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AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE
MANHATTAN, KANSAS

DEPARTMENT OF DAIRY HUSBANDRY

PRODUCING QUALITY CREAM[1]

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HIGH-QUALITY CREAM AND GREATER PROFITS

The reports of the Kansas State Board of Agriculture show that in 1926 Kansas produced 62,966,998 pounds of butter valued at $26-391,672.82, an average price of 41.9 cents per pound. During the same year the average price of 92-score butter at the five leading wholesale markets in the United States was 43.7 cents per pound. If all of the Kansas product could have been sold as 92-score butter, the producers would have received $1,133,405.96 more for their product. The producers of Kansas cream could increase their returns over $1,000,000 annually if they would market cream that will make 92-score butter. The return to the cream producers is dependent to a large extent upon the price which the butter will command on the market.

Conditions are changing in the dairy industry. Rapid progress has been made by the creameries in improving the methods of processing and manufacturing cream into butter. It is regrettable, however, to note that very little progress has been made in improving the quality of the cream on the farm before it reaches the creamery. Since the quality of butter is directly dependent upon the quality of

Acknowledgment.—The authors are indebted to Prof. A. C. Fay of the Department of Bacteriology for his helpful suggestions and criticisms in the preparation of this circular.

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the cream received, future progress of the butter industry will necessitate an increase in the per cent of high-quality cream. The use of mechanical refrigeration, new information on starters, neutralization, and churning, together with other scientific knowledge, have helped to develop the butter industry to a point where further progress is going to be very slow unless there is an improvement in the quality of cream delivered to the creamery.

The cream producers of Kansas have within their own control the necessary solution to the problem of greater returns for their cream. Good butter not only commands a higher price on the market, but it encourages consumers to use more butter. The task of producing high-quality cream is neither difficult nor time consuming. The small amount of extra time and labor expended in improving the quality of cream will be more than offset by the increased dividends to the cream producers in the state.

BACTERIA SPOIL CREAM

Milk as it comes from the cow is clean, but it always contains a few bacteria. The bacteria, which are tiny single-celled organisms invisible to the naked eye, will develop very rapidly unless certain precautions are taken to prevent their multiplication. Thus milk and cream produced by careless methods will contain large numbers of bacteria. Since bacteria are responsible for the deterioration of milk and cream, any improvement in the quality of these products depends upon preventing their entrance and multiplication. Most of the bad flavors of cream are caused by bacteria which enter the cream as a result of careless methods of production. Once these organisms gain entrance they multiply rapidly and produce many off-flavors unless the cream is held at a low temperature until sold.

A MILK HOUSE IS DESIRABLE

Every milk and cream producer should be provided with a milk house. The milk house should be entirely separate from the stables and should be used exclusively for the handling of milk and cream. Provision should be made in the milk house for a cooling tank, sink, cream separator, and a rack for holding the dairy utensils. Some provision must be made in the milk house for providing an adequate supply of hot water for washing and sterilizing utensils. This may consist of a small laundry stove, a kerosene or gas stove, or in some cases a small boiler may be installed. It makes very little difference what method of heating is used, as long as provision is made for an adequate supply of hot water.

HEALTHY COWS AND ATTENDANTS IMPORTANT

Milk from cows which have infected udders or are suffering from tuberculosis or any other disease, is unfit for human consumption. Every farmer should have his herd examined each year by a competent veterinarian and tested for tuberculosis.

Milk that is abnormal, such as ropy, slimy, watery, or milk from caked udders, should not be used. Cows producing abnormal milk should be milked last, otherwise the trouble may spread to the other animals.

No person who is suffering from any contagious disease should be permitted to milk or handle milk and cream.

CLEAN COWS, BARNS, AND ATTENDANTS ESSENTIAL

Cleanliness begins with the cows. They should be free from dirt, especially the udders and flanks. Clipping the hair on the udder, flanks, and belly facilitates proper cleaning. The best results can be secured only when the udder and teats are washed or wiped with a clean, damp cloth just previous to milking. The method used will depend somewhat on the condition of the cows; when the udders are very muddy or dirty, washing is necessary. On the other hand, if the cows are reasonably clean, wiping the udder and teats with a clean, damp cloth will suffice.

The cows should be housed in a clean, well-lighted and ventilated barn. A barn with poor light, ventilation and drainage renders it extremely difficultto produce cream of high quality. Plenty of sunlight and free use of whitewash in the barn are important factors in the production of good cream. Concrete floors in dairy barns aid materially in keeping the cows and the barn clean.

The practice in some dairies of requiring the milkers to wear white suits is desirable but not essential. In no instance, however, should the milkers be permitted to wear dirty clothes. Every milker should be required to wash his hands with soap and water before milking. Personal cleanliness is essential in the production of clean milk and cream.

CLEAN AND STERILE UTENSILS NECESSARY

Milk should never come in contact with dirty utensils. Milking pails should be bright and shining, free from rust and dents. All seams should be flushed with solder to make them easier to wash and sterilize.

Under ordinary herd conditions there is usually considerable dirt adhering to the cows' bodies which may fall into the milk. Much of this dirt may be kept out of milk by the use of a small-top milking pail. The effect of the small-top milking pail is greatest when the cows are dirty, but its use is desirable at all times.

Utensils must not be only visibly clean, but as free from bacteria as possible. Any container which is used for milk should be rinsed with cold water soon after it is used in order to remove the milk adhering to it. The utensils should then be thoroughly brushed with warm water containing a satisfactory washing powder. Soaps are unsatisfactory for washing dairy utensils, as they leave a greasy film on the utensils. A good mineral washing powder should be used which will dissolve milk solids and aid in removing the fat.

The next step in the cleaning of the milk utensils is to heat them to a temperature which will kill most of the bacteria present and also leave the utensil in a dry condition. Bacteria will multiply very rapidly if any moisture is present, but if the utensils are left in a dry condition the increase will be negligible.

Steam is the most desirable method of sterilizing milk utensils, but on the average farm steam is not available. If steam is not available, boiling water may be used very effectively, provided a sufficient quantity is used. In pouring boiling water from one utensil to another the temperature soon drops to a point where it will neither kill the bacteria present nor heat the utensil sufficiently that it will become dry from its own heat. The extent to which the temperature of water will be lowered by pouring from one vessel to another is shown in Table I.

TABLE I.—DROP IN TEMPERATURE OF RINSING WATER WHEN POURED FROM ONE CAN TO ANOTHER.

Quarts of water used.	Temperatures—degrees F.					
	Before rinsing.	After first can.	After second can.	After third can.	After fourth can.	Total drop.
2	210	158	131	113	100	110
6	210	178	160	150	138	72

The table also shows that the volume of boiling water used has a big influence on the rapidity with which the temperature of the water drops. It is impossible to sterilize effectively all the milk utensils on the average farm with a single teakettleful of boiling water.

Once the utensils have been scalded they should be inverted on a suitable rack and exposed to the sun if possible, The rack and utensils should be protected from flies, dirt, and other sources of contamination. A well-lighted, well-ventilated, and properly screened milk house is the logical place to keep the utensils.

CHEMICAL STERILIZATION

The average farm does not have the equipment to sterilize effectively its milk utensils with steam or boiling water. However, at a very small cost utensils can be sterilized successfully with chemical disinfectants. Care must be exercised to cleanse thoroughly everything before sterilization and then make sure that the chemical solution is of adequate strength. Chemical sterilization is not a substitute for any of the steps previously outlined in the cleaning of dairy utensils,

The three most important precautions that should be taken in the use of a chemical sterilizing agent pertain to: (1) Cleanliness of the utensils to be sterilized; (2) time the chemical is allowed to remain in contact with the utensil; and (3) strength of the chemical solution used.

Chemical sterilization is ineffective unless the utensils are entirely free from dirt of all sorts. It is never a substitute for thorough washing or scalding of all milk utensils. Sufficient time must be allowed for the chemical to act upon the bacteria; otherwise the utensils will not be sterilized. The chemical solution should remain in contact with the utensil for not less than 30 seconds, and preferably not less than 1 minute.

Chemical disinfectants and Sterilizing agents are worthless unless they are up to the required strength. It is a mistake to depend upon chemical sterilization without having some means of testing the solution being used. The orthotoluidine test provides a simple and practical means of checking the strength of chemical disinfectants on the farm. This test may be purchased from the Diversey Manufacturing Company, Chicago, Ill.

Chemical sterilizing agents are available in many different commercial forms. The cheapest way, however, of obtaining an effective chemical agent is to make it. The following directions, prepared by Prof. A. C. Fay, Department of Bacteriology, Kansas State Agricultural College, should be followed closely.

DIRECTIONS FOR MAKING HOME-MADE HYPOCHLORITE DISINFECTANT

Materials needed for 5 gallons of stock solution:

5 one-gallon jugs.
1 ten-gallon stone jar.
1 five-gallon open vessel.
10 pounds soda ash or 27 pounds sal soda.
20 pounds fresh bleaching powder. (This should be purchased fresh from manufacturer with a guarantee of 35 per cent available chlorine.)

Directions for compounding:

1. Dissolve the chloride of lime (bleaching powder) in four gallons of warm, not hot, water (about 120° F.) This should be done in the stone jar. Do not use a metal container.

2. Dissolve the soda ash or sal soda in three gallons of warm water, using any convenient container.

3. Add the soda solution to the bleach solution already in the stone jar. Stir this mixture vigorously three or four times during the remainder of the day. Allow to stand undisturbed over night.

4. On the next day, very carefully siphon the clear supernatant liquid into gallon jugs. It is advisable to filter the liquid through a layer of absorbent cotton which may be placed in a funnel fitted in the mouth of the jug. Stopper the jug tightly and keep in a cool place.

Precautions

1. The success or failure of this disinfectant is very largely dependent upon the quality of bleaching powder used. Bleach is a very unstable substance, and unless purchased absolutely fresh, is likely to be practically useless. It should contain not less than 35 per cent available chlorine. Any unused bleach left should be tightly sealed in the can and stored in a dry place.

2. The keeping quality of this stock disinfectant is largely dependent on the absence of foreign matter in the clear solution. The jugs should be thoroughly cleaned before use. Great care should be taken to prevent siphoning pieces of the heavy calcium carbonate precipitate into the jugs.

3. Fit the jugs with tight fitting stoppers, preferably rubber. If clear glass jugs are used they should be stored in a dark place.

Dilutions

The extent to which this stock solution may be diluted depends upon the strength of the disinfectant desired and the chlorine content of the stock solution. If properly prepared from good bleach, dilutions may be made as follows:

Solution A.—1 part stock solution to 50 parts of water to be used where a very strong disinfectant is necessary, as in deodorizing floors, moldy walls, etc.

Solution B.—1 part stock solution to 100 parts of water, for a sterilization rinse for cans, pails, separator parts, etc.

The proper time to apply a chemical disinfectant is just before the utensils are used. A disinfectant solution of the proper strength and of sufficient volume may be conveniently made up in the wash sink prior to milking and then the pails, etc., can be sterilized in this solution just before using. It is advisable to rinse the utensils with clean, cold water immediately after they come out of the disinfectant solution to avoid any possibility of the flavor of the disinfectant being carried into the milk.

The separator should be sterilized by running a small quantity of the disinfectant solution through the machine followed by thorough rinsing with clean water just before the machine is used.

SEPARATORS NEED SPECIAL ATTENTION

A recent survey of 117 separators in Idaho showed that the skimmilk from 57 of the machines contained in excess of 0.03 per cent fat. This resulted in a yearly average loss of $10.85 per separator. Cream separators need frequent, inspection and for maximum efficiency must be operated according to the directions of the manufacturer. Attention must be paid to the speed of the machine, which must be uniformly kept at the recommended rate. Other factors which affect the efficiency of the machine are the rate of inflow of milk, into the machine, the temperature of the milk, the cleanliness of the separator, and the smoothness of operating. Milk should be separated as soon after milking as possible, because warm milk can be separated more thoroughly than cold milk.

Time spent in cleaning and washing a separator will pay big dividends. A dirty machine will not separate efficiently. Furthermore, milky water and slime allowed to remain in the separator bowl will contaminate the next batch of cream and cause it to spoil rapidly.

At the conclusion of each separation and while the bowl is still revolving it should be flushed with water until clear water runs out of the skimmilk spout. The machine should then be dissembled, washed, and sterilized in the manner previously described for other utensils.

RICH CREAM KEEPS BETTER THAN THIN CREAM

An easy method of reducing the spoilage of cream is the separation of rich cream. In warm weather the cream screw of the separator should be set to deliver cream testing between 35 and 45 per cent butter fat.

Experiments at the Kansas Agricultural Experiment Station have demonstrated that rich cream has much better keeping quality than thin cream. A portion of the results of this study are presented in Table II.

TABLE II.—THE EFFECT OF BUTTER FAT CONTENT ON THE ACIDITY OF CREAM SAMPLES HELD AT A TEMPERATURE OF 45 TO 50 DEGREES F.

Acidity expressed as per cent lactic acid.

Age of sample	Fresh.	48 hours.	96 hours.
Group I. 15.5 to 30 per cent butter fat, five samples	0.154	0.300	0.590
Group II. 30 to 40 per cent butter fat, six samples	0.141	0.320	0.435
Group III. 40 to 57 per cent butter fat, five samples	0.122	0.185	0.277

Referring to Table II, it will be noted that the initial acidity of cream decreases as the per cent of fat increases. The development of acidity is very materially retarded by an increase in the butter fat content of the cream. For sake of explanation, cream will be considered as consisting of butter fat and skimmilk. The bacteria which induce souring act upon the milk sugar of the skimmilk portion of the cream, breaking it down into lactic acid. Obviously the smaller amount of skimmilk, milk sugar, in the high-testing cream affords less material for the production of acid and consequently prolongs the keeping quality.

TABLE III.—RELATION OF THE PER CENT OF BUTTER FAT IN CREAM TO THE PER CENT FAT LOST IN THE SKIMMILK.

Separator No.	Per cent fat in— Cream.	Per cent fat in— Skimmilk.
1	15.5	0.045
1	34.5	0.045
1	56.5	0.050
2	18.5	0.090
2	38.0	0.080
2	55.0	0.040
2	57.0	0.050

Cream containing 45 per cent butter fat may be separated with the same degree of efficiency as cream with 25 or 30 per cent butter fat. This fact is demonstrated in Table III. Similar results were obtained with three different makes of farm separators. No correlation was found between the richness of cream separated and the per cent of fat lost in the skimmilk.

Care must be taken to recover all of the fat. Even under the best of conditions some fat will be lost as a result of the cream adhering to the bowl and other utensils. (Table IV.) The average loss of 15 separations conducted under farm conditions, in which the pounds of milk separated and the pounds of cream sold were taken as a basis, showed that the average fat loss amounted to 0.205 of a pound for each 100 pounds of milk separated. This figure takes into consideration the fat lost in the skimmilk as well as all mechanical losses incurred through separation.

TABLE IV.—TOTAL BUTTER FAT LOST DURING THE SEPARATION OF 75 POUNDS OF MILK.

Separator No.	Per cent fat in—			
	Cream.	Original milk.	Milk on basis of fat recorded in cream.	Difference.
1	55.0	4.3	3.920	—0.380
	38.0	4.3	4.350	0.050
	18.5	4.3	4.147	—0.153
2	14.0	4.4	4.340	—0.060
	21.0	4.4	4.253	—0.147
3	40.5	4.3	4.040	—0.260
	57.0	4.3	4.173	—0.127
	50.0	4.4	4.093	—0.307
4	34.5	4.9	4.920	0.200
	36.0	4.9	4.560	—0.380
	56.5	4.9	4.580	—0.320
5	15.5	4.6	4.340	—0.260
	26.5	4.6	4.320	—0.280
	35.0	4.6	4.340	—0.260
6	22.5	4.3	4.080	—0.220
Average difference				—0.205

No correlation has been found between the richness of cream separated and the loss of fat resulting from the cream adhering to the separator parts, provided the separator was reasonably well flushed with skimmilk at the completion of the separating process.

COOLING CREAM

There are usually enough bacteria in cream produced by careful methods to cause the cream to spoil rapidly unless their multiplication is retarded. The rapidity with which the bacteria will multiply is dependent to a large extent upon the temperature at which the cream is held. A single bacterium at 70 degrees F. may produce 750 bacteria at the end of 24 hours, whereas if held at 50 degrees F.

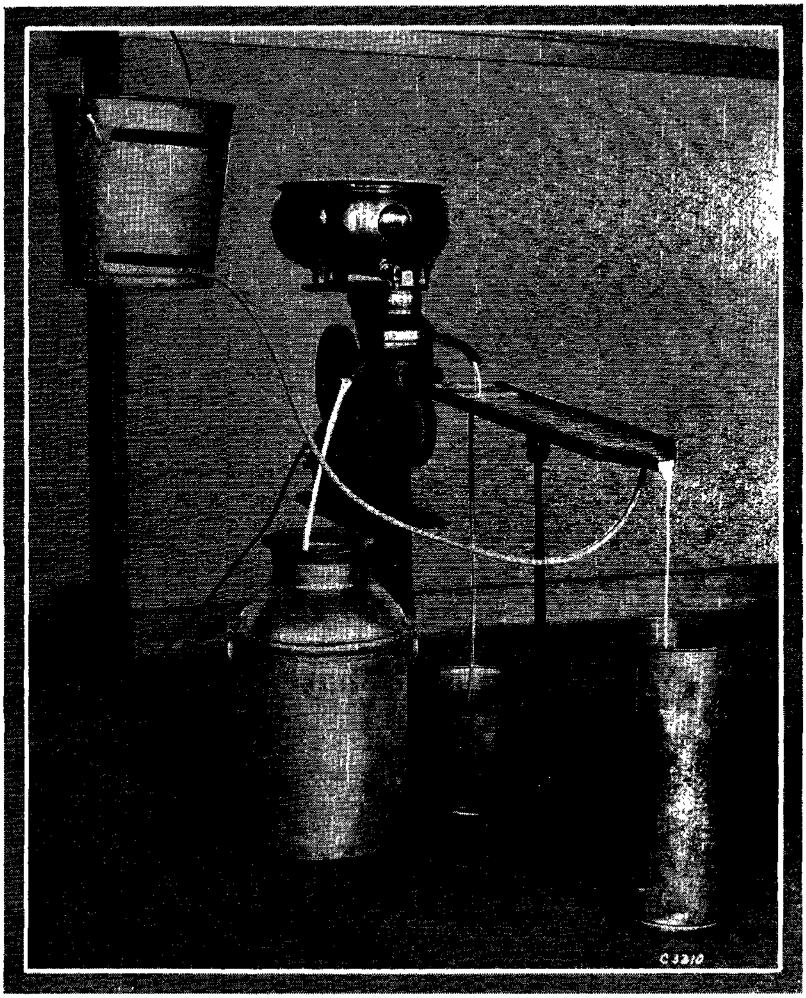

FIG. 1.—Cream cooler designed for cooling cream direct from separator.

one bacterium may produce only 5 bacteria in the same length of time. There is a tremendous increase of bacteria in milk or cream that is not promptly cooled to 50 degrees F. or below.

Quick cooling is an essential factor in controlling the multiplication of bacteria. If possible cream should be cooled as it flows from the separator; if this is not feasible it should be cooled immediately after separation. Coolers may be obtained for a small sum which can be attached directly to the separator. The cooler shown in figure 1 has been found satisfactory, provided real cold water or iced water is used.

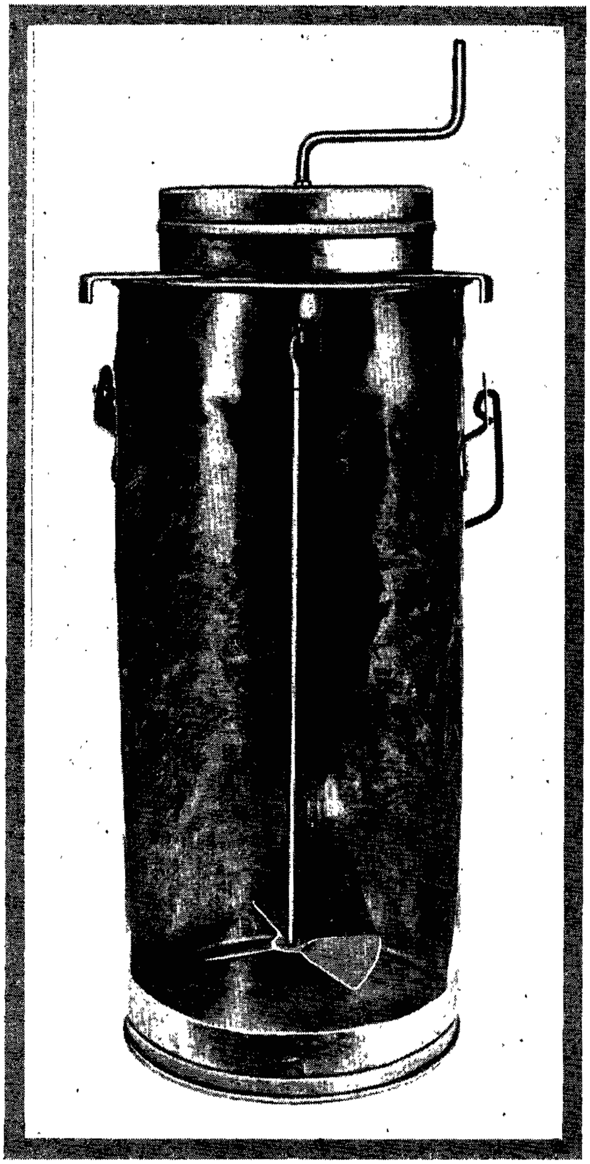

FIG 2.—Mechanical stirrer for cooling cream.

The cooler must be set so that its entire surface will be covered with cream. The angle at which the cooler is set also is important from the standpoint of the temperature to which the cream is cooled. One can best determine the way the cooler should set by taking temperature readings of the cream as it flows off the cooler. The position which will cool the cream to the lowest temperature is the correct position. The bucket holding the iced water should be raised sufficiently above the separator to force the water through the cooler at a fairly rapid rate. Some results obtained with the use of this type of cooler are as follows:

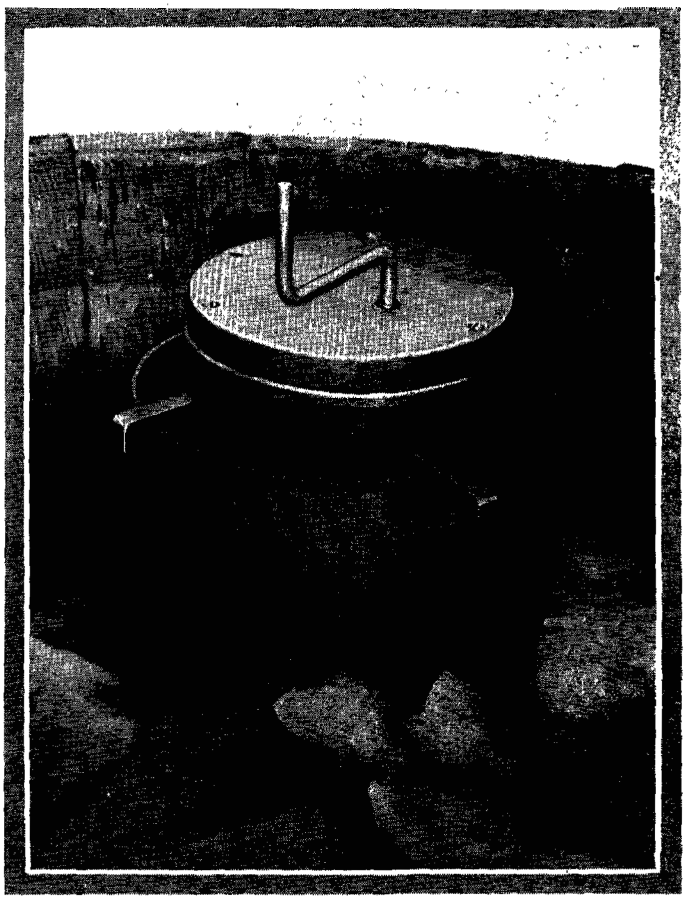

FIG. 3.—A mechanical cooler will give best results when can containing cream is immersed in iced water.

	Trial No. 1	Trial No. 2
Temperature of water	37° F.	52° F.
Temperature of milk separated	94° F.	94° F.
Temperature of cream	61° F.	66° F.

It will be noted that the cooling process is not completed by simply flowing the cream over the cooler. The cream must be placed at once in iced water if possible and cooled on down to 50° F. or below. Cream that is not cooled as it leaves the separator should be set in cold water and stirred frequently or preferably be poured over a surface cooler.

Stirring cream is an important but often neglected step in the cooling of cream. A mechanical stirrer is illustrated in figures 2 and 3, which has been found to give very satisfactory results provided the cream is held in iced water or very cold water. If this stirrer is used with water having a temperature higher than 55, degrees F., the agitation is sufficient to cause the cream to churn, which is objectionable.

Table V shows that cream which is properly stirred can be cooled to 50 degrees within 30 minutes, provided the cream is held in iced water at approximately 40 degrees F. At the end of one hour the temperature of the unstirred cream was considerably above 50 degrees F.

TABLE V.—THE EFFECT OF STIRRING ON THE RATE AT WHICH CREAM COOLS WHEN HELD IN ICED WATER.

	Temperature of cream—degrees F.		
Type of agitation (*a*)	Not agitated.	Hand stirred.	Mechanically stirred.
Initial	94	94	94
At end of 5 minutes	91	76	74
At end of 10 minutes	85	66	65
At end of 20 minutes	78	63	56
At end of 30 minutes	64	53	50

(*a*). Twenty pounds of 38 per cent cream used in each case.

A cooling tank is a very profitable piece of equipment on any dairy farm. It can be constructed of concrete or wood, and in some instances a barrel will suffice. Water from the pump can pass through the cooler and from there to the stock tank. The cooling tank should be covered and protected from the sun. The following specifications and details of construction of two types of inexpen-

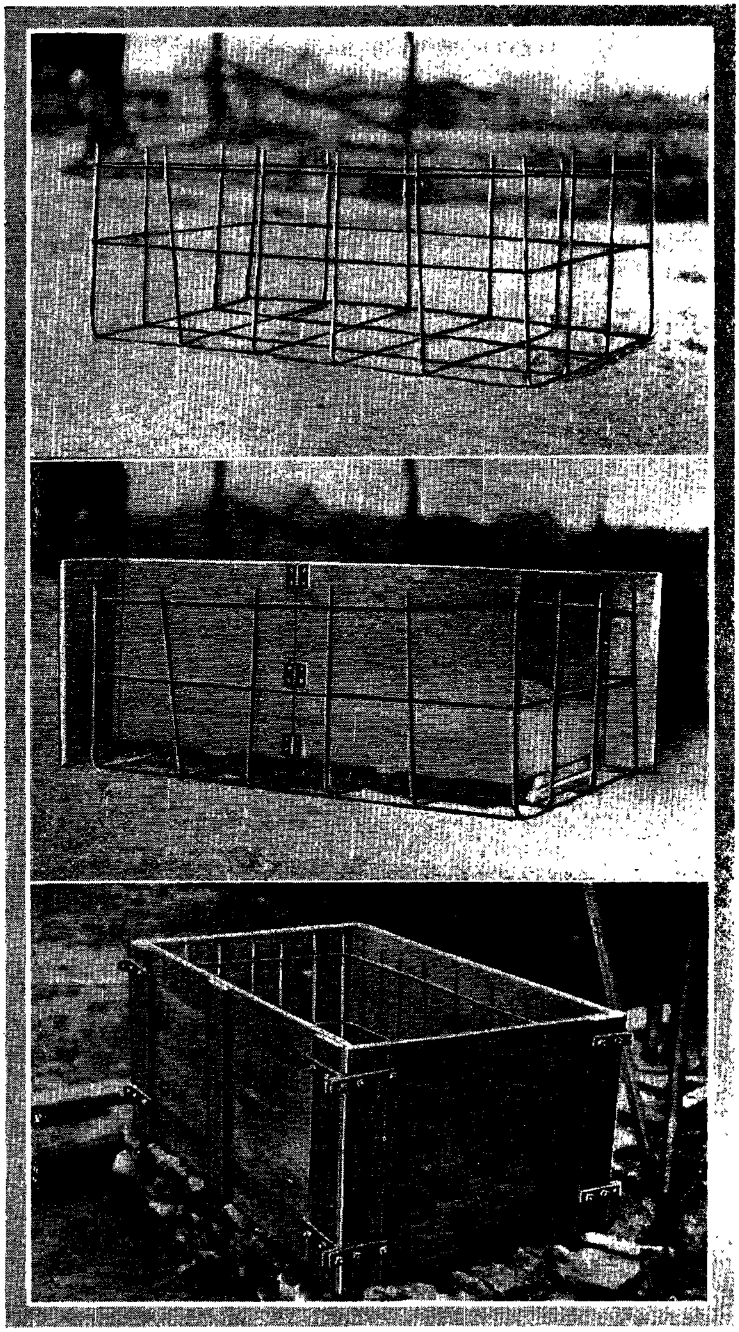

FIG. 4.—Concrete cooling tanks for cream. *Top:* Reinforcement for tank. *Middle:* Reinforcement and inside form for tank. *Bottom:* Form for cooling tank.

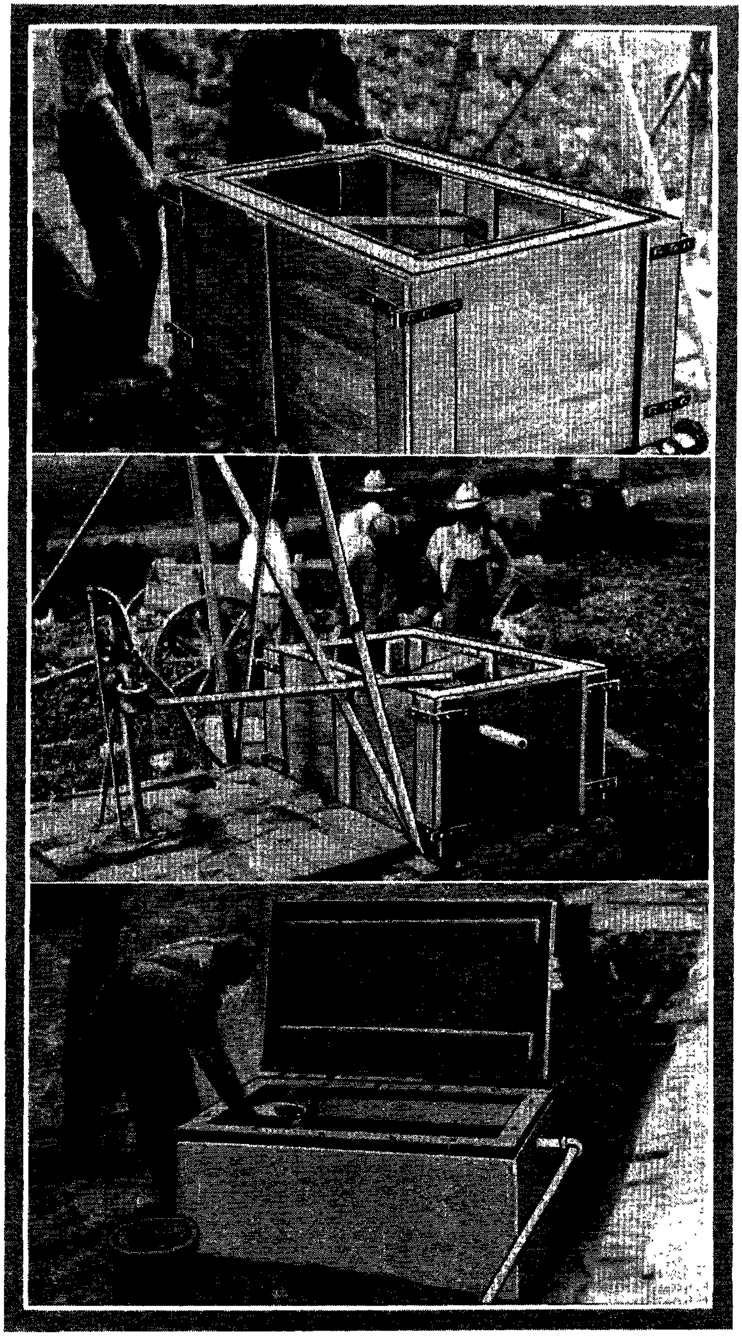

FIG. 5.—Concrete tank for cream. *Top:* Tank after pouring concrete. *Middle:* Finished tank before forms are removed. *Bottom:* Completed concrete cooling tank.

sive concrete cooling tanks are furnished through the courtesy of the Portland Cement Company. Figures 4 and 5 show the cooling tanks in the various stages of construction.

SIZE OF TANKS

Tank No. 1.—Outside dimensions, 5' long by 3' wide by 2'4" deep. Capacity, six 10-gallon cans and two shotgun cans. Materials needed, 5 sacks cement; 1,500 pounds, 15 cu. ft., clean, coarse sand; 100 feet of ¼-inch round reinforcing rods; inlet and overflow pipes.

Tank No. 2.—Outside dimensions, 4'8" long by 2' wide by 2'4" deep. Capacity, three 10-gallon cans and one shotgun can. Materials needed, 4 sacks cement; 1,200 pounds, 12 cu. ft., clean, coarse sand; 84 feet of ¼-inch round reinforcing rods; inlet and overflow pipes.

CONSTRUCTION DETAILS

1. Use only clean, coarse sand.
2. Use a 1:3 mixture; walls and floor 4 inches thick.
3. Do not use over 5 gallons mixing water to the sack of cement. If mixture is then too stiff cut down on the amount of sand.
4. Reinforcing rods should be placed 12 inches apart each way.
5. Remove forms after 24 hours.
6. Keep concrete wet for at least one week while curing.
7. If the tank is to be located outside, bolts should be set in the concrete for fastening the lid down.
8. Device for holding cans in tank—place eyebolts in wall about 21 inches from bottom of tank. In the large-sized tank the holders are placed as shown in illustration. In the smaller tank only one holder is used and thus fastened lengthwise of the tank.

The estimated material cost for tank No. 1 is $6.30 and that for tank No. 2 is $5.08. These estimates will necessarily vary for different localities.

MECHANICAL REFRIGERATION FOR COOLING AND STORING CREAM

Mechanical refrigeration is being used more extensively each year as a means of household refrigeration. The time is not far distant when mechanical refrigeration will be used extensively for cooling and storing cream on the farm. Specially designed units have already been built for use on the dairy farm. (Figs. 6 and 7.)

The purchase of a unit such as is shown in figure 6 or 7 is excellent insurance against poor-quality cream.

MARKETING CREAM

Frequent deliveries of cream are desirable. Cream is very perishable, and, like all food products, is best when fresh. There are many markets available for cream. Many producers favorably situated can sell sweet cream to ice cream plants at a good premium over

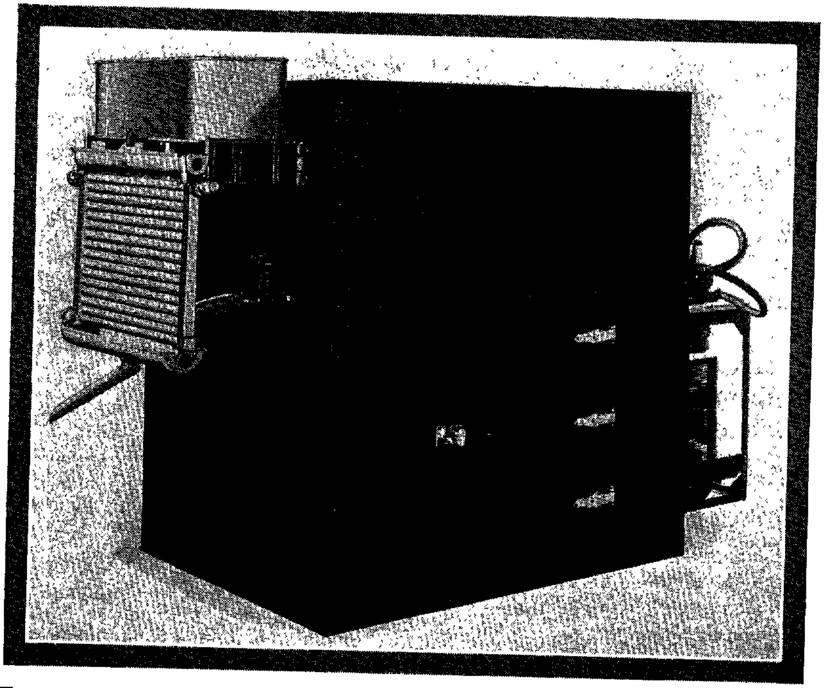

FIG. 6.—Dry type electrical refrigerator for cooling and storing milk and cream on the farm.

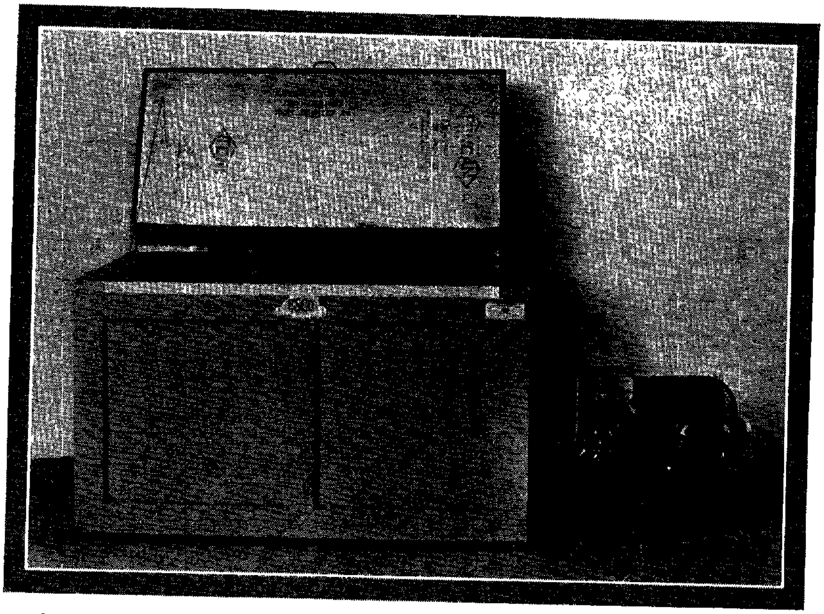

FIG. 7.—Wet type electrical refrigerator for cooling and holding cream.

sour cream, the price usually being from 3 to 10 cents per pound of fat above the price for sour cream. The cream station offers a steady market and quick returns for cream. Under the service charge plan the creameries are trying to procure their cream more efficiently, which should reduce buying cost and in turn be reflected in the pay check to the producer. The direct-shipper method of selling cream is also available and can be used by producers who ship a full can of cream frequently. This method of marketing, in many instances, permits a producer to sell on the graded basis and receive a premium for sweet or premium cream. The cooperative creamery and cooperative cream selling, when successfully operated, offer the producer an opportunity to receive maximum returns for cream.

WHAT TO DO

1. Have a clean, properly drained barnyard and clean barn.
2. Remove manure daily.
3. Clip cow's flanks and udder and keep them clean.
4. Remove milk from barn immediately after milking each cow or, if allowed to stand until milking is completed, keep can covered tightly.
5. Use a small-top or covered pail.
6. Keep dirt out of milk or use a wire strainer.
7. Have a separate, clean, well-ventilated room for skimming and handling milk.
8. Milk with clean, dry hands.
9. Feed hay and dusty feeds after milking.
10. Feed silage after milking.
11. Take cows off pasture which contains onions, garlic, or rag weed four to six hours before milking.
12. Cool the warm cream before adding to cold cream already in can.
13. Keep cans covered to eliminate flies and dust.
14. Protect cream from sun; keep it in a cool place.
15. In summer separate cream containing 35 to 45 per cent butter fat.
16. In winter separate cream containing 30 to 40 per cent butter fat.
17. Keep gas fumes away from cream.
18. Sell cream often.
19. Use cream cans for cream only.
20. Use a stiff brush for washing utensils.
21. Sterilize all utensils with steam, boiling water, or chemical disinfectants.

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