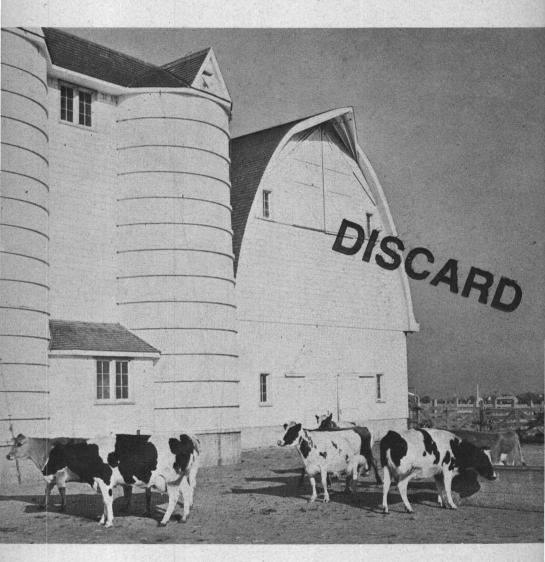
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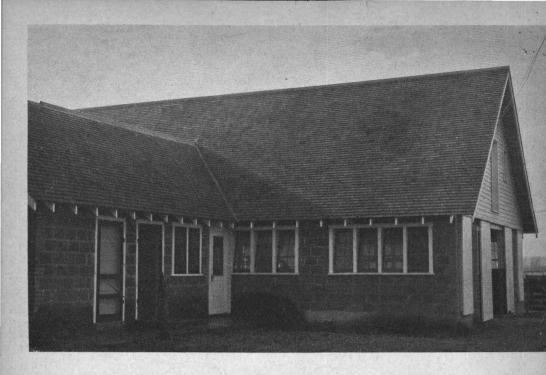
Clean Milk



Oregon State System of Higher Education Federal Cooperative Extension Service Oregon State College Corvallis

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Upper picture: This modern milking barn with milkhouse connected to the center of one side of the barn saves labor. The barn drains to a liquid manure tank.

Lower picture: A part of the interior of the milking barn shown above. There is plenty of light and ventilation with smooth wall construction.



# Producing Clean Milk

G. H. WILSTER H. P. EWALT

OREGON'S 260,000 dairy cows in 1942 produced 1½ billion pounds of milk. Slightly more than 200 million pounds were consumed on the farms where it was produced. The remainder was used as market milk and cream and for the manufacture of butter, ice cream, cheese, condensed milk, and dry milk. The milk had a gross farm value of \$38,000,000.

The production of this volume of milk on nearly 50,000 farms involves a number of important factors, each of which must be considered important if a product is to be marketed that will net the

highest returns to the producer.

It is only by using proper methods in the production of milk that the dairy farmers can obtain the highest price when the milk is

sold on a graded basis.

Milk and milk products, to be acceptable to the consumers, must have a good flavor, an attractive appearance, and be of uniform composition from day to day. The keeping quality must be satisfactory. The products must be free from undesirable bacteria and foreign matter. Clean milk is fundamental to high quality dairy products.

This bulletin outlines and discusses the principles of clean milk production. The principles discussed are equally important in producing market milk, or milk for manufacturing purposes. Elaborate buildings and equipment are not necessary but sanitation and orderliness are essential.

# THE FACTORS NECESSARY IN THE PRODUCTION OF CLEAN MILK

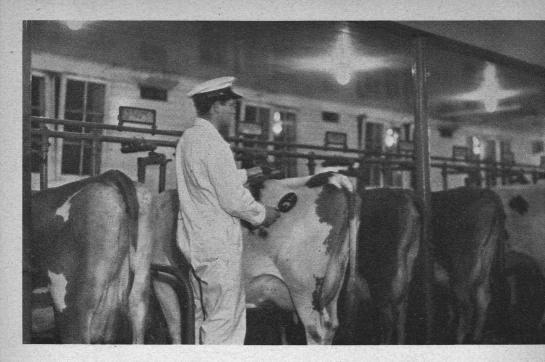
#### THE COW

## Health

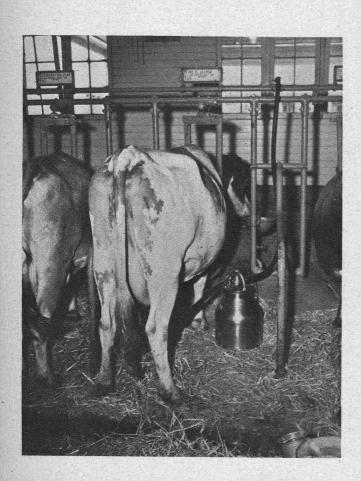
Keep only healthy cows. Do not sell milk from cows that suffer from tuberculosis, Bang's disease, or mastitis. Do not use milk from a cow with a diseased udder. Discard bloody or abnormal milk. Keep cows out of swamp land and stagnant water; ropy milk bacteria are often present in stagnant water.

#### Period of lactation

Cows late in their lactation period often produce salty milk. The enzyme lipase may be present in relatively large amount in milk



If cows are to be kept clean they must be thoroughly brushed each day.



A clean healthy cow, with udde washed, and milked by a clean sterilized milking machine wil produce good quality milk. Milk ing should be done rapidly a an average of 3 to 4 minutes per cow. Stripping may be done with the machine and further educe possible contamination of the milk.

from cows late in their lactation period. This enzyme during a few hours may cause the milk to turn rancid. There is no remedy for these defects. The cows should be turned dry. Do not sell milk obtained from cows 15 days before calving and until 5 days after calving.

## General condition

Dirty cows will mean dirty milk. Keep the hair clipped short on the udder, legs, and flanks at all times. Curry and brush the cows daily. The udder should always be washed before milking. Use a cloth dipped in a pailful of warm chlorine solution (200 parts per million). Outing flannel cloth 8 by 16 inches is satisfactory. Under average conditions 15 to 20 cows may be washed in 2 gallons of solution. When the udders are dirty renew the solution frequently. The use of an individual cloth for each cow and placing the used cloths in a second pail will aid in preventing and controlling mastitis. Wash and dry the cloths at the end of the milking period.

## DUST AND FLIES

## Dust

Avoid feeding hay immediately before or during milking. Keep dust out of the milk by having the air in the barn reasonably free from dust during milking. Cobwebs collect dust. Remove cobwebs from ceiling, walls, ledges, and ventilators.

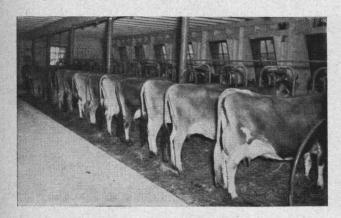
## Flies

Flies are filthy. They spread disease. They deposit filth on walls, windows, ceiling, and equipment. They torment cows and may reduce milk flow. They are our enemies and should be controlled. A fly may carry thousands of bacteria into the milk. Flies should be controlled by:

- 1. Spraying.
- 2. Trapping and poisoning.
- 3. Using electric or common fly screens on door and window frames and openings.
- 4. Frequently removing accumulations of manure, decaying straw, and refuse in which flies lay eggs.
- 5. Flyproofing privies.
- 6. Providing proper drainage and sewage disposal.

The common female housefly may lay 2,000 eggs during its lifetime. The period from egg to adult is generally from 10 to 14 days. From egg through larval stage is only 3 to 6 days. The blood-sucking stablefly develops from the egg to the adult stage in





Upper picture: An Oregon dairy barn and milkhouse satisfactory for the production of bottled milk.

Lower picture: A clean barn and a clean healthy herd of cows are the first essentials in clean wholesome milk production.

from 3 to 4 weeks. The fly lays its eggs in manure, decomposing straw, decomposing vegetables, and garbage.

Remove the manure to fields during summer every 3 days or oftener, or store it in a tight, screened, and properly closed shed to control the movement of flies.

#### BARN

## Construction

Select a well-drained location. The floor of the milking barn preferably should be of concrete. Watertight wood also may be used. The walls and ceilings should be smooth, the joints tight. Avoid dust-collecting ledges and rafters. Gutters should be properly constructed for good drainage. Provide clean bedding when the cows are kept in the barn.

Ask your county agricultural agent for information regarding barn construction.

#### Ventilation

Provide an abundance of fresh air so as to remove feed and other odors and to keep the barn dry. Avoid direct drafts of air through the barn.

# Lighting

Allow 4 square feet of window space for each cow. It is easier to clean a well lighted than a poorly lighted barn. Keep the windows clean. Provide adequate artificial light.

#### Sanitation

Remove the manure and used bedding a distance of at least 50

feet from the barn. Spread manure often on the fields. Clean the barn twice daily. Each time new bedding is added scrape the old bedding to the rear of the stall. Sweep the floor and sprinkle it with superphosphate or lime. Cement floors should be washed clean daily when facilities are available. Remove uneaten feed from the mangers. Keep out dogs, hogs, chickens.



A good dairy barn and milkhouse are not necessarily expensive. Proper construction saves labor and aids sanitation.

out dogs, hogs, chickens. Wash the milk stools. Paint or whitewash the interior of the milking barn as needed.

## MILKHOUSE

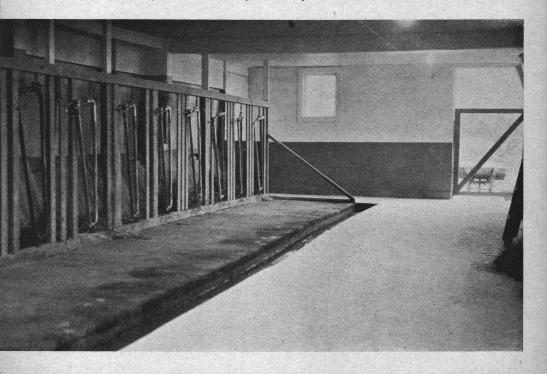
#### Location

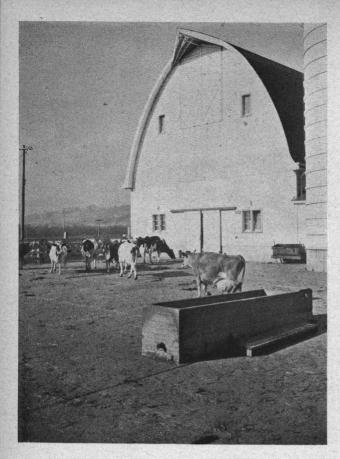
For convenience the milkhouse should be constructed within 6 to 10 feet of the barn. The location should be such that prevailing winds during the dry season will carry barnyard dust away from it.

#### Construction

Select a well-drained site for the milkhouse. The floor should be watertight. Use concrete and provide good drainage. Other de-

The interior of a remodeled barn, a corner of which is shown above.





A clean, well drained barnyard is a very desirable feature when dairy cattle are turned out during the winter. The removal of droppings during the fly season will reduce the number of flies. Flies lay eggs in manure.

sirable features are: tight, smooth walls and ceiling; self-closing screen doors opening outward: racks for cans, pails, strainers, and brushes; facilities for washing and drying hands. The building should be vermin-proof. Avoid ledges and exposed rafters. Keep interior well painted. Control flies. Milkhouse plans can be obtained from your county agricultural agent.

## Ventilation

Good air circulation prevents odors, keeps the walls and ceilings dry, and helps to dry the cleaned utensils and prevent rust. All openings should be screened. A ceiling ventilator should be installed. A high, arched ceiling is preferable to a low, flat ceiling.

# Lighting

The rooms should be well lighted. The win-

dow space should be equal to at least 10 per cent of the floor space. Provide sufficient artificial light.

# Equipment

Adequately equip the milkhouse for proper cleaning, sterilizing, and storing of utensils. The wash sink should be of the two-compartment type when steam or hot water sterilization is practiced, and of the three-compartment type when the cleaned utensils after having been rinsed are to be chemically sterilized. Provide adequate facilities for cooling and storing milk.

## Water

The water supply must be pure. If in doubt regarding the

purity of the water, arrange to have it examined bacteriologically. Information regarding the construction of wells that meet sanitary requirements can be obtained from the State Board of Health, Oregon Building, Portland.

#### SURROUNDINGS

## Yard-

Grade the surroundings to facilitate drainage. Remove all trash. Remove droppings to the manure shed, or spread them on the fields at least every 3 days to prevent the hatching of flies.

## Drainage

By means of a sloping concrete or tile drain, waste can be conducted some distance from the premises.

## Chicken coops, toilet, hog pens

Locate chicken coops, outdoor toilet, and hog pens a distance of 100 or more feet from the barn and milkhouse. Select a well-drained location. These structures should preferably be on the leeward side of the barn and milkhouse so that the prevailing winds do not convey odors to the interior of the buildings. The toilet should be constructed in accordance with sanitary regulations and should be

A wintertime scene on an Oregon dairy farm. Note the well drained yard free from mud.



flyproof. The State Board of Health can give information regarding the proper construction of toilets.

#### UTENSILS

## Construction

Milk cans, pails, and strainers should be constructed of heavy gauge material so that they do not become dented easily. "Seamless" construction is most sanitary.

Use well-tinned utensils. Do not use utensils that have cracked seams and that are pitted and rusty. Keep them properly reconditioned. Milk pails of the hooded type are best, even under the cleanest conditions. A single-service cotton disk or pad should be used for filtering all milk. Cloth is not satisfactory and should not be used.

## Method of cleaning

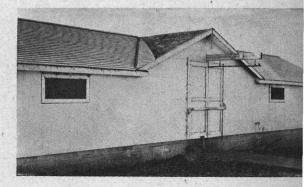
Five steps in properly cleaning utensils include: first, rinsing with cold or lukewarm water; second, washing, using a warm soda solution; third, rinsing with clean hot water; fourth, sterilizing; fifth, placing on racks to dry.

Do not use soap as a cleaner; a film will form on the surface of the utensils. A soda washing powder, especially prepared for cleaning dairy utensils, should be used. Use clean brushes, not dishcloths. Be sure that all milk remnants and dirt have been removed before the utensils are sterilized. Steel wool may scratch the tinned surface. Do not use a scouring powder. To remove a milkstone deposit, use a commercial preparation that does not damage the metal surface.

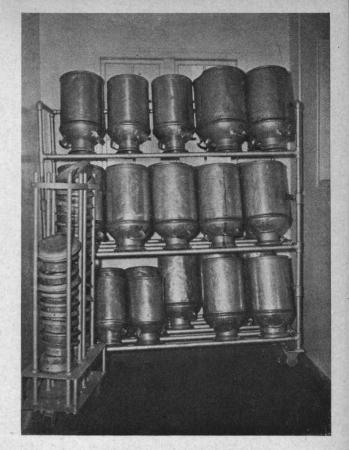
Approved sterilization of the cleaned utensils consists of any one of the following:

- 1. Exposure to steam for at least 15 minutes at 170° F. or higher in a cabinet; or for at least 5 minutes at 200° F. or higher in a cabinet.
- 2. Exposure to steam from a jet for at least 1 minute (inverted cans and pails only).

A covered manure pit with tight doors and screened openings. The proper handling of manure is important. It should be spread on the fields every three or four days or stored in a fly tight pit.



- 3. Immersion of the equipment in or exposure to a chlorine solution for at least 2 minutes. The solution should be made up to a strength of 100 parts per million of active chlorine. After sterilization the used solution must contain not less than 50 parts per million of active chlorine.
- 4. Immersion in hot water at 170° F. or higher for at least 2 minutes; or exposure to a flow of hot water at 170° F. or higher at the outlet for at least 5 minutes.
- 5. Exposure to air at a temperature of not less than 180° F. for not less than 20 minutes in a hot-air cabinet.



A good method of storing cans and lids. This method of storing aids drying and prevents rust.

After sterilization,

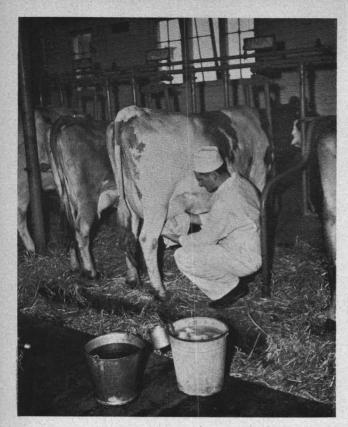
the sterilized surfaces that come in contact with milk must not be contaminated by touching with the hands or by flies or dust. When the utensils are not stored after sterilization in a dust-free cabinet they should be rinsed with a chlorine sterilizing solution and thoroughly drained before they are used.

# Storing

Keep the cleaned utensils in the screened milkhouse on racks. Invert the cans and pails. Keep everything in order. Do not contaminate the cleaned utensils. Dry utensils do not become rusty. Bacteria do not grow on clean, dry utensils.

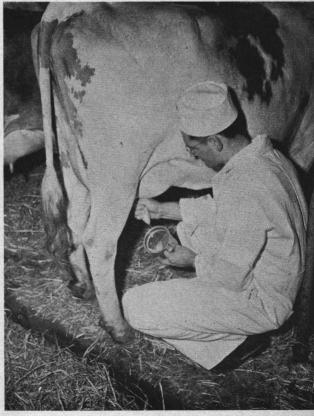
# Contamination of milk by utensils

Improperly cleaned and unsterilized utensils may contaminate the milk with millions of bacteria.



The udder should be washed with warm water just before milking Wash water with chlorine is de sirable. Individual cloths wil help to prevent spread of mastitis. Note the strip cup at tached to the bucket.

Squirt a stream of foremilk into a strip cup to check for abnormal milk and aid in preventing the spread of udder infections. Cows giving abnormal milk should be milked last and milk discarded until the udder is again normal.



## Hot water and steam

Automatically operated electric water heaters or electric steam boilers are efficient and convenient to use. An adequate supply of hot water for washing utensils is necessary on all dairy farms.

## THE MILKER

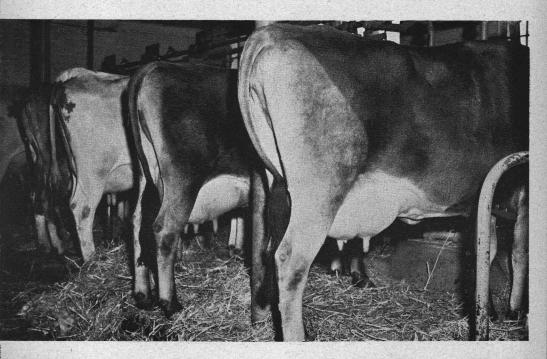
## Health

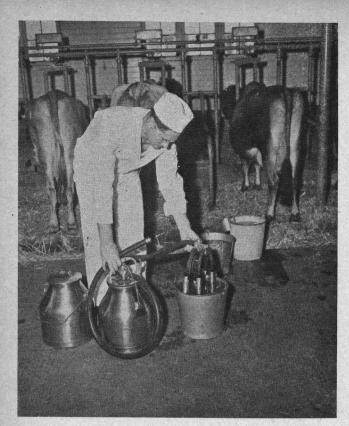
Milkers and milk handlers should be healthy and must not attend persons affected with contagious disease. A person suffering from a severe cold or cough, who has a sore throat, or who has abscesses or sores on the body, hands, and arms, should not milk cows or handle milk. Don't sneeze or cough over the milk pail.

## Hands

Wet-hand milking is filthy. It is prohibited by state regulation. Before milking, wash hands with soap and water, then dry them with a clean paper towel. Keep fingernails well trimmed. Wash and dry hands when they become soiled.

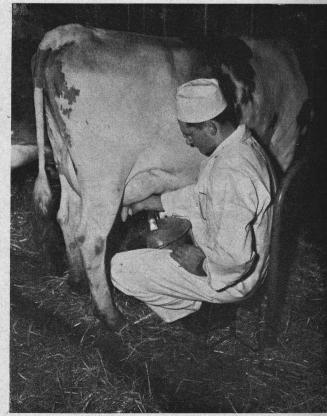
Keep the long hair clipped from udder, flanks, and rear quarters, as shown in this picture. This practice is a material aid in clean milk production.





After milking each cow open the vacuum release on the milkin machine and dip the teat cups a chlorine solution containin not less than 400 parts per milion of chlorine. This aids in the control of mastitis.

When milking by hand use a covered top milk pail. Milk with dry clean hands. Vaseline or any other udder salve should be thoroughly removed before milking. All-metal milk stools can be kept cleaner than wood stools.



# Clothing

Wear clean, preferably white, cotton clothes including a cotton cap during milking and while handling milk. White cotton garments are easy to wash and are convenient to use. Wash the clothes often.

Before milking each

# Milking



Milk and cream should be transported in a closed truck.

cow a small amount of milk from each quarter should be milked into a strip cup. The first milk obtained may have a high bacterial count. The fat content is low. Abnormal milk can easily be detected on the screen of the strip cup. The early detection of mastitis is of a distinct advantage as the dairyman can adopt remedial measures. The milk in the strip cup should be discarded into the milkhouse drain. Do not sell milk from cows having chronic mastitis. Bloody milk should be discarded.

Dirt will add millions of bacteria to the milk. Do not soil hands during milking. Always wash and dry hands after toilet use.

## Milk stool

A metal milk stool is best. It is easier to clean than one constructed of wood. Hang the milk stool on the wall when not in use.

#### MILKING MACHINE

## Condition

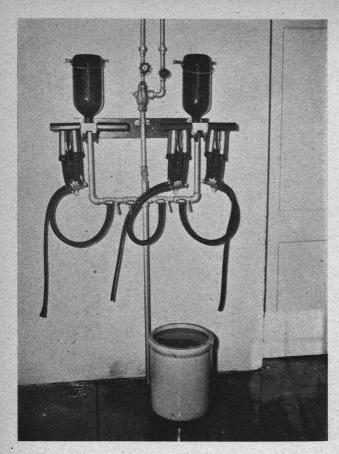
The rubber teat cup liners and tubes should be free from defects. Discard old and soft rubbers. Checked or split rubber teat cup liners and tubes cannot be cleaned. They will harbor millions of bacteria.

# Strip cup

Before milking, a small amount of milk should be milked into a strip cup to determine whether the milk is free from abnormal physical properties. Discard this milk into the milkhouse drain.

# Contamination of milk by an unclean machine

Milk containing thousands of bacteria per cubic centimeter results from using unwashed and unsterilized milking machine parts. Milk containing only a few bacteria per cubic centimeter can be produced when a clean and properly sterilized machine is used. Dipping the teat cups in a chlorine solution (400 parts per million)



Milking machine parts may be sterilized and stored in a number of ways. The crock with lye solution is a common practice. This picture also shows the solution rack with two glass solution jars. The rack is connected to the steam and water pipes so that the milking machine parts may be rinsed and sterilized on the rack with water and steam. This method is satisfactory and may be used in place of the solution.

after milking each cow is effective in mastitis control and helps to produce milk having a low bacterial count. The vacuum release valve on top of the pail should be opened when the teat cups are rinsed to allow the chlorine solution to flow into the inflations.

# Methods of cleaning a milking machine

Wash the machine after each milking. Rinse with cold or lukewarm water, then brush all parts, using warm water containing a soda washing powder. Use a brush or cleaning rod for cleaning the inside of the rubber tubes. Rinse all parts with warm water, followed by sterilization of the metal parts as outlined previously.

Where steam under pressure is available the usual solution rack may be connected to the cold water and steam by means of a mixing chamber. With this method the rubber parts of the

milking machine are rinsed with flowing cold water immediately after the machine is removed from the last cow. After thorough rinsing, the amount of water is reduced and steam is turned into the flow of water, allowing sterilization with hot water at 200° F. Then cold water is again used to cool the parts. Cold water may be left in the rubber parts until the next milking or they may be left dry. Once each week the rubber parts are taken apart and thoroughly brushed.

If steam is not available the cleaned rubber tubes and teat cup liners may be kept in a chlorine solution containing 100 parts per million of active chlorine until the following milking. A stone crock should be used for the solution. Prepare fresh solutions daily. Another method is to place the teat cup assembly on a rack and fill the tubes and teat cup liners with a fresh chlorine solution containing 200 parts per million of active chlorine or with a 0.4 to 0.5 per cent lye solution. Leave them until the next milking. Before using the rubber parts kept in or filled with the lye solution, they should preferably be rinsed with a fresh chlorine solution.

To prepare the lye solution dissolve a 13-ounce can of lye in 1 gallon of cold water in a crock. Stir well. Keep this stock solution, which has a strength of 8.5 per cent lye, in a jug plainly labeled. Keep the solution away from children. By means of a glass or enameled measuring cup measure out 6 ounces or  $\frac{3}{4}$  cup of this solution and make up to 1 gallon with cold water. This makes a 0.4 per cent solution. Lye is corrosive to certain metals, particularly aluminum and tin.

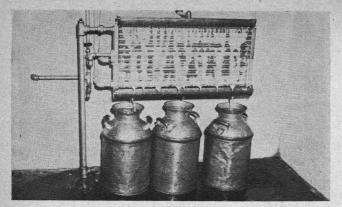
#### STRAINER

## Type of strainer

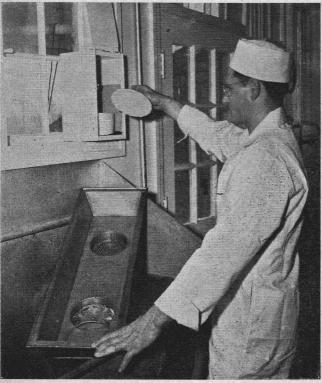
A well-tinned strainer of adequate size should be used. It should be free from cracks and crevices. The most desirable type

Steps in preparing a lye sterilizing solution. Add a 13-ounce can of lye to 1 gallon of cold water in a crock. Stir well. Place in a gallon jug. This is the stock solution. To make the sterilizing solution put 6 ounces or \( \frac{2}{3} \) cup of the stock solution in a jug. Add cold water to make 1 gallon. Label containers. Keep away from children.





Milk should be cooled immediatel after milking by use of a sur face cooler or a cooling tan with flowing water.



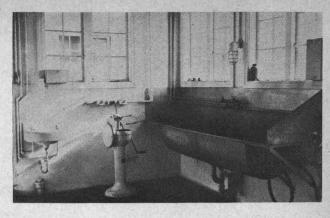
Single-use cotton filter pads shoul be used. Note that the pads ar stored in a box that is dust fre and that the pad may be picke up with the moist metal dish Handle all equipment so as no to contaminate it before use o while it is being used.

is the kind that utilizes a single-service cotton filter pad. Cloths are unsatisfactory for straining; they are difficult to clean. Don't use them.

# Straining

With clean, dry fingers place a filter pad in position in the strainer. After 10 to 20 gallons of milk have been strained, remove

the pad and place it in a waste receptacle. Rinse the strainer with tap water and insert a new cotton pad, using clean, dry fingers, or pick up the pad with the moist metal strainer disk. Using single-service cotton filtering material in the top perforated tray of a surface cooler is also satisfactory. Strainers should never be bounced



A well lighted conveniently arranged milkhouse washroom.

as this breaks the filter disk. When straining is slow replace the filter.

## Purpose of straining

Straining removes only coarse dirt particles and such extraneous material as hair and small bits of straw. Dirty milk does not become clean by straining. Some fine dirt remains in the milk. Bacteria cannot be removed by straining; therefore, keep the dirt out of the milk.

Do the straining in the milkhouse, not in the barn.

#### COOLING AND STORING

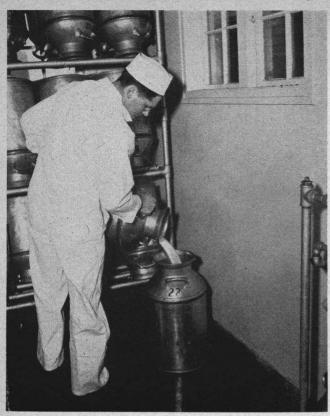
## Mechanical refrigeration

Milk can be cooled satisfactorily in 10-gallon cans, set in a tank of 35° F. water, when the water is circulated around the cans. The milk temperature will be reduced from 95° F. to 50° F. or slightly below in 1 hour, and to 42° F. in 2 hours. Stirring the milk does not materially speed the cooling by this method.

By means of a surface cooler, using tap or well water in the upper half of the cooler and either refrigerated brine or water in the lower portion, milk can be cooled to a temperature of 40° F. or below as it flows over the cooler. A "direct expansion" cooler using water in the upper half and gas refrigerant in the lower half may also be used with similar results.

# Cooling with water

With a surface cooler, using water at 50° F. as the cooling medium entering at the bottom of the cooler and leaving at the top, the cooled milk in the can will be only a few degrees above the temperature of the cooling water. With a normal flow of milk over the cooler, about 4 or 5 gallons of water for each gallon of milk must pass through the cooler.



Warm milk should not be mix with cold milk.

Two types of milk strainers both of which are quite satisfactory. The filter pads should be replaced for every 10 to 20 gallons of milk. Milk should be strained in the milkhouse, not in the barn.



Experiments with cooling a can of milk submerged to the neck in a tub of water at  $54^{\circ}$  F. with the water flowing into the bottom of the tub and leaving at the top at the rate of 4 gallons per minute showed that 80 pounds of milk could be cooled from  $90^{\circ}$  to  $60^{\circ}$  F. in 1 hour without stirring.

Do not mix warm and cold milk.

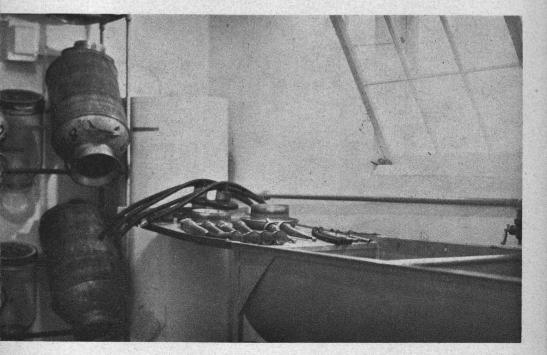
## Cooling with air

Cooling by placing a can of milk in a refrigerator room is so slow that it is not practical. If a 10-gallon can full of milk at 95° F. is placed in a refrigerator in which the air is maintained at 40° F., several hours are required to reduce the temperature of the milk 15 or 20 degrees. About 10 hours are required to cool it to 60° F. Do not use this method of cooling.

## Absorption of odors

Milk absorbs odors readily. Keep the milk away from the odors of gasoline, unclean barns, musty cellars, and strong-flavored fruits and vegetables. Strong-flavored feed should never be fed before, but always *after* milking.

A dairy farm milkhouse with adequate storage for utensils, hot water tank, and washing facilities.



## Covering cans

Cover cooled cans of milk with clean lids in order to keep out dust and insects and avoid absorption of odors. When milk is being cooled in cold water tanks, the lids should be left on the cans.

## Growth of bacteria during storage

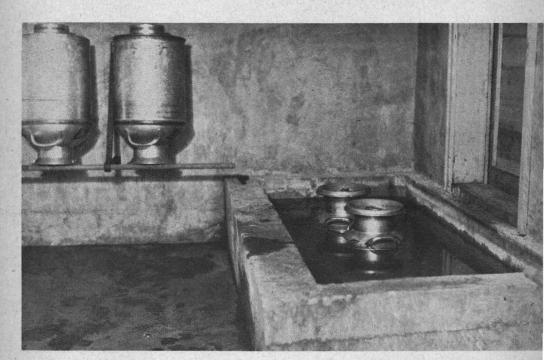
Milk from healthy, clean cows contains on an average only 1,000 to 2,000 bacteria per cubic centimeter. (A pint contains 473 cubic centimeters.)

The growth of bacteria in milk kept at different temperatures is illustrated by the data given in the table below. Milk containing 6,400 bacteria per cubic centimeter was stored at various temperatures.

RATES OF GROWTH OF BACTERIA IN MILK

	Refrigerator temperature 38°-40° F.	Flowing water temperature 51°-52° F.	Room temperature 52°-67° F.	Room temperature 72° F.	Room temperature 72°-82° F.
	Bacteria per cc	Bacteria per cc	Bacteria per cc	Bacteria per cc	Bacteria per cc
After 24 hours	8,200	10,300	39,000	10,000,000	48,000,000
After 48 hours	7,600	14,800	7,700,000	990,000,000	1,470,000,000

When refrigeration is not available a water tank with flowing cold water is quite satisfactory.



# IMPORTANT POINTS IN THE PRODUCTION OF CLEAN MILK

- 1. Keep only healthy cows.
- 2. The milker should be free from contagious disease.
- 3. The milkhouse water supply must be pure.
- 4. Bitter, salty milk from cows late in lactation should not be sold. Bloody or thick, lumpy milk should be discarded.
- 5. The milking should be done in a clean barn. Protect the milk from dust and flies.
- 6. The cows should be clean. Clip udders and flanks and brush each cow daily.
- 7. Wash the udder before milking. Use a clean cloth and a chlorine solution.
- 8. The milker's hands should be clean and dry, fingernails trimmed. Wear clean clothes while milking. Milk stools should be clean.
- 9. If a milking machine is used, it should be clean and free from bacteria so that the milk does not become contaminated.
- 10. If milking by hand, use a hooded, well-tinned, clean pail.

This dairy farm milkhouse has a granite pan in which to place rubber parts in lye solution. Plenty of light and ventilation is necessary. The windows are screened. Hot water is supplied by a gas water heater.



- 11. Remove the milk from the barn as soon as it has been taken from the cow.
- 12. Strain the milk through a single-service cotton filter pad.
- 13. Provide an adequate supply of hot water for washing utensils. Clean the utensils thoroughly.
- 14. Sterilize all equipment used for milk. Use either steam, hot water, or chlorine. Do not attempt to sterilize unclean utensils.
- 15. Use clean, sterilized cans for the milk. Never put milk into dirty, dusty, or bad-smelling cans.
- 16. Cans and other utensils should be free from cracks, crevices, and rust. They should be well-tinned.
- 17. Cool the milk as quickly as possible to 50° F. or below. Cooling is not a substitute for cleanliness.
- 18. Do not mix warm and cold milk. Such a practice will favor bacterial growth. The milk may churn during transit. The warm milk should be cooled before it is mixed with the milk from the previous milking.
- 19. Keep the milk at a temperature between 40° and 50° F. until it is shipped to the milk plant or creamery.
- 20. The air in the room where milk is handled and kept should be free from objectionable odors and dust.
- 21. Cover the filled cans of milk with clean lids while stored.
- 22. Store the cleaned and sterilized utensils on racks in a ventilated room when not in use. The cans and pails should be inverted for complete draining. Keep brushes on racks.
- 23. Keep insects, rodents, birds, dogs, and cats away from the milkhouse.
- 24. Protect cans of milk waiting at the roadside and during transportation against dust and the direct rays of the sun. With an open truck use a wet blanket over the cans during the summer. An enclosed truck is best.

Milk as it comes from healthy cows is clean and wholesome. When once contaminated it can never be restored by any method of processing to its original high standard of purity and quality. For that reason produce clean milk and keep it clean.

THERE IS NO BETTER FOOD THAN MILK OBTAINED FROM CLEAN, HEALTHY COWS AND HANDLED IN A SANITARY MANNER.