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Bulletin No. 96 - Care of Milk on the Farm and the Manufacture of Butter and Cheese

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FIG 1.--A CONVENIENT CHEAP WAY OF COOLING MILK.

CARE OF MILK ON THE FARM
AND THE
MANUFACTURE OF BUTTER AND CHEESE

MARCH, 1906.

LOGAN, UTAH.
FIG 2.—This picture was taken a month after the cow had gone to pasture. It is impossible to get clean milk from such a cow.

FIG. 3.—This picture was taken long before going to pasture. Milk of good keeping quality can come only from clean cows.

FIG 4.—A POORLY KEPT YARD, AND A SOURCE OF CONTAMINATION TO THE MILK.
The Agricultural Experiment Station of Utah.

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The Bulletins will be sent free to any address in the State, on written application to the Experiment Station, Logan, Utah.
Dairying is one of the most profitable lines of agriculture in Utah.

Ever since the establishment of the dairy industry in the State, the demand for Utah butter and cheese has been strong and prices have averaged good. A good article will always sell at top price; a poor article may sell at a good price when the demand is strong, but it will not sell at a good price, if at all, when the demand is weak. High prices are undesirable at any time if they create a tendency to put out a poor article. The success of any business depends largely upon the markets.

The object of the fore part of this bulletin is to set forth the way that milk may be secured in good condition and kept so until it reaches the factory or consumer, and its manufacture into butter and cheese. The average cow produces milk of good keeping quality. Poor keeping milk is usually due to the presence of ferments or bacteria that gain entrance to the milk after it is drawn. Bacteria are small living organisms invisible to the naked eye, and they have the power of multiplying very rapidly under favorable conditions. Warm milk furnishes most favorable environments for the development of these organisms and it is only through the changes that take place in milk that the dairyman is able to detect their presence. These organisms require food and are found wherever life is possible. They are found in large numbers in the air, in water, in food, in manure, on the milkker's hands and clothing and on the bodies of the cows, etc. Bacteria are found in the udder, but only to a limited extent, unless the animal is suffering from
such diseases as tuberculosis, anthrax, etc., the bacteria of which may gain entrance to the milk. Practically sterile milk may be secured under clean conditions by discarding the first few streams that come from the udder. In the healthy animal it is only by way of the teat that milk can be contaminated before being drawn. Bacteria can more easily enter the udder of some cows than that of others, but it is not this infection that troubles the dairymen most; it is usually the bacteria that get into the milk after it is drawn that cause greatest trouble. Bacteria multiply most rapidly and thrive best at a temperature between 70 and 100 degrees F, but are destroyed by high temperatures and rendered inactive by low temperatures. A temperature of 140 degrees kills a large number of them, but many forms of them are resistant to this temperature and can be destroyed only by boiling. Milk and cream kept at a low temperature for a considerable length of time may keep sweet, but are likely to develop taints or bad flavors, which are due to certain rare forms of bacteria that work at low temperatures. The belief that milk and cream can be kept several days and then be made into good products is erroneous; they should not be kept longer than two or three days, winter or summer, before being worked up.

THE BARN.

The first essential for the production of good milk is to have a clean stable. It should be well lighted and ventilated, and a coat of whitewash applied once or twice a year will add much to its appearance and wholesomeness. The stable may be plainly constructed, but it should have tight boarded walls, ceilings and floors. Hay and straw ceilings cannot be kept clean and are harboring places for cobwebs, rats, mice and all kinds of bacteria. The stable should be cleaned regularly and as often as is necessary, and lime put in the gutters every day after cleaning will have a beneficial effect.

If wooden or cement floors with gutters cannot be provided the stalls should be filled in with clay or coal cinders or a mixture of these materials, and they should be refilled at least once a year. Cattle cannot be kept clean and will not do their best when compelled to stand and lie in filthy mud puddles. Lime should be freely used on all earth floors.

The mangers should be clear of the ground, tight enough to
hold any feed that may be given, and they should be arranged so as to be easily cleaned. In the feeding of such fermentable stuffs as brewer's malt and beet pulp, the mangers and floors may be the sole cause of poor keeping and bad flavored milk. Musty or rotten food, fermented beet pulp, manure, etc., should not be stored where they will contaminate the milk, but should be well removed from the stable. Odors from such materials are readily taken up by milk.

**CARE OF THE COW.**

This is most important in the production of good milk. The cow when housed should be brushed when necessary and provided with some kind of clean litter for a bed. She should receive good wholesome food and only such water as is fit for human consumption. Good water is very important, as it composes 87 per cent of the milk. The cow's sides and udder should be brushed and the latter wiped with a damp cloth just before each milking. More hair and dirt get in the milk from a dry udder than from a damp one. *Twenty to ninety times as much dirt comes from the unbrushed unwashed udder as from the clean one.* Sprinkling the floors in hot weather will settle the dust and add much to the comfort of the animal and the milker and to the keeping qualities of the milk. Dusty forage should be well sprinkled and fed some time before the milking begins.

**THE MILKING.**

The milking should be done with full, clean, dry hand. Stripping with finger and thumb, milking with thumb knuckled under and milking with wet hands are bad habits and should not be tolerated. These practices are bad for the cow and cause contamination of the milk. Can one conceive of a more filthy habit than the milker dipping his hands into the milk or squirting it between his fingers? When practicable the milking may be done in the pasture, which, from a sanitary standpoint, is preferable to most barns.

The milker should be clean in person and his hands well washed and wiped dry before beginning to milk. A clean jacket and pair of overalls should be kept near at hand and used only while milking.

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CARE OF MILK.

As soon as the milk is drawn, it should be taken from the stable and strained. A milk room in the barn may be partitioned off from the cattle with tight walls and, if the barn is poorly ventilated and at times foul, the door to this room should open from the outside to avoid stable odors and dust. Milk that is strained and allowed to stand in the stable any length of time is often nearly unfit for use because of the bad odors it has taken up. If a room remote from the cows cannot be provided the straining may be done out of doors, care being taken lest rain and dirt enter the can. This trouble can be largely averted by covering the can between strainings with a clean, moist cloth.

Under the best of conditions some dirt will get into the milk and the strainer is always a very important utensil and will remove a great deal of this dirt if well cleaned and provided with a fine wire gauze and two or three thicknesses of cheese cloth. The strainer and cheese cloths should be well cleansed after every milking. This should be done by first rinsing with cold water, second by washing with warm water to which some washing compound has been added, and third, by rinsing again and then scalding. All dairy utensils should be cleaned in this manner and, when possible, should be thoroughly steamed.

As soon as the milking is finished, the cans should be placed in cold water, the milk stirred occasionally for a few minutes, and the covers left off until the milk is thoroughly cooled, precautions being taken that no dirt gets into the milk. In order to hasten the cooling process, it may be necessary to change the water surrounding the cans occasionally. During a greater part of the year in the irrigated sections the milk cans may be placed in ditches brought near the buildings. Warm and cold milk should never be mixed. They should be kept separate until thoroughly cooled or heated and ready to run through the separator. Milk should not be frozen. It is a good practice in delivering cream or milk to the factory or depot in hot weather to cover the cans, while on the road, with a wet blanket or canvas.
MILK, BUTTER AND CHEESE

BUTTER MAKING.

Milk should be separated in pure air and as soon after it is drawn as possible. When thus separated there is no heating required and the skim milk is of greater value than when thoroughly cooled and re-heated before being fed. Skim milk from the separator may need some heating before being fed to calves, but the fresher it is the better. The separator should not be placed near the cattle where the atmosphere is dusty and foul, but preferably in a separate building reasonably remote.

The separator, like the other dairy utensils, should be cleaned after every using as previously described; first, by rinsing all parts with cold or tepid water, then by washing the different parts with warm water, using some kind of an efficient washing compound in the water; third, by rinsing again and lastly by thoroughly scalding or steaming the parts. Flushing the bowl until the water runs from it clear is not sufficient cleaning and when this is the practice only evil results can be expected. The separator should be be well washed every time it is used. A brush is better than a cloth for washing utensils as all corners and seams can be reached by it.

CARE OF CREAM.

The care of cream is a very important part of dairy work and it can be truly said that most of the poor butter found upon our markets is due to neglect along this line.

A cream containing 35 or 40 per cent fat is preferable to too thin or too thick a cream. Too thin a cream is likely to cause slow, difficult churning with a large loss of fat in the butter milk, while the same loss is likely to occur through too thick a cream.

As soon as the separator stops the temperature of the cream should be reduced to 45 or 50 degrees and held there in a pure atmosphere until ready to ripen, which is within two or three days at the most. Cream kept in cellars, kitchens, smoke houses, etc., will absorb undesirable odors. There is a tendency to keep cream too long when the weather and roads are bad. When cream is kept too long, even at low temperatures, it will not make good butter and should be paid for according to its merits. The butter maker will find it a good practice to keep and churn all poor cream by itself and pay the patrons who furnish it only what it will bring
when made into butter. The result of educating the patrons to better ways and methods of handling their cream will pay for the extra labor required.

Warm cream should never be mixed with cold cream; when cool and ready to ripen the temperature of the whole should be brought to 70 degrees after which a thorough mixing should take place. No cream should be added during the ripening process. To secure a uniformly ripe cream it should be stirred occasionally during the ripening process. There is likely to be a large loss of fat in the butter milk when cream of uneven ripeness is churned.

Pasteurizing destroys germ life and helps in getting rid of bad odors and flavors, but it cannot change old, poor-keeping, bad-flavored cream to good cream. Cleanliness at every point in dairy-work is more important than pasteurization, but they should go hand in hand.

THE STARTER.

In ripening cream, i.e., souring it, getting it ready for churning, the most important thing is a starter which will produce a good flavor in the cream. When milk is drawn under clean conditions and thus kept, and the cream from it ripened with good starters, the action of the lactic acid ferment, which produces good flavors, is not hindered by the action of ferments that produce undesirable flavors, and a sharp pleasant flavor in the cream is produced; but when the milk is drawn under dirty conditions, kept in dirty utensils and the cream from it ripened with poor starters, the action of the lactic acid ferment is held in check and the result is a cream productive of a bad-flavored, poor-keeping butter. If cream is of poor flavor, there is all the more reason why a good starter should be used.

A starter may be sour skim milk or sour butter milk, put into the cream to ripen it. Butter milk should be used only when it is of good quality. A butter milk starter from poor butter will produce poor butter and the trouble may be thus carried from churning to churning and be a great annoyance for months. The skim milk starter is the more desirable. The milk, to begin with, should be clean, free from undesirable bacteria and taken as it runs from the separator. The vessel in which the milk is to sour should be well washed and thoroughly scalded. After filling the vessel with milk, cover it closely to keep out dirt and heat to 85 degrees by placing it in warm water. If this temperature is maintained for
twenty-four hours, the milk should then be well soured and ready for use. It should not be too thick or possess objectionable flavor, but should have a pleasant sharp taste.

If, for any reason, milk from the whole herd cannot be used for a starter, then milk drawn under clean conditions from one cow may be run through the separator and handled as described above.

Commercial starters which are pure cultures of bacteria may be used in sterilized or pasteurized skim milk and will repay for all outlay and trouble if a fair quantity of butter is made. By the use of these starters it is possible to secure better prices.

CLEANLINESS IN THE FACTORY.

The factory man should be scrupulously clean. He should clean all factory utensils, including churns, vats, etc., in the manner described above and thoroughly steam them every time they are used. Sewers are often a source of offense and should be looked to closely. They should be well cleaned every day. The factory should always be clean, fresh and wholesome Nothing can take the place of cleanliness in handling milk and cream.

THE CHURN AND ITS CARE.

Any wooden revolving churn without inside fixtures will be satisfactory. Paddle, dash, "whole milk humbug" churns and the like are not recommended. They injure the texture of the butter and give a heavy loss of fat in the butter milk.

The size of the churn depends upon the amount of cream to be handled. The churn should never be over half full.

The churn should be well scalded and cooled down with cold water before the cream is put in. When the churning is complete and the butter removed from the churn the latter should be first scalded, then scrubbed inside and out in the same manner as other dairy utensils, and finally well rinsed with clean, cold water. Leaving the churn partially filled with water will prevent it from drying out and from opening on bottom and sides.

PREPARING THE CREAM FOR THE CHURN. The cream when ready to churn should have a good consistency but not too thick. A sweet cream containing about 35 to 45 per cent fat ripened for eighteen to twenty-four hours with a 15 to 20 per cent starter will possess about the right consistency.
The temperature at which to churn depends upon such factors as season of the year, character of food, stage of lactation, individuality of cow, etc. Churn at as low temperature as possible and have the butter come in a reasonable length of time. (A reasonable length of time would be about forty-five minutes.) A quick churning at a high temperature produces soft butter and gives a large loss of fat in the butter milk, while the opposite is true of slow churning at a low temperature. In the Agricultural College dairy the average winter temperature is 52-56 degrees F., and the average summer temperature 48-52 degrees F. In winter the cows usually receive lucern hay, bran, shorts and roots or beet pulp, and in summer they are on pasture. By use of a thermometer bring the cream to a churning temperature an hour or two before the churning begins. Always use a thermometer; never guess at the temperature.

**Speed of Churn.** The speed of the churn will vary at times but should be such as to give a good dash of considerable rapidity to the cream. Too rapid or too slow a speed will give a slow churning.

**Coloring the Butter.** The amount of butter color to use will depend mainly upon the consumer. In winter when the cows are on dry feed more color is needed than in summer when they are on green grass. Standard butter color is harmless and should be added after the cream is weighed and placed in the churn. Ascertain the degree of color that the market demands and then by varying and noting the amount of color used the right shade can be secured. It is only by weighing the cream that the correct amount of color and salt to use can be determined.

**Stopping the Churn.** The churn should be stopped when the granules of butter are the size of large wheat kernels and are separated well from the butter milk. Take the temperature of the butter as soon as the churn stops and draw off the butter milk through a strainer. If the temperature is right and the butter comes in a very fine, granular condition and does not gather, add a little salt or brine. If the temperature is too low warm up the cream a few degrees. When the butter comes too soft, add some cold water as it breaks.

**Washing the Butter.**

Add water to the churn until the butter floats well. The temperature of the wash water should not be over four or five degrees
lower than the temperature of the butter. If the water is too cold the butter granules will be hard outside and soft inside. Butter in this condition does not take salt well and will be mottled. Butter should never receive more than two washings as washing takes out the flavor. The second wash water should run from the churn nearly clear and be one or two degrees colder than the first wash water. To wash the butter revolve the churn slowly five or six times.

SALTING THE BUTTER.

Use only good grades of salt. The salt may be added to the butter in the churn or the butter may be spread on the worker and the salt sprinkled over it. In either case the butter granules should be preserved as much as possible until by the careful use of the ladle, the salt is well distributed. After the salt has been added, work until the butter begins to gather and then let stand for about an hour, until the salt is thoroughly dissolved. If the butter has been salted in the churn revolve the latter a few times to distribute the salt.

Use one ounce of salt to every unworked pound of butter, unless the market demands otherwise. Weigh the butter until the ratio between the pounds of cream churned and the pounds of butter made has been determined. After this the pounds of butter can be approximately determined from the weight of the cream. Always weigh the salt.

WORKING THE BUTTER.

The object of working the butter is to expel excessive moisture, to incorporate salt and to give a firm body. Over-working injures the grain of the butter and makes it greasy. There is more danger of over-working than under-working. Work until the butter breaks with a clean break and not until it pulls out in threads.

FINISHING THE BUTTER.

Carefully mould the butter into neat, one-pound, prints and wrap it in strong parchment paper made for this purpose. Make the prints as attractive as possible and handle carefully when packing. Keep the butter in a cool place and sell it while fresh. Aim to make the best butter in the State.
CHEESE MAKING.

The most important factor in making cheese is to have good, sweet milk, free from all odors and dirt. In securing milk for cheese the methods given in the fore-part of this bulletin regarding the care of milk should be rigidly adhered to.

DETECTING GASSY MILK.

Almost invariably some patrons will bring poor milk and the operator should find out which ones furnish the bad milk. One patron alone may be the cause of all the cheese being bad and gassy. The operator should see that the trouble does not originate in the factory.

The best and only way to detect bad milk is to apply the “Wisconsin Curd Test.” Take nearly a pint of milk from the cans of each suspected patron; after stirring thoroughly heat uniformly to about 85 degrees F. and then add ten drops of rennet to each sample of milk. Maintain a constant temperature and as soon as the milk thickens cut and stir as in ordinary cheese making, keeping they whey poured off. Mason jars or ordinary tin fruit cans may be used for this purpose. Allow the curd to mat and after a few hours note its flavor and condition. If gas germs are present it will show by the pin hole condition of the curd. If only tainted it can readily be detected by the smell. All gassy and tainted milk should be rejected. In making this test the milk should not be too sour.

HEATING THE MILK AND MAKING THE RENNET TEST.

After the milk has all been carefully examined, weighed and placed in the vat, heat to 86 degrees F. and stir thoroughly. In order to determine the progress of the fermentation changes in the milk apply the rennet test. Secure a Marshall apparatus which consists of a quart cup with a small glass tube in the bottom and graduation on the inside, a 1 cc. pipette, a small bottle and a spatula. The graduation inside the cup is from 0 to 9. Put 1 cc. of rennet into the bottle and dilute with water to the mark on the outside of the bottle. Place the cup on the edges of one corner of the vat and fill it with milk from the vat. When the milk has receded to the zero mark add the rennet and stir rapidly for a few moments. The
distance the milk recedes from zero before it thickens and stops running from the hole in the bottom of the cup is a measure of its condition.

The action of the rennet depends upon its strength, the amount used, the temperature and acidity of the milk. The rennet test is only a guide as to the condition of the milk and by its daily use the operator can have his milk in about the same condition at time of setting and will know approximately how long to hold the curd in the whey to get a proper cook and thus have his work uniform from day to day.

If the milk is not sufficiently sour after the rennet test has been made, a pure, wholesome starter of two to six per cent should be added. The test will show when the proper degree of ripeness has been reached. The starter is very important as the quality of the cheese made depends largely upon it. A poor starter will produce poor cheese though the milk may be of first-class quality. A good starter intelligently used in milk possessing abnormal fermentation will lessen the dangers from such, but the results are more or less unsatisfactory. The most satisfactory results can be secured only through good milk and the intelligent use of starters.

COLORING THE CHEESE.

The color to give cheese depends upon the market. Three-fourths of an ounce to 1,000 pounds of milk will give the desirable light straw color. The color should be diluted and well stirred into the milk before the rennet is added. Standard color in small quantities used in cheese is harmless.

ADDING THE RENNET.

The amount of rennet to use depends upon its strength and the kind of cheese made. Ordinarily three ounces of standard rennet to one thousand pounds of milk, with a rennet test of \( 4\frac{1}{2} \), will thicken the milk and have it ready for the knife in about twenty-five or thirty minutes, and will produce a rather slow curing cheese; one that will cure in not less than six weeks, depending largely upon the amount of salt used and the temperature of the curing room.

Dilute the rennet with cold water to five or six times its volume and then pour evenly into the vat from one end to the other. Stir the milk thoroughly just before, and gently for a few minutes
immediately after, adding the rennet. The last stirring should be only on the surface and all currents should stop before the milk begins to thicken.

**CUTTING THE CURD.**

Ordinarily the curd will be fit to cut in twenty-five to thirty-five minutes from time of adding the rennet. It is fit to cut when it will break clean across the finger leaving clear whey in the break. The cutting should be done quickly and carefully with horizontal and perpendicular curd knives. Cut lengthwise of the vat with horizontal knife, then with the perpendicular knife and then crosswise with the perpendicular knife. To insert the knives bring them nearly parallel to the surface of the curd with the handle ends resting on the end of the vat and then swing them down into the curd to the bottom and parallel to the end of the vat. To turn the knife in the curd swing it on end of its edge toward the uncut curd through an angle of 180 degrees, bringing it parallel against the end of the vat.

**HEATING THE CURD.**

The heating is to contract the curd and to expel the whey. After cutting the curd it should be gently stirred for five or ten minutes by hand, before heat is applied, to keep it from settling and matting in the corners and cooking on to the sides of the vat. The curd should be rubbed from the sides and bottom of the vat with the flat hand.

After this has been done the temperature should be raised slowly and gradually to 98 degrees F., one degree in three to five minutes, taking 40 to 60 minutes for it. If the heating is too rapid the curd particles will cook on the outside, thus holding the whey on the inside, and will be productive of a "whey soaked" cheese. The stirring should be kept up until the curd is cooked. After the temperature has reached 93 or 94 degrees a wooden hay rake can be used to stir with but the cheese settled in the corners will have to be put to moving by the bare hand. Rough handling of the curd will produce losses of fat in the whey. The whey should have a clear color, not oily and specky.

If the milk is over-ripe, as shown by the rennet test, cut finer,
heat four to ten degrees higher and stir more rapidly. If this is not done, too much acid will have developed before the curd is properly cooked.

**DRAWING OFF THE WHEY.**

It is very important to know just when to draw off the whey. This is determined by the amount of acid that has developed. There should be one-eighth of an inch of acid on the curd when the whey is drawn and the curd should be of such a nature that when pressed in a double handful and released the particles will readily fall apart. In using the iron have it clean and of the proper temperature; squeeze the curd in one hand firm and dry and then press it firmly to the iron. Draw the curd from the iron slowly and fine threads one-eighth of an inch long should show. When the proper degree of acidity has developed draw off the whey and place the curd on a rack, covered with a large, linen strainer cloth, in one end of the vat, until it is thoroughly drained.

If too much acid has developed work the cheese quite dry when dipped, or in bad cases, wash it with water at 98 degrees F. If washing is necessary draw off the whey down to the curd and then add water.

**MATTING, CUTTING INTO BLOCKS AND TURNING.**

After the curd is sufficiently dry let it mat on the rack about six inches deep and cover with the free ends of the cloth to maintain the proper temperature. In fifteen or twenty minutes the curd will have matted and should then be cut into large blocks and turned over a few times before piling. The whey should be kept drained off and an even uniform temperature of 95 degrees maintained. Do not break or tear the blocks of curd in handling them and place the exposed pieces on the inside.

**GRINDING.**

After the curd has been piled for some time it will become fibrous and flaky or meaty and will show three-fourths to an inch of acid by the hot iron test. It is now ready to grind. The most satisfactory curd mills are those that cut rather than tear.
SALTING.

After the curd is cut it should be stirred about every fifteen minutes until the particles become soft and silky and when the curd is squeezed in the hand fat, not clear whey, escapes between the fingers. It is then ready to salt.

The amount of salt to use will depend upon the kind and condition of the cheese that is being made. A quick curing cheese requires less salt than a slow curing one. Ordinarily two and one-half to three pounds of salt to one thousand pounds of milk will be sufficient, the exact amount depending upon the moisture of the curd. A moist curd should receive more salt than a dry one, and fine salt of large crystals should be used and be evenly distributed over the curd. The curd should be stirred about every ten minutes until the salt is thoroughly dissolved and worked into it. Salt extracts the moisture, adds flavor and checks fermentation.

PRESSING.

The curd is ready to press as soon as the salt is thoroughly dissolved. By this time the temperature of the curd should be 80 or 85 degrees F. If put to press when too warm fat will be lost and if too cold the cheese will not close well.

The curd should be weighed equally into the hoops and gentle pressure applied at first so as not to force out fat. Full pressure may be applied after fifteen or twenty minutes. After the cheese has been subjected to full pressure for an hour or more it is taken from the press, dressed and put back for fifteen or eighteen hours.

CURING.

This is very important. The curing room should have a constant uniform temperature of sixty to sixty-five degrees F., and the moisture and ventilation should be controlled. The air of the curing room should be kept moving and have as much moisture as it will hold without causing the cheese to mould. Place the cheese on the upper shelves and then turn them over every day for two or three weeks, after which time they may be turned over every other day. Because of the difference in temperature between the upper and lower portions of the curing room the older cheese should be kept on the lower shelves.
MARKETING.

Cheese should not be marketed under six weeks. If kept to this age or longer it will find a better market and give better satisfaction than if sold as soon as out of the press.

GASSY MILK.

Gassy milk is very troublesome and is usually caused by a germ that gets into the milk after the milk is drawn. It is the cause of floating curds and "huffy, pin-holey cheese." This germ, like most others, increases rapidly under favorable conditions, and, though the number of germs present in the milk may be few, they soon multiply and the milk in a few hours or minutes may be unfit for cheese. Gassy milk gives unsatisfactory results at best.

Cheese from gassy milk may be improved in quality by the following treatment:

Use a good starter and develop more than the ordinary amount of acid before setting; cut fine and heat a little higher than usual and dip when one-fourth inch of acid shows. Allow the curd to mat thoroughly on the racks, pile eight or ten pieces high and turn often. This maintains the proper temperature, 98 degrees, flattens out the gas holes and aerates the curd. Cut the curd fine, if necessary, by putting it through the mill twice and stir and aerate until the gas holes disappear.

Gassy curds may be washed but such treatment is not desirable and usually not necessary.
Realizing that there was a field in canning cheese, several experiments along this line, extending over two years, were carried out, the results of which are given in this bulletin.

The cheese was manufactured in the way previously described in this bulletin, care being taken that the milk be of good sanitary quality, and free from gas germs.

In the beginning the curd was pressed in the cans, which were lined with parchment paper, and was allowed to drain well before being sealed. The cans were thoroughly cleaned before using. Later trials proved that the better way was to press in common moulds and to paraffin the inside of the cans before filling them. The cans were paraffined by placing some paraffin (cheese coating) in them, setting them in hot water until the material melted, and then, after revolving them rapidly, pouring out all the paraffin that did not adhere, into another can. Cans not paraffined corroded and some of them could not be used the second time, while the well paraffined cans were as bright after being used as before. The cheese should fit snugly into the can, but not too tight, and should come out easily.

The cans used varied in size, holding from five to thirty pounds of cheese. They were made and sealed by a local tinner; the smaller size cost fifteen cents, and the larger thirty-five cents each. The price of the cheese was increased from one to three cents per pound by canning. Cans made of low grade tin (I. C. quality) served as well as those made of higher grades, the only trouble experienced was caused by some of the cans not being sealed air tight and the cheese deteriorating in quality.

The cans should be examined often for air leaks.

A great advantage in canning cheese is that very little attention is required during the curing and that there is no loss in weight by drying, moulding or from rind. Canned cheese needs to be consumed quickly after opening as it tends to mould.

The scoring of the cheese was done by the writer, Prof. F. B. Linfield of the Montana Agricultural College and his assistant, Mr. W. J. Elliott, and the scores given in this bulletin are designated as Montana, Utah and Average. In order that the scoring
be impartial the samples were designated by numbers, which were unknown to the parties who did it.

The first cheese canned was held for four months at a temperature of 50, 60 and 70 degrees Fahrenheit, and the Montana score was 93, 93.75 and 92 respectively. Prof. Linfield's report on this cheese was that it appeared "to have been of good, smooth, firm-bodied curds."

Another lot of cheese was made, only a part of which was canned, the rest being put in the ordinary way and cured at a temperature of about 60 degrees F. for comparison. Four months later the average scores on the canned cheese were 88 and 93 and the uncanned cheese 93 and 96.5. The canned cheese when opened was lighter in color than the other.

In another trial three cheeses weighing about thirty pounds each were made; one was canned the day after it was made, another one week later and the third two weeks later. This cheese was kept at an average temperature of 67 degrees F. for four months, at the end of which time the average scores were 96.25, 94.5 and 95.8. This cheese was sold at the local stores and gave good satisfaction. Since first placing canned cheese on the market a light local demand for it has sprung up.

Five experiments were carried out in which canning, paraffining and ordinary curing were compared. The results have been averaged and are given in the following table:

**TABLE I.**

<table>
<thead>
<tr>
<th>Number of Trials</th>
<th>Age of Cheese (days)</th>
<th>Total Wt. of Green Cheese</th>
<th>Total Wt. of Cured Cheese</th>
<th>Loss Lbs.</th>
<th>Per cent Loss</th>
<th>Temperature</th>
<th>% Moisture in Curing Room</th>
<th>Av. of Montana score</th>
<th>Av. of Utah score</th>
<th>Av. of Total Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canned .........</td>
<td>5 106 ........ *</td>
<td>None</td>
<td>None</td>
<td>65</td>
<td>65</td>
<td>94</td>
<td>92.6</td>
<td>93.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paraffined ........</td>
<td>5 106</td>
<td>141.5</td>
<td>133.6</td>
<td>7.9</td>
<td>5.5</td>
<td>65</td>
<td>93.3</td>
<td>92.4</td>
<td>92.8</td>
<td></td>
</tr>
<tr>
<td>Unparaffined ....</td>
<td>5 106</td>
<td>139.7</td>
<td>127.6</td>
<td>12.1</td>
<td>8.6</td>
<td>65</td>
<td>93</td>
<td>93.6</td>
<td>93.3</td>
<td></td>
</tr>
</tbody>
</table>

*Deducted weight of paraffin.

As can be readily seen canned cheese, after ninety days curing, compared well in quality with paraffined and unparaffined cheese, there being no loss from evaporation, which in the case of the paraffined and unparaffined amounted to 5.5 and 8.6 per cent respectively. According to above figures, unless the cost of canning be reduced there is nothing gained by it other than the ease in curing.
The claim is made that paraffining cheese increases the quality, reduces the losses in curing and protects from mould, mice and vermin, etc. As no investigations known to the writers have been made along this line in the West, where arid conditions exist, a few experiments were carried out, the results of which are reported below. The process consisted of dipping the cheese for a moment in liquid paraffin, heated to a temperature of 190 to 200 degrees F. The paraffin, commercially called cheese coating, used in this work was secured through a local creamery at thirteen cents per pound and was especially prepared for this purpose, being of a "cheese yellow" color and melting readily by the use of hot water. It came in twenty-pound blocks. These blocks were broken up and placed in a galvanized tub surrounded by boiling water where they soon melted. The dipping apparatus consisted of four pieces of ordinary light flexible wire about four feet long placed parallel to each other and four inches apart. Each parallel wire consisted of three sections. The center section was eighteen inches long and the two end sections about twelve. The ends of these wires were fastened to two round pieces of wood about eighteen inches long and parallel to each other. After immersion the cheese was held for just a moment above the hot liquid to drain. *A more satisfactory, but more expensive apparatus, can be constructed in which a derrick and tackle are employed.

The following table gives the results of a number of trials in which paraffined cheese was compared with unparaffined cheese.

**TABLE II.**

<table>
<thead>
<tr>
<th></th>
<th>No. of Trials</th>
<th>Lbs. Loss</th>
<th>Per Cent. Loss</th>
<th>Av. of Montana score</th>
<th>Av. of Utah Score</th>
<th>Av. of Total Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paraffined</td>
<td>8</td>
<td>5.6</td>
<td>3.7</td>
<td>91.9</td>
<td>91.45</td>
<td></td>
</tr>
<tr>
<td>Unparaffined</td>
<td>8</td>
<td>11.4</td>
<td>7.6</td>
<td>94.2</td>
<td>93.95</td>
<td></td>
</tr>
</tbody>
</table>

This cheese was cured for three months at a temperature of 65 degrees F. The paraffined cheese lost only 3.7 per cent in curing. *Michigan Bulletin No. 21.
and scored 91.4, while the unparaffined lost 7.6 per cent and scored 93.9. The difference in quality was in favor of the unparaffined cheese and the loss in favor of the paraffined.

During the summer of 1904 cheese were placed in curing room and in cold storage. The main object of this experiment was to note the effect of age, temperature and moisture on quality and loss of paraffined and unparaffined cheese. The cheeses were all of one make and were furnished by a local factory.

The following table gives the results of this experiment:

**TABLE NO. III.**

<table>
<thead>
<tr>
<th>Age when Scored</th>
<th>Kind of Cheese</th>
<th>Where Cured</th>
<th>Temperature</th>
<th>Per cent Moisture</th>
<th>Montana Score</th>
<th>Utah Score</th>
<th>Average Score</th>
<th>Per cent Loss in Curing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Mos.</td>
<td>Paraffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unparaffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paraffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unparaffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three Mos.</td>
<td>Unparaffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>83</td>
<td>89</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paraffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>88</td>
<td>87</td>
<td>87.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unparaffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>91</td>
<td>93</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paraffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>94.5</td>
<td>95</td>
<td>94.75</td>
<td></td>
</tr>
<tr>
<td>Four Mos.</td>
<td>Paraffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Unparaffined</td>
<td>Curing Room</td>
<td>65</td>
<td>65</td>
<td>88</td>
<td>91</td>
<td>89.5</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Paraffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>94</td>
<td>92</td>
<td>93</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Unparaffined</td>
<td>Cold Storage</td>
<td>56</td>
<td>86</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>5.8</td>
</tr>
</tbody>
</table>

The conclusions from this table are that the cheese kept in cold storage scored higher than cheese kept in the curing room and that the quality increased with the age. Here as in Table I and II, unparaffined cheese scored higher than the paraffined, which may be due to the variety of the cheese. Paraffined cheese in cold storage lost 2.1 per cent in the curing against 3.2 per cent in the curing room, while unparaffined cheese in cold storage lost 5.8 per cent against 6.6 per cent in the curing room.

In twelve trials the weight of cheese before paraffining was 25.03 pounds and after paraffining 25.27 pounds. Therefore, .96 pounds of paraffin was required for one hundred pounds of cheese at a total cost of 12.5 cents.

According to Tables I and II the paraffined cheese lost, on an average, 3.5 per cent less in the curing than the unparaffined.
Therefore, there would be a saving of 22.5 cents per hundred, cheese selling at ten cents per pound, by paraffining cheese and cur­ing it for ninety to one hundred days at ordinary temperature.

**COMPARISON OF THE BABCOCK WITH THE CHEMICAL TESTS FOR DETERMINING THE BUTTER FAT IN SKIM MILK.**

In testing skim milk about one-fourth more acid should be used and the tester run at a higher speed and several minutes longer than usual. By taking these precautions the test will show a much higher per cent of fat than is ordinarily secured. At best, the Babcock test will give too low a reading of fat as shown by comparison with chemical analysis in the following table.

The following table shows the per cent of fat in skim milk as determined by the Babcock test and by chemical analysis:

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>BABCOCK TEST.</th>
<th>CHEMICAL ANAL.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Double Neaked Bottle)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.12</td>
<td>.184</td>
</tr>
<tr>
<td>2</td>
<td>.10</td>
<td>.163</td>
</tr>
<tr>
<td>3</td>
<td>.12</td>
<td>.200</td>
</tr>
<tr>
<td>4</td>
<td>.17</td>
<td>.371</td>
</tr>
<tr>
<td>5</td>
<td>.09</td>
<td>.249</td>
</tr>
<tr>
<td>6</td>
<td>.10</td>
<td>.212</td>
</tr>
<tr>
<td>7</td>
<td>.12</td>
<td>.200</td>
</tr>
<tr>
<td>8</td>
<td>.14</td>
<td>.253</td>
</tr>
<tr>
<td>9</td>
<td>.20</td>
<td>.204</td>
</tr>
<tr>
<td>10</td>
<td>.06</td>
<td>.200</td>
</tr>
<tr>
<td>11</td>
<td>.07</td>
<td>.120</td>
</tr>
<tr>
<td>12</td>
<td>.06</td>
<td>.190</td>
</tr>
<tr>
<td>13</td>
<td>.08</td>
<td>.158</td>
</tr>
<tr>
<td>14</td>
<td>.08</td>
<td>.116</td>
</tr>
<tr>
<td>15</td>
<td>.07</td>
<td>.150</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>100</strong></td>
<td><strong>198</strong></td>
</tr>
</tbody>
</table>

The difference between the Babcock test and chemical analysis is usually much greater than the above table indicates owing to the precautions that were previously mentioned in these trials to secure an exhaustive Babcock test.
COMPARISON OF DIFFERENT TEMPERATURES OF MILK WITH VARIATIONS IN SPEED OF SEPARATOR BOWL IN THE SEPARATION OF MILK.

Owing to the widely different conditions under which the average farmer runs his cream separator a few tests were made with hand machines in which the conditions were varied. The object was to ascertain the amount of loss of fat in the skim milk. Four different makes of separators were used and the results were combined.

The following table gives the amount of fat left in the skim milk when the temperature of the milk, the speed of the separator bowl and the capacity of machine were varied.

<table>
<thead>
<tr>
<th>CONDITIONS UNDER WHICH MACHINE WAS RUN.</th>
<th>No. of Trials</th>
<th>Per cent of fat left in skim milk by Babcock test.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper conditions</td>
<td>14</td>
<td>.028</td>
</tr>
<tr>
<td>Cold milk and proper speed of bowl</td>
<td>17</td>
<td>.35</td>
</tr>
<tr>
<td>High temperature of milk and proper speed</td>
<td>16</td>
<td>.017</td>
</tr>
<tr>
<td>Cold milk and low speed</td>
<td>14</td>
<td>.44</td>
</tr>
<tr>
<td>Cold milk and high speed</td>
<td>11</td>
<td>.38</td>
</tr>
<tr>
<td>High temperature and low speed</td>
<td>14</td>
<td>.06</td>
</tr>
<tr>
<td>Proper temperature and low speed</td>
<td>12</td>
<td>.08</td>
</tr>
<tr>
<td>Proper temperature and high speed</td>
<td>10</td>
<td>.015</td>
</tr>
<tr>
<td>High temperature and high speed</td>
<td>15</td>
<td>.014</td>
</tr>
<tr>
<td>Capacity fluctuating</td>
<td>6</td>
<td>.12</td>
</tr>
</tbody>
</table>

The poorest skimming was done with cold milk and low speed, under which conditions .44 per cent of fat was left in the skim milk as determined by the Babcock test. Chemical analysis would doubtless have shown this still larger, probably about .84 per cent. (See Page 132.) With milk containing 3.8 per cent fat this is 22 per cent of the total fat.

The closest skimming was secured by high temperatures and high speed. The former cannot be secured on most farms and the latter is hard on both the machine and the operator and is therefore impracticable.
Varying the capacity by rate of inflow gave a high per cent of fat in the skim milk.

The most satisfactory skimming was secured when the milk had a temperature of about 85 degrees F. and the separator operated according to the directions of the manufacturers. A great deal of the dissatisfaction between patron and creamery is often due to the way the hand separator is cared for and operated. Cold milk too much fat in the skim milk.

If the skim milk is occasionally carefully tested a great deal of dissatisfaction will be dispelled.

**SUMMARY.**

1. Canned cheese after ninety days curing compared well in quality with paraffined and unparaffined cheese, and suffered no loss from evaporation, which, in the case of the paraffined and unparaffined cheese, amounted to 5.5 and 8.6 per cent respectively.

2. Paraffined cheese cured for three months at a temperature of 65 degrees lost 3.7 per cent in the curing, while the unparaffined cheese lost 7.6 per cent.

3. Unparaffined cheese scored a little higher than the paraffined, but not enough to overcome the other advantages of paraffining.

4. The cost of paraffining one hundred pounds of cheese, excluding the cost of labor, was $12 1/2 cents. The saving effected thereby, cheese selling at ten cents per pound, was $22 1/2 cents per hundred.

5. Cheese lost the least in curing and scored the highest when cured in cold storage.

6. The quality of cheese increased with the age up to four months.

7. In comparing the Babcock test with chemical analysis for testing skim milk, the former showed one-tenth of one per cent fat present, while the latter showed nearly two-tenths. In testing skim milk about one-fourth more acid should be used and the tester run at a higher speed and longer than usual.

8. A large amount of fat may be lost in using the hand separator under improper conditions. In 14 trials with cold milk and a low speed, as high as twenty-two per cent of the total fat was lost.
The following literature can be obtained from most agricultural journals on receipt of price.

BOOKS.

Milk and Its Products—Wing .................. $1.00
Testing Milk and Its Products—Farrington & Woll ................................. 1.00
Outlines of Dairy Bacteriology—Russell ........ 1.00
Cheese Making—Decker: .......................... 1.75
Elements of Dairying—Decker ..................... 1.00
Chemistry of Dairying—Snyder .................... 1.50
Creamery Patrons' Handbook ...................... 1.00
Creamery Accounting—Vye ........................ 1.00
Feeds and Feeding—Henry ......................... 2.00
Feeding Farm Animals—Jordan .................... 1.50

DAIRY PAPERS.

Hoard's Dairyman, Fort Atkinson, Wis., (weekly) ........................................ $1.00
Kimball's Dairy Farmer, Waterloo, Iowa, (semi-monthly) .................................. 1.00
Dairy and Creamery, Chicago, Ill., (semi-monthly) ........................................... .50
The Live Stock and Dairy Journal, Fresno, Cal., (monthly) .................................... 1.00

CREAMERY PAPERS.

Creamery Journal, Waterloo, Iowa, (monthly) $1.00
Chicago Dairy Produce, (weekly) ................ 1.50

NOTE:

Courses in dairying are given in practically all agricultural colleges. The Agricultural College at Logan gives an eighteen weeks' course in home and factory dairying, and a special four weeks' course in the winter. Particulars regarding the courses can be had by applying to the Agricultural College, Logan, Utah.