides and bottoms, will do much toward improving the quality of dairy products. Pails of pressed tin are the most satisfactory.

![Fig. 17](image.png)


On the average farm, milk vessels are seldom properly washed. Often they are simply rinsed in cold water. This removes only the milk that does not adhere to the pail. Pails thus treated soon become greasy and the corners and the seams filled with dried milk and dirt. Usually they are washed with warm water, soap and a dish cloth. No amount of washing in this way will render milk pails or other utensils clean.
Even if one could remove all the dirt from the seams in this manner, great numbers of bacteria will adhere to the sides and seams of the pail. In other words, to be properly cleaned, milk vessels must be not only thoroughly washed, but also thoroughly sterilized.

Milk vessels should first be rinsed in luke warm water to remove the milk. Do not put any utensils into hot water before rinsing. The hot water cooks the milk fast to the sides and seams rather than removing it. After rinsing in warm water, wash thoroughly in hot water, to which soap, or better, some good washing powder has been added. Use a good brush rather than a cloth for washing. The brush not only removes the dirt from the seams more thoroughly, but is also much more easily kept in a sanitary condition than a cloth. After washing thoroughly in this way, all utensils should be rinsed in boiling water and then carefully sterilized by steaming in a steam sterilizing oven or by inverting over a steam jet for several minutes. If the dairy is large it should be equipped with a sterilizing oven.

The steam jet is also a very important article of equipment, and by all means should be used in the absence of the sterilizing oven. The steam jet should connect with a hole in the drain board at the wash vat. In dairies that have no steam supply, the utensils should be thoroughly scalded in boiling water. It is best to leave them in the water for ten or fifteen minutes. After the milk vessels are scalded or steamed they should be inverted on a drain rack to dry. Do not dry them with a cloth, it only serves to introduce numerous bacteria, is unnecessary labor and does no good.

Strainer cloths require especial care to keep them in a sanitary condition. It is best to rinse them first by pouring water through the opposite way from which the milk passed to remove all loose dirt and hairs. Use cold or luke warm water for this. When the dirt and hairs have been removed, rinse thoroughly in luke warm water and wash carefully in clean hot water to which some washing powder has been added, and
rinse in clear hot water. The strainer cloths should be sterilized either in the sterilizing oven or by boiling for ten or fifteen minutes.

If milk is retailed in bottles, great care should be exercised in washing and sterilizing these bottles when they are returned to the dairy. This precaution will insure a high quality of milk that means satisfied customers, will protect the dairyman from losses from sour milk, and will prevent the spread of contagious diseases from one family to another along the milk route. Wash and sterilize bottles the same as other milk vessels.

**Flies**

Flies are a source of a great deal of trouble in the dairy business. They introduce some of the most undesirable forms of bacteria, including disease germs, into the milk. Their habit of feeding on decaying material and the feces of all animals makes them a very dangerous source of contamination. They will fly directly from the manure gutter to the milk pail, thus introducing into the milk the germs of any contagious disease with which any of the cows may be affected. They also carry the germs of the sick room or the privy vault to the dairy buildings, in many cases serving to spread disease broadcast by introducing the germs into the milk supply of many families. The barn, milk room and all other places where milk is handled should be kept as free from flies as possible. Flies are hatched in the manure pile and other refuse. If, therefore, the manure is hauled out frequently and the premises are kept free from refuse, the number of flies will be greatly reduced. The manure should at least be removed before warm weather comes and the flies begin to hatch.

**THE ATTENDANTS**

No person affected with any contagious or infectious disease should be allowed to have anything to do with the handling of milk. Persons just recovering from typhoid, or scarlet fever, diphtheria and other contagious diseases often
continue to give off the germs of the disease for some time after they are able to go about their work. Any milk handled by such person is liable to become contaminated with the germs of the disease. No person in whose family there is a case of any contagious disease should be allowed to handle milk.

The germs of the disease from the sick room are very apt to lodge in the clothing of all members of the family, and if such persons be allowed to care for the milk, it is liable to become infected with these germs and prove a means of transmitting the disease to the consumer. A number of outbreaks of contagious diseases in cities have been found to follow certain milk routes, and, when traced out, the source of infection in a number of cases proved to be an attendant, a member of whose family was affected with the disease, or who was himself just recovering from the disease.