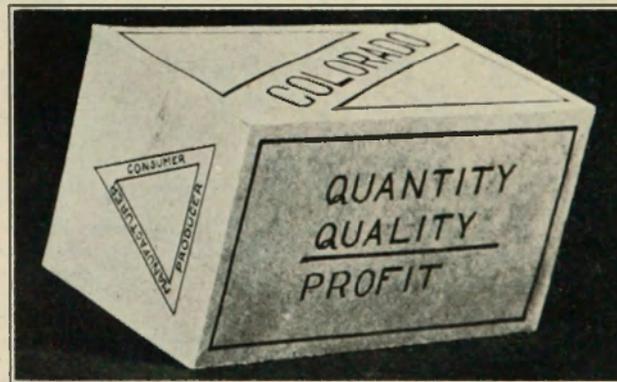


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TESTING AND HANDLING OF MILK
AND CREAM



BY

R. McCANN

Deputy Dairy Commissioner

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TESTING AND HANDLING OF MILK AND CREAM

By R. McCann, Deputy Dairy Commissioner

INTRODUCTION

The use and understanding of careful, uniform methods of testing and handling milk and cream by the producer and receiver has led the advance of the dairy industry to higher planes and to broader fields wherever practiced. To secure uniform and accurate methods of testing and bring about a mutual understanding of the producer's and receiver's problems has been the aim of this bulletin.

The dairyman should know the requirements and rules of the receiving stations for his own protection and the advancement of his industry. The station operator should know and help solve the problems confronting the producers of the cream which he is handling.

Co-operation for the advancement of all concerned will work wonders in effecting changes of great economic importance to the dairy world of Colorado.

HERD TESTING

Dairying, when properly conducted, is one of the most profitable lines of farming. But as a rule the average dairyman neither knows nor suspects the amount of profit or loss from each cow in his herd. It is not the large amount of money taken in, but the money that stays in the dairyman's pocket, which counts. Every cow must eat whether she produces much or little and she can bring no profit to the owner until she has first paid for her board.

To advance in dairying, herd improvement must go on. Elimination of low producing animals is without doubt the first step toward herd improvement, and this elimination cannot be successfully accomplished unless records of the milk production of each cow are systematically kept.

The only way to know how much a cow produces in a year is to weigh her milk at each milking and find its per cent of butter fat by the Babcock test. This should be done two days of every month, the middle two days of each month being preferable. Along with such records of production it is at least desirable, if not absolutely essential, that a record of food consumed be kept as well.

To facilitate the tabulating of such tests and weights as are necessary for the keeping of records, especially prepared sheets will

be supplied upon application, either by the State Dairy Commission or the Dairy Division of the U. S. Department of Agriculture, Washington, D. C.

The equipment needed for running tests for a small dairy herd, with the cost, is given below:

One automatic milk scale (30-lbs. capacity).....	\$3.50
On 4-bottle Babcock tester, with necessary glassware for milk.....	5.00
One dairy thermometer.....	.25
Sulphuric acid.....	
	\$8.75

A large covered tester may be had without glassware equipment at prices ranging from the 6-bottle size at \$9.00 to a 12-bottle size at \$14.00. Where many tests are to be run at once, it is a saving of time to have the larger machine.

If cream is to be tested, scales for weighing the tests are required, which cost from \$4.50 to \$12.00 for the one bottle size. Cream bottles will also be needed, which will cost \$1.00 for four, or additional glassware needed for making cream tests may be included in the order for the 4-bottle Babcock tester for an added cost of 50 cents.

Complete directions for running milk tests will be found on page 5.

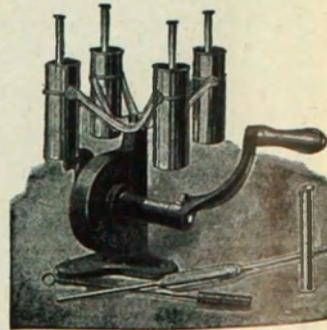
Approximate cream tests may be made by measuring the cream into cream test bottles by the use of a 9 c. c. or an 18 c. c. pipette instead of weighing. In this case the pipette should be rinsed out and the rinsings transferred to the test bottle, or the test will be too low.

If cream is measured into the test bottles, care should be taken that the cream when measured is not in a foamy condition. Cream from the centrifugal separator should not be measured into the test bottle immediately after separation as such cream contains considerable foam. It should be understood, however, that cream



Milk scale.

tests made by measure are only approximate and are not as accurate as the weight measure tests. This method is given only for testing on the farm where cream is not bought or sold upon tests made, and test scales are not at hand. Such a method will serve as a rough check upon creamery tests, and then if sweet cream is sold for direct consumption, it is desirable to know the proper richness of the cream.



Babcock tester for a small herd

MILK TESTING.

The method of operating the Babcock test when determining the amount of fat in milk, is here given in brief outline by steps:

1. Mix thoroughly sample of milk which is at 65 degrees to 70 degrees F.
2. Fill pipette to mark with milk at once.
3. Run milk into test bottle from pipette.
4. Fill acid measure to mark with acid and pour into test bottle
5. (1) Mix milk and acid thoroughly by rotary motion; (2) let stand one to three minutes; (3) mix again.
6. Whirl four minutes at proper speed.
7. (1) Add water up to neck of bottle of 170 degrees F., whirl two minutes; (2) add 170 degrees F. water to within the two or three percent mark of top, and whirl one minute.
8. Read results at temperature of 120 degrees to 130 degrees F.

The sampling of milk is the most important operation of the test. Unless the sample is representative of the milk from which it is taken, the result of the test cannot be correct. Thorough mixing before taking a sample or a test from a sample, is absolutely necessary and always the first step toward accurate results in testing. Pouring from one vessel to another is the best method of mixing.

Care of Milk Samples.—Samples of milk should be placed in airtight receiving jars, if the sample is to be left any length of time before testing. Tight sealing prevents evaporation. Should evaporation take place, the per cent of fat increases causing inaccurate tests.

Milk samples should not be permitted to sour before testing, as souring causes lumps of curd to form which require extra care in dissolving before testing. Souring may be prevented by keeping in a cool place or by use of some preservative, as formaldehyde or corrosive sublimate. When preservatives are added the sample should be shaken gently to insure mixing. One corrosive sublimate tablet will preserve one pint of milk for more than a week.

Composite Samples.—Composite samples of milk or skim milk are taken the same as for cream, and the tests run according to directions given for whole or skim milk.

METHOD OF MAKING THE TEST

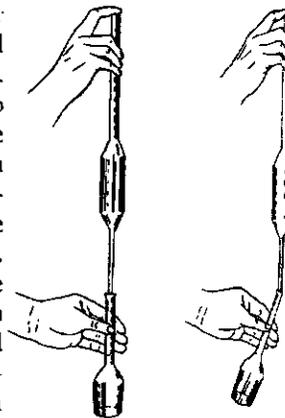
Samples in good condition may be brought to a temperature of 65 to 70 degrees F., thoroughly mixed, and the test taken at once, after thorough mixing and pouring. Samples that are sour or lumpy must be brought to a temperature of 110 degrees F. before mixing is attempted.

All tests should be made in duplicate so that one test will serve as a check on the other for accurate work. If both tests of a duplicate are not alike, some mistake has been made.

Measuring the Milk.—Milk is measured by the use of the milk pipette which holds, when filled to the mark on the stem, 17.6 c. c.

The milk is sucked into the pipette above the mark and the finger quickly placed on the upper end of the pipette and pressed firmly to keep the milk from running out of the pipette. The pipette is then held vertically, with the mark on a level with the eye, then by gently relaxing the pressure of the finger on the end of the pipette, air is admitted and the milk is allowed to flow slowly out until the top of the column of milk is level with the mark on the pipette.

Running Milk into the Test Bottles.—The point of the pipette is placed in the mouth of the test bottle, holding the test bottle in an inclined position. Removing the finger from the end of the pipette, the milk will flow out of the pipette into the test bottle. The object of inclining the test bottle is to allow the milk to run down the side of the neck of the test bottle, thus allowing an exit for the air in the bottle. If this precaution is not observed, the air will bubble out and cause some of the milk to overflow. Blow the last drop of milk out of the pipette before removing it from the bottle. Each bottle should be numbered with a lead pencil, giving the same number to each bottle as that corresponding to the name on the milk sheet.



The wrong way The right way
Manner in which the tests should
be transferred to the bottle.

Adding the Acid.—The milk should be between 65 degrees and 70 degrees F. when the acid is added. 17.5 c. c. of sulphuric acid of a temperature of 65 degrees to 70 degrees F. should then be added to the test bottle, its specific gravity being 1.82 to 1.83 at 60 degrees F.

On pouring the acid into the test bottle, the latter should be held at an inclined position so that the acid will flow down the sides of the test bottle and not drop through the body of the milk in the bottle, the bottle being revolved so as to wash down all adhering particles of milk that may cling to the neck of the bottle. By observing this precaution, charring of the milk is avoided and also spilling of the acid.

If the acid has been properly added there will be distinct layers of acid and milk in the test bottle without any black layer of partially mixed acid and milk between.

Acid will eat holes in clothing wherever spilled on them. If any should be spilled on the skin or clothing, it should be quickly washed off with water. Color can be restored to clothing by treating the spots with ammonia water.

Mixing the Milk and Acid.—Mixing the milk and acid is done by giving the test bottles a combined rotary and shaking motion, being careful not to allow any curd to get into the necks of the bottles. Such mixing should be continued until all of the curd is dissolved and

the color and body of the test appears to be uniform. The bottles may then be let stand from one to three minutes, given another gentle, rotary motion, and they are then ready for the tester.

Whirling.—The test bottles, with the acid and milk properly mixed, are now placed in the tester.

The bottles should be arranged in pairs at opposite sides of the center so that they will balance when rotating.

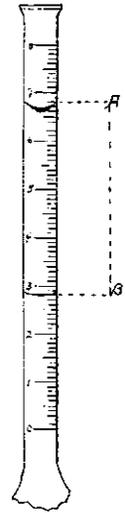
First, whirl four minutes, at speed of machine indicated on the cover, then fill with soft, hot water to the bottom of the neck and whirl two minutes, fill the neck of the bottle with hot water of 170 degrees F. to within two or three per cent of the top, and whirl one minute. The periods of whirling given means the time during which the tester is run at full speed and does not include the time of starting and stopping.

Reading the Tests.—Milk tests should be read at a temperature between 120 degrees and 130 degrees F. This temperature may be best obtained by use of a five minute hot water bath before reading.

In reading the tests, hold the bottles perpendicular and on a level with the eye. Place one point of the dividers at the lower end of the fat column and the other point at the top of the meniscus or upper curved surface of the fat column. Then lower the dividers until the lower point is on the zero mark of the test bottle, the upper point will indicate the per cent of fat. Care must be taken to hold the dividers rigid while lowering.

The following are a few precautions in making milk tests:

1. Always make tests in duplicate.
2. Make sure that the sample is a representative one.
3. Have the temperature of the milk and acid at 65 degrees to 70 degrees F. before mixing.
4. Use only acid of right strength, specific gravity 1.82 to 1.83.
5. Mix milk and acid thoroughly as soon as acid is added, by gentle rotary motion.
6. Mix a second time after a short interval.
7. Make sure that tester does not jar.
8. Set bottles in water of 120 to 130 degrees F. five minutes before reading.
9. Read each test twice to make sure no mistakes have been made.



Showing length of fat column to be read on milk tests, A to B

TESTING SKIM MILK

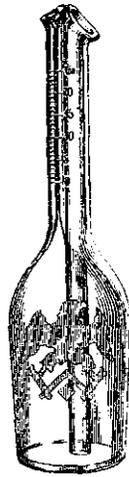
The following changes should be made in testing skim milk from methods used in testing whole milk:

Skim milk bottles must be used; these bottles are graduated to be read to one one-hundredth of one per cent. More acid is needed than

for whole milk, about 20 c. c. instead of 17.5 c. c. The speed of the tester should be increased 10 per cent and the tester kept as warm as possible. Skim milk always contains some butter fat, and should a test fail to reveal the presence of butter fat, it is an indication that the testing was poorly done and should be repeated.



Milk test bottle



Skim milk test bottle



Dairy thermometer



Dividers

VARIATION OF FAT IN MILK.

The percentage of fat in normal milk varies a great deal. However, the fat content seldom falls below 2 per cent or rises above 7 per cent. The fat content of milk from a whole herd of cows varies only within comparatively narrow limits. The following are the chief factors which cause the fat content of milk to vary:

1. Individuality of cows.
2. Breed of cows.
3. Time between milkings.
4. Manner of milking.
5. Whether the milk is fore or after milk.
6. Age of cow.
7. Lactation period.
8. Surrounding conditions.
9. Condition of cow.

PREPARATION OF MILK AND CREAM SAMPLES FOR MAILING

When a sample of milk or cream is sent to the Dairy Commission for testing, it must be received in good condition or an accurate test cannot be made.

The following suggestions will serve as an aid outline to be followed:

1. Secure a representative sample by pouring milk or cream from one can to another at least three times. Sample must be smooth, free from streaks and lumps.
2. Fill a clean sample bottle full, the bottle or jar should have a capacity of from two to four ounces. If the sample is not to be tested for adulterations or preservatives and is likely to be more than twenty-four hours in transit, add two or three drops of formaldehyde to prevent souring.
3. Seal the sample absolutely air tight. Test by inverting for an hour on white paper to see if the cover leaks.
4. Wipe the sample jar clean and dry, and pack well with plenty of soft, white paper in a small wooden or strong pasteboard box. Send by parcel post.
5. At the same time the shipment is made, send a letter stating what tests are desired. Give the name and address of the person that took the sample, of the person whose milk or cream was sampled, and of the person to whom analysis is to be sent.

If solids, adulterations or bacterial examinations are to be made special directions for sending will be mailed from this office upon application. All applications for directions for sending should give full information as to the kind of tests that will be required so that special instructions may be sent for securing the same.

Samples arriving in a leaky, unsatisfactory condition cannot be tested, but the sender will be notified of the probable cause of his trouble.

No charges are made for making tests.

About a week is required for making tests and reporting.

CARE OF CREAM; AND CREAM QUESTIONS

Good butter cannot be made from poor cream. If a grade of butter can be produced that will bring the highest market value, better prices can be paid for cream.

The first step in the production of good cream is clean milking. This can be accomplished when barn, cows and utensils are clean. It is a good plan to dampen a cloth and wipe off the cow's udder and flanks each time previous to milking. Small top milk pails should be used. Cows should be kept in a good, healthy condition, economically

but well fed and cared for. Then as soon as the milk is drawn it should be taken at once to the separator room, a room apart from the milking barns and free from all odors that may taint the cream in the least. As soon as all the milking is done, the cream should be separated at once and then cooled down to 50 degrees, or between 40 degrees and 50 degrees F. if possible. All utensils used must be kept clean and given plenty of sunlight and air when not in use. All strainers, pails, separator and separator parts must be washed and cleaned thoroughly after using.

Other important cream questions can be most concisely set forth by the following questions and answers:

1. Q. How thick should cream be skimmed?

A. Between 35 per cent and 40 per cent. Thick cream keeps better than thin cream, there is also not the waste in handling a smaller bulk of cream that there is in handling larger amounts, in the way of hauling and express charges. Moreover, the skim milk is kept on the farm for feeding the pigs and calves. If cream is skimmed thicker than 45 per cent, there is a loss in some of the cream going over into the skim milk, and there is also a considerable loss from the amount of cream that will adhere to cans and utensils.

2. Q. How can cream be skimmed near the same thickness each time?

A. (a) By using the same amount of water to flush the bowl of the separator each time.

(b) By keeping the cream screw the same.

(c) By running the separator at the same and a uniform speed. It is best to have the same person turn the separator at each skimming, if possible. By this means a more uniform speed will be obtained.

(d) By having the temperature of the milk the same.

(e) By keeping a uniform inflow to the bowl.

(f) By washing the separator thoroughly after each time it is used.

3. Q. How cool must cream be before it is mixed with other cream of previous skimmings?

A. Always cool cream down to between 40 degrees and 50 degrees F. before mixing with other cream and stir all cream thoroughly every time new cream is added.

Warm cream should never be mixed with previous skimmings.

4. Q. Under what condition should cream be kept?

A. Cream should be kept in a cool sanitary place, the temperature should be below 50 degrees F. Odors of vegetables, oils, etc., must not be present. A spring house or a building provided with cold, running water is best. A cellar or cave is not a good place to keep

cream because the air is seldom pure and the temperature is not low enough in summer.

5. Q. Where should a cream separator be kept?

A. The separator should be kept in a separate room or building provided for that purpose.

6. Q. How often should a separator be washed?

A. The bowl and all parts of a cream separator which come in contact with milk or cream should be thoroughly washed and scalded after each separation. This requirement is necessary to secure uniform skimming each time the separator is used, and, furthermore, dirty utensils are classed as unsanitary by law and must not be used.

7. Q. How should cream be taken to the market?

A. During warm weather, cream should be protected from the sun, while delivering, by wrapping dampened blankets around the cans and over the tops. In severe winter weather cream should not be permitted to freeze while delivering.

8. Q. What causes cream to become sour?

A. The action of bacteria. The action of such bacteria may be delayed by keeping cream cool and clean.

9. Q. What are the chief causes of bad flavors in cream?

A. Strong-flavored weeds or feeds, unsanitary surroundings and undesirable bacteria.

10. Q. Can sour cream be tested.

A. Yes, but cream in a sour or bad condition is much harder to sample and test accurately than sweet cream.

11. Q. What standard of butter fat is required by the state law when cream is sold for table or private use?

A. 16 per cent butter fat.

12. Q. What is first grade cream?

A. First grade cream shall consist of cream that is clean to the taste and smell, free from all foreign matter and sweet or only slightly sour.

13. Q. What is the best breed of cows to keep when cream is sold?

A. Holstein, Guernsey, Jersey, and Ayrshire are the four best breeds. As to which of these four breeds should be placed first, depends largely upon the owner's individual liking and the conditions that must be met by way of climate and feeds.

14. Q. When should dairy herds freshen?

A. In the fall as much as possible, for it is through the winter months that cream brings the highest prices. Cream is more easily kept in good condition, and labor for caring for the herd is cheaper at this time than any other season of the year. Records also show that cows freshening in the fall produce from 25 to 40 lbs. of

butter fat in a year more than the same cows freshening in the spring.

15. Q. Are silos an economical factor in feeding dairy cows?

A. They are in reality a necessity, but they must be properly made and filled.

16. Q. What is the best make of cream separator?

A. The one that will skim the closest, last the longest, run the smoothest and be the easiest to clean thoroughly. Too much attention cannot be paid to investigation before a purchase is made.

17. Q. Is the Babcock test accurate?

A. Yes, if the method of operation is understood and care is taken to work it carefully.

18. Q. What protection has the farmer against inaccurate testing?

A. He may make an occasional test of the cream himself at his own farm by following the instructions given in this bulletin. All station operators must pass an examination and hold a state license before they can sample or test milk or cream or other dairy products. In order to continue to hold this license, they must do accurate sampling and testing. Inaccurate testing or false reading of tests is a direct violation of the law and will be punished by law enforcement wherever found.

18. Q. Should cans be borrowed from cream stations or creameries?

A. Milk cans should not be borrowed from station operators or creameries, as in this way many cans are not only lost each year, but others are returned in damaged and unsanitary condition.

Station operators are hereby authorized not to loan milk cans to their patrons or others desiring them.

20. Q. When should a patron expect pay for a cream delivery?

A. When a cream delivery is made and the empty can of that delivery is ready for return by the operator, the check for the previous delivery should be expected together with a statement of the present delivery and the price being paid for butter fat. By this method of payment, the patron always has a check coming upon the day deliveries are made, excepting the first delivery at a station, and ample time is given the operator so that testing may be done accurately and carefully during hours that are not rushed with business.

Patrons should insist that operators take plenty of time to do their work accurately and follow this method of payment, as such a plan is decidedly to the advantage of both parties concerned.

22. Q. How should cream be cared for at the cream station?

A. Cream brought to the station is then under the operator's care, and it is his duty to keep it in the best condition possible, emptying the cream after sampling and weighing into clean, well aired cans. Cream of second grade or poor grade, should not be mixed with good, first grade cream, as such mixing will spoil the good cream in stock. Good

cream must be kept free from additions of poor cream. Every time new cream is added, the entire amount should be thoroughly stirred. The lid of the can should not be closed tightly, but left open and protected from dust and flies. Cream held at the station should be stirred often. Stirring keeps it in better condition and the top will not become dry and crusted. The temperature should be kept between 40 degrees and 50 degrees F. The station must be in a sanitary condition and free from all odors such as oil, vegetables, etc.

METHODS OF RECEIVING AND SAMPLING CREAM.

Nearly every person has a particular business method of their own which they follow, others never get the habit of having systematized work.

The following ten steps will serve as a guide and aid to all who are just taking up this work, and may also hold some worthy suggestions for older followers of the business.

1. Write the patron's name plainly upon the receiving sheet.
2. Balance scales and weigh the cream.
3. Record the gross weight of cream and can.
4. Sample as required by Colorado law.
5. Place the number of the sample jar opposite the patron's name.
6. Rinse the empty can.
7. Wash the can thoroughly, then drain it.
8. Weigh the empty can.
9. Subtract the weight of the empty can from the weight of the can and cream obtained in No. 3, then enter the remainder on the receiving sheet as the weight of the cream to be paid for.

10. Then when the patron calls for the can, give him the check for the previous delivery, and also a statement of the amount of cream just received and the price being paid for butter fat. This rule is a very important one. Show the patron that it is to his advantage not to receive payment for cream the same day of delivery, for the reasons that during the rush hours of the day an operator has not the time to do the accurate, careful testing that the patron should require. Hurried testing will not be permitted.

Sampling Cream.—It is always best, if possible, for the person taking the sample to do the testing. Accurate samples must be taken. The taking of inaccurate samples is just as much a violation of the law as improper testing.

Too much stress cannot be laid upon the need of thorough and careful mixing just before the sample is taken, and also before putting the final charge into the test bottle.

To secure an accurate and legal sample of cream, according to Colorado law, it shall be poured from one vessel to another at least three times before sampling, unless said cream is thoroughly stirred

and sampled by the McKay sampler, or some other recognized sampler that will secure a representative sample. Always mix by pouring, unless the McKay or a similar sampler is used.

The ordinary stirring rod generally used will not get an accurate average sample unless pouring is resorted to in addition.

Cream that is frozen or lumpy should be heated to 110 degrees in a water bath and then thoroughly mixed, stirred and poured. It should remain in the water bath until the body of the cream has become smooth, free from lumps and of a uniform texture. After such cream has become free and smooth it may be sampled the same as other cream.

Milk may be sampled the same as cream, with the exception that only one pouring is required by law. However, additional mixing is often necessary and always beneficial toward securing an accurate sample.

Composite Samples.—"In sampling milk or cream, from which composite tests are to be made to determine the per cent of butter fat contained therein, such samples or sampling shall not be lawful unless a sample be taken from each weighing and the quantity thus used shall be proportioned to the total weight of the cream or milk samples." The sampling should be done the same as for taking samples for other tests, with the exception that the composite sample must be proportional to the quantity of cream from which it is taken. That is, take only half as large a sample from a half can of cream as from a full can. The samples taken from all the cans of cream should be mixed together and warmed in a water bath and a test made from them the same as from other samples. This test multiplied by the number of pounds of cream sampled, will show the number of pounds of butter fat in the total amount of cream sampled.

This method of making a composite test of each shipment of cream should be used as a check on the day's business, and as an aid toward checking out with the creamery. The amount of rinse water used in the cans will not affect the total pounds of butter fat, since the slight lowering of the test by the addition of the water will exactly compensate the increase in weight.

The value of such a check on shipments rests entirely upon the care given in taking the samples or sample, providing the test is completed by the usual methods.

Care of Samples.—If samples are allowed to stand any length of time before testing, they should be tightly covered in order to prevent evaporation. The use of common milk bottle caps in the tops of the small sample jars now generally used is an effective seal. Where it is absolutely necessary for tests to stand many hours, it is best to add some preservative to prevent souring and curdling. A few drops of formalin or corrosive sublimate is good, but all such preserved samples should be emptied in the waste as soon as tested, for corrosive sublimate is poisonous and formalin also if very much is used.

All samples should be kept until all the tests have been made and recorded, for occasionally something may happen to a test, and an additional quantity of the sample will be needed to run another test.

Considering the conditions under which most samples are handled and the length of time that they are sometimes kept, it is usually most economical to empty the small quantities of cream left in them into the waste rather than into the cream cans.

CREAM TESTING

In describing the method of operating the Babcock test, when determining the amount of butter fat in cream, special attention will be called at each step to such difficulties as may occur, and emphasis will be laid upon precautions necessary to obtain accurate results.

In brief outline, the different steps may be stated as follows:

1. Heat sample to be between 100 and 110 degrees F.
2. Balance test bottle or bottles on scales.
3. Mix the sample thoroughly by pouring from one vessel to another.
4. Weigh test or tests.
5. Cool to between 60 degrees and 70 degrees F.
6. Add acid of same temperature.
7. Mix.
8. Add hot water of 170 degrees up to neck of bottle. whirl five minutes.
9. Add hot water of 170 degrees to within three or four divisions of the top and whirl two minutes.
10. Read at a temperature of between 120 degrees and 130 degrees F.

Preparing samples of cream for testing.—Cream samples should first be heated in a water bath at 100 to 110 degrees F. The cream must not be heated to more than 110 degrees F. or the fat will become liquified and the sample taken will not furnish an accurate test.

The bottle or bottles to be used for the test may be balanced on the scales in the meantime while the cream is heating. Mark each test bottle plainly with the same number given the corresponding sample jar.

Mix the samples thoroughly by pouring from one jar to another



Showing the height to which cream free from air bubbles must be raised in a pipette to get 18 grams of cream. It shows that to measure in a pipette is inaccurate in cream testing. (Modified from Iowa Dairy Com. 1903)

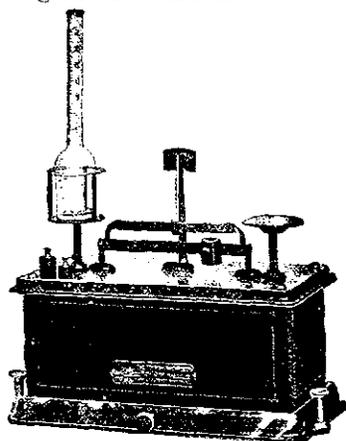
until the cream is uniform in color, and smooth. Cream samples containing lumps or streaks must be classed as not thoroughly mixed, and should not be tested until all lumps and streaks have been dissolved.

To insure accuracy, all samples of cream should be tested in duplicate. If the results of the duplicate tests do not agree, there is an error somewhere and the work should be repeated. Then, also, if something happens to one test, the other is left.

Weighing the Test.—After again making sure that the scales are level and balanced, weigh out the test immediately, nine or eighteen grams, using a large mouthed pipette to transfer the cream to the test bottle. No cream should be allowed to get on the outside of the bottle or in the scale pan while the weighing is done.

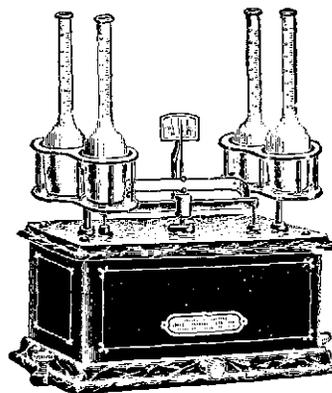
To lengthen the life of the scales, use the rest rod whenever adding weights or taking weights from either scale pan.

If too much cream should be added to the test bottle, the excess may be removed with a clean wire or glass rod. Be sure to get the weight accurate, as not quite enough or a little too much will not bring correct results.



M21500

One-bottle torsion balance scale



Four-bottle torsion balance scale

Adding the Acid.—Before adding the acid the cream should be brought to between 60 and 70 degrees F. by placing in a water bath of that temperature or colder until the cream has reached the desired temperature. Unless the cream and acid are brought to the above temperature at the time of mixing, the action of the acid may cause burnt or cloudy tests. In cold weather it will be necessary to warm the acid slightly in order to bring it to the desired temperature.

The proper measure of acid to be added will depend upon the size of the test, whether nine or eighteen grams, the strength of the acid and the richness of the cream. For a nine gram test, about 8.8 c. c. of acid may be used, for an eighteen gram test 17.5 c. c. of acid is the usual amount. While adding the acid, the bottle should be held at an

angle and at the same time revolved so that the acid may wash down all adhering cream on the inside of the neck of the bottle. Acid should not be allowed to fall directly into the cream, as such a practice may cause black particles to appear in the fat column. There is also danger of the neck choking up and the acid overflowing on the operator's hands.

The contents should then be mixed by a gentle rotary motion, avoiding spilling or shaking curd particles into the neck of the bottle. The sample should then turn a dark chocolate color. After mixing, each bottle should be allowed to stand a short time, until the desired uniform chocolate color is obtained.

Commercial sulphuric acid of a specific gravity of 1.82 to 1.83 should be used. Such acid should not be left in an open container, as the action of the air will very soon cause it to become weak and unfit for use.

Rich cream will require a little less acid than thin cream, and sour cream will require a little less than sweet cream.

Whirling.—The tests having been let stand after mixing with the acid, as described above, a second gentle rotary motion should be given and hot, soft water of 170 degrees F. added in proportion to the amount needed as indicated by the color of the mixture, usually up to the neck of the bottle. Balance in tester and whirl at the proper speed of tester for five minutes.

Stop the tester and add soft water, 170 degrees F., to within three or four graduations of the top of the graduated scale on the neck of the bottle. Unless a steam tester is used, care should be taken to keep the tests at 170 degrees F. by inserting in a hot water bath of that temperature for five minutes.

Whirl two minutes.

All water added must be soft. If soft water cannot be obtained, hard water may be softened by adding a few drops of sulphuric acid before putting into the bottle. The use of hard water will cause air bubbles on the top of the fat column.

The periods of whirling given mean the time during which the tester is run at full speed, and do not include the time used in starting or stopping the machine.

The following table gives the necessary number of revolutions for different size testers.

Diameter of Machine	No. of Revolutions per Minute
10	1074
12	980
14	909
16	848
18	800
20	759
22	724
24	693

Reading Tests.—Having finished the last whirling, all tests shall be maintained at a temperature of between 120 and 130 degrees until read. If glymol is used, the test should be kept between 135 and 140 degrees until read. These temperatures are best maintained by the use of the water bath for ten minutes. The careful use of the water bath will contribute greatly in cutting down shortages caused by over-reading of tests.

The color of a test to be read should be a golden yellow, free from cloudiness, specks or curd. Any tests that have curd, dark specks or foreign matter at the lower portion of the fat column causing an irregular line, must be retested.

In reading the test, hold the bottle perpendicular and on a level with the eye. Place one point of the dividers at the lower end of the fat column and the other point in the middle of the meniscus formed on the upper curved surface of the fat column. Then lower the dividers on the graduated scale until the lower point is on the zero mark of the test bottle, the upper arm will indicate the per cent of fat. Care must be taken to hold the arms of the dividers rigid while lowering.

When glymol is used, the upper surface of the fat column is made straight and the reading may be taken from the top of the fat column, no allowance being made for the meniscus, as it has been overcome.

Cream test readings should always be made to the nearest half per cent or full per cent marks. Reading to the half per cents is necessary in order to check out closely with the creamery.

The reading completed should be entered opposite the patron's name, being sure that the number on the test bottle corresponds to the number given the patron's name.

How to Clean Test Bottles.—Empty the bottles while warm into the earthen waste jar, at the same time shaking the bottles to loosen the white deposits in the bottom, then wash in warm water using a washing powder and a small brush. Weak acid and washing powder will often remove sediment which water will not dissolve.

Test bottles should be inverted and allowed to drain until dry. If glassware does not drain clean after it has been thoroughly washed, too much washing powder has been used.

Glymol and Its Use.—Glymol is a white mineral oil and can be obtained at most drug stores. It serves its purpose better in making the fat column easier to read by coloring with akanet root. The akanet root may be wrapped in cheese cloth, an ounce to a quart, and left in the oil two or three days, after which time the oil will

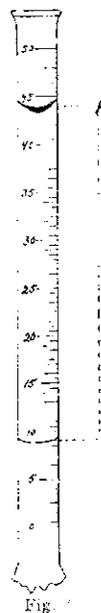
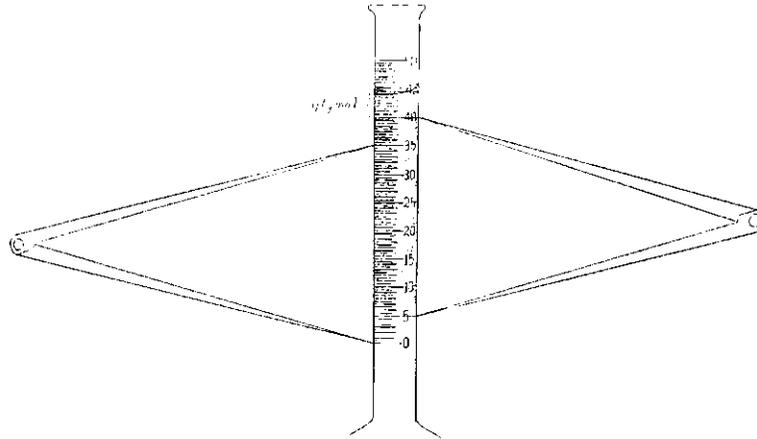


Fig. 4.—Read the fat column for cream from A to B, or from the bottom of the column to half way up on the upper dark curved surface or meniscus.

be colored a cherry-red. A few drops of this dropped on top of the fat column will entirely remove the meniscus, leaving a straight line for the top of the fat column.

Tests on which glymol is used must be read at 135 to 140 degrees F. temperature in order to check with ordinary tests read at



Note the straight line on top of the fat column when glymol is used. The lighter portion at the top is glymol. The use of dividers is also shown in measuring the length of the fat column. (Missouri Bulletin)

from 120 to 130 degrees F. on account of the fact that the added heat is needed for the proper expansion of the fat column.

Action of Sulphuric Acid on Milk or Cream.—Sulphuric acid dissolves all milk solids other than fat, leaving the fat globules free to collect in a mass. Sulphuric acid liquifies the fat, due to the development of heat.

Sulphuric acid increases the specific gravity of the milk or cream mixture, the butter fat being much lighter, more readily rises to the surface of the heavy liquid.

The Value of Cream.—To find the number of pounds of butter fat in a certain quantity of cream, or in a delivery, multiply the number of pounds of cream by the test, point off two decimal places; this gives the number of pounds of butter fat. The number of pounds of butter fat multiplied by the price per pound paid for butter fat, will give the value of that quantity of cream, or the amount due the patron.

To Find the Average Per Cent of Fat.—In calculating the average per cent of fat from a number of cows, or the milk or cream furnished by different patrons, the mistake of adding the tests of all samples tested is often made. Milk or cream from different patrons or from different cows will always vary, some in quality and some in quantity, and in order to get a correct average test, both quantity and quality must be taken into consideration.

The wrong way:

Sample	Cream Delivered	Per Cent of Fat
1	100 lbs.	30.0
2	50 lbs.	30.5
3	300 lbs.	40.0
4	200 lbs.	45.5
		4) 146.0

36.5

The correct way:

Sample	Cream Delivered	Per Cent fat	
1	100 lbs.	30.0 per cent	30.0 lbs. fat
2	50 lbs.	30.5 per cent	15.3 lbs. fat
3	300 lbs.	40.0 per cent	120.0 lbs. fat
4	200 lbs.	45.5 per cent	91.0 lbs. fat
		650) 256.3	

39.4 per cent

The average test as figured by the wrong method gives 36.5 per cent. Figuring by the correct method gives 39.4 per cent, the average per cent of butter fat.

If the percentage of fat or the number of pounds of milk is uniform, then it does not make any difference in the results as to which of the two ways illustrated above is used. Such uniformity seldom exists in practice, so that the only correct way of calculating the percentage is to find the total number of pounds of fat and divide it by the total number of pounds of milk or cream.



Combined acid measure makes work more rapid



Acid measure



Acidometer, showing glass tube in which the acid is tested for specific gravity.

STATION PROBLEMS.

Probable Cause of a Shortage.—When the creamery reports a shortage of butter fat, the cause probably lies in one or more of the following reasons:

1. The number of cans shipped and net weight not agreeing with the creamery report.
2. Samples not having been taken according to directions as to securing a representative sample, or not kept tightly sealed and in a cool place.
3. Dirty test bottles having been used.
4. More than a 9 or 18 gram test having been taken.
5. An abnormal fat column.
6. Reading tests at a point higher than the center of the meniscus.
7. Failure to keep the tests at from 120 to 130 degrees F. until read, and from 135 to 140 degrees F. when glymol is used.
8. Hasty reading, or slipping of dividers.
9. Inaccurate glassware.

Probable Cause of Excess.—When the creamery reports an excess of butter fat, the cause probably lies in one or more of the following reasons:

1. The number of cans shipped and net weight not agreeing with the creamery report.
2. Samples not having been taken according to directions as to securing a representative sample, or not kept tightly sealed and in a cool place.
3. Less than 9 or 18 gram test having been taken.
4. Not running tester long enough periods or at high enough speed.
5. Reading tests at the base of the meniscus instead of half way up the curve.
6. Failure to keep the tests from 120 to 130 degrees F. until read, and from 135 to 140 degrees F. when glymol is used.
7. Hasty reading or slipping of dividers.
8. Inaccurate glassware.

Stations and creamery records should agree at the end of every month. The Babcock test is accurate, and careful and observing testers should agree in their work.

Frozen Cream.—Cream should not be permitted to freeze, but should such happen the cream should be thawed in a water bath of not over 110 degrees F. then sampled in the usual manner.

Cause of Air Bubbles in the Fat Column.—When hard water is used in tests, air bubbles often form at the top of the fat column.

A Milky Fat Column.—A milky fat column may be caused by the mixing of the acid with the test when both are not near the same temperature, 60 to 70 degrees F. The acid used may be too weak, or enough may not have been used.

Filling Cream Cans.—The amount of cream in a can must be determined by the condition of the weather and the cream. For average conditions a can should not be filled more than half way between the handle fastener and the top band of the can; second grade cream should not go above the top band especially during hot weather. Not filling cans over full will prevent waste and shortages. Foamy cream is especially likely to waste. A small piece of ice dropped into such cream just before shipment will prevent further foaming.

McKay Sampler.—The McKay sampler is one of the most reliable samplers that can be found on the market. It takes a vertical sample of the cream for its entire depth and truly represents the richness of all portions and depths of cream so sampled.

The amount of the sample is proportional to the depth or amount of cream in the can. The sampler consists of two tubes, one within the other. Each tube is provided with a handle and each tube has vertical slots on one side. By turning the handles, the sampler may be opened or closed.

In use, the sampler is plunged to the bottom of the can of cream to be sampled, with the slot closed. The handles are then turned to allow the contents of the can to run into the sampler, then the handles are turned to close the tube. The sampler is then withdrawn and the contents emptied into a sample jar by slightly pulling out the inner tube or opening the handles. If cream sampled is very thick, an inside plunger is needed for removing all the cream from the inside, or dip the sampler in warm water.

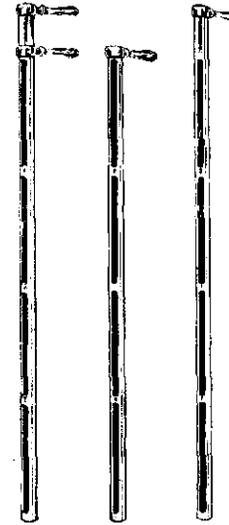
The best results are obtained when the sampler is kept warm. McKay cream samplers have wider slots than those intended for milk.

THE CREAM STATION.

A cream station should be a building where sanitary conditions for the handling of cream may be maintained. It should not be located near obnoxious factories, yards or buildings, on side streets or alleys back of other buildings. Good drainage is a very important requirement both for the disposal of surface water and waste within the station. As dairying in Colorado is a growing industry, ample provision should be made for future growth.

The following sizes and capacities give a fair estimate of the size of building needed:

10 cans per week.....	10 x 12
25 cans per week.....	14 x 16
50 cans per week.....	16 x 18
100 cans per week.....	20 x 24



McKay sampler

All empty cans should always be kept inside, not out exposed to the hot sun or other weather elements. Plenty of room makes work for the operator lighter and more rapid, especially on busy days. The hot water boiler should always be in an adjoining room to that where the cream is kept; thereby the dirt and dust made while firing is avoided, as is also the heat caused by the same during the hot summer weather.

The floor should be of close fitting, well matched boards, painted, if a cement floor is not available.

The ceiling and side walls should be of smooth, hard finish, so as to be easily kept clean. Paper should not be used for finishing, as it soon becomes torn or cracked leaving catching places for dust and insects.

Window space should be provided for one-fifth as much window space as floor space. Sunlight is necessary as a disinfectant and for the operation of efficient work. Good ventilation should also be provided for, as a cool room is essential for keeping cream, good and free moving air with plenty of light is one of the greatest aids toward keeping the room sweet and fresh at all times.

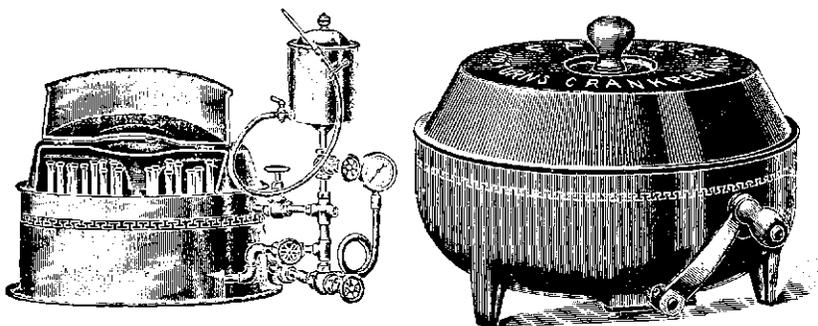
All doors and windows should be fitted with screens, either a canvas shade or a covered porch is very desirable for the principal door, as it is a protection against rain and the bright sunshine. If the station is a frame building it should be attractively painted.

All stations of modern type will need primarily the following equipment:

1. Upright Tubular Boiler and steam fittings.
2. Wash sink with drain.
3. Babcock tester.
4. Can rack.
5. Weigh scale.
6. Cream sampler.
7. Cream scales.
8. Dividers.
9. Pipette.
10. Acid measure.
11. Sulphuric acid.
12. Water bath.
13. Test bottle brush.
14. Can brush.
15. Sample jars.
16. Test bottles
17. Dairy thermometer.
18. Washing powder.
19. Waste jar.

1. An Upright Tubular Boiler with steam fittings and connections is the best and most efficient means of securing plenty of hot water so necessary in every station. It also will provide steam for running the Babcock tester.

2. A wash sink made of half rounded galvanized steel large enough to hold a ten gallon milk can is considered best. The two compartment sink has the advantage of keeping wash water and rinse



Steam tester

Hand tester

water at hand at the same time. There should be a good drain connected with the sink; if a drainage system is not at hand to drain to, a fifty-foot tile drain four feet under ground leading to a stream, gully, or ditch, will serve the purpose.

3. The Babcock tester should set level and on a solid foundation in order that it may run smoothly. If it shakes it will cause a remixing of the fat, and consequently an inaccurate reading.

A twelve-bottle tester is large enough for the average station.

4. The law requires that milk cans or receptacles be inverted in pure air and cover removed. This is a very wise and necessary precaution, to keep the cans in a good, sweet condition, and can best be accomplished by the use of can racks made along the side of the wall. Substantial uprights and one by four or one by two crosspieces nailed with eight nails makes a very desirable and cheap rack.

The boards should be painted so as to be more easily kept clean.

Nails in the racks directly above the position of each can will serve as hangers for the lids.

5. Weigh scales should be accurate and sensitive to a quarter of a pound.

6. The most common and most accurate samplers, when used in combination with one another, are the stirring rod having the curved disk on the end, and the McKay sampler.

7. Cream test scales should be level when in use, and sensitive to a drop of cream. The Torsion balance is the most satisfactory form. It may be obtained with a capacity of from one to twelve bottles. Where a large amount of testing is done, the large scales are best as the work is more rapid. However, an error made in weighing one bot-

tle on the large scales causes an error for the next sample weighed in the same set of weighings.

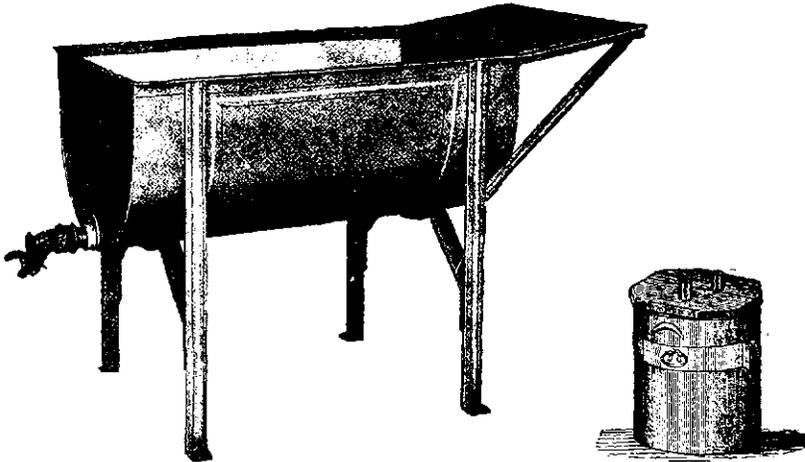
8. Dividers should be sharp-pointed and move with plenty of friction at the hinge. Dividers which are loose and likely to slip should be mended at once.

9. A pipette may be used to transfer a cream charge to the test bottle or for adding hot water to the test, but it must not be used to measure the cream test.

A wide mouthed pipette is better for cream, as it will not clog so easily as a narrow mouth.

10. An acid measure is a small glass cylinder marked at 8.8 c. c. capacity for 9 gram tests and 17.5 c.c. for 18 gram tests, used in measuring the proper amount of acid to be added to the cream charge.

11. Sulphuric acid of a specific gravity of 1.82 to 1.83 should be used, and care must be exercised to keep it tightly corked, as it absorbs moisture from the air and may thus become too weak for use.



Wash sink

Waste jar

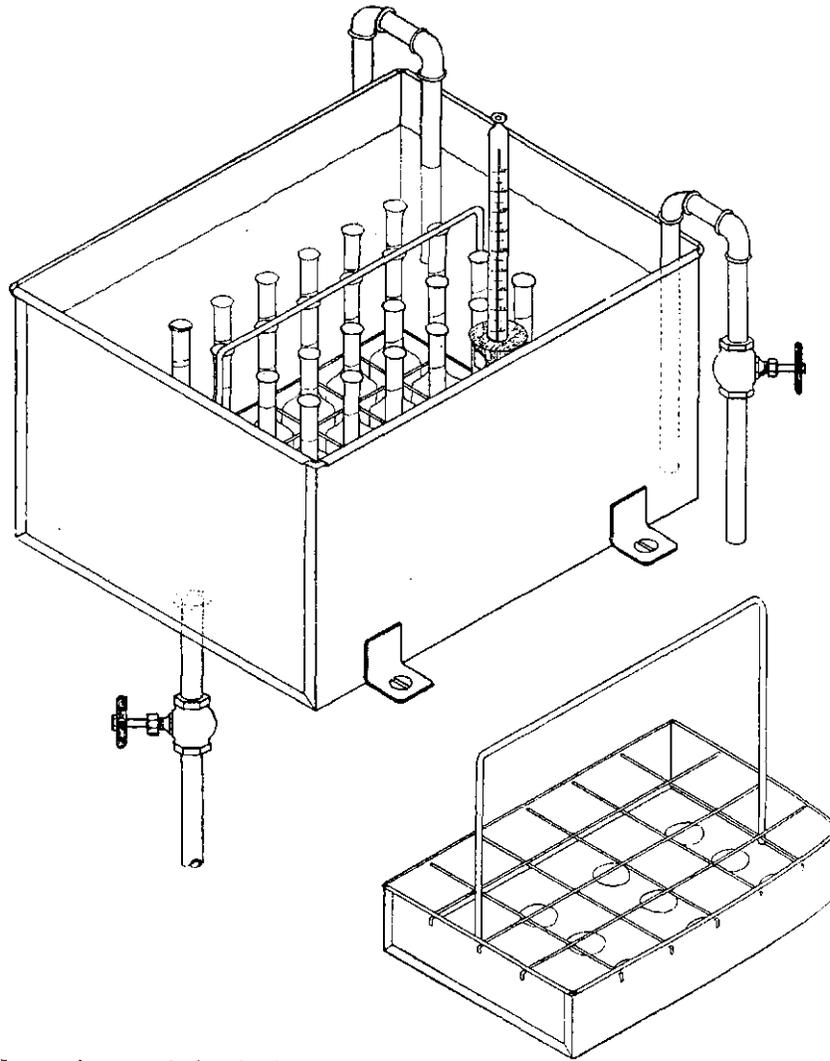
12. A water bath is necessary, especially so in case of hand testers, to maintain or bring the temperature of the tests between 120 and 130 degrees F. until read.

13. Test bottle brushes are necessary for cleaning bottles in which the dirt sticks badly.

14. Brushes for milk cans should be on hand so that all cans used and returned may be kept in a clean, sanitary condition.

15. Sample jars should have air-tight covers to prevent evaporation. As a matter of convenience they must be wide-mouthed and have a capacity for at least two tests. A half more jars are needed than the greatest number of patrons likely to deliver cream any one day.

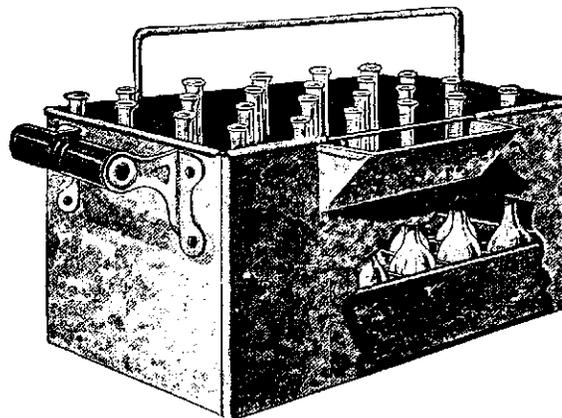
16. Cream test bottles are graduated to read the percent of fat according to their size; that is, 18 gram or 9 gram.



Improved water bath, showing water and steam inlet, drain, thermometer and basket holding twenty-four test bottles. Length, fourteen inches; width eleven inches; height, eight and one-quarter inches. The water should reach the top of the fat column in the test bottles.

The basket accomodating twenty-four test bottles. Length, nine and one-half inches; width six and one-half inches.

(Indiana Circular No. 42.)



Water bath

The best style of bottle is known as the "Standard Cream," since it is recommended by the Dairy Instructors Association and the U. S. Bureau of Standards. It is 6.5 inches high and has scale graduation to .5 per cent.

17. A dairy thermometer floats upright, being weighted on lower end, and generally reads 32 degrees F. up.

18. A mineral washing powder is the only effective cleaner for station work. Soap will not do the work required.

19. A waste jar provided with a wood cover bored full of $\frac{7}{8}$ -inch holes is the most convenient method of disposing of the test when



Bottle brush



Can brush

finished. The test bottles may be inverted by inserting the necks of the bottles in holes and left to drain. The jar should be of earthenware because the sulphuric acid will eat up or destroy all metals and enamels.

LICENSES, EXAMINATIONS AND INSPECTIONS.

(Procedure of the State Dairy Commission, Fort Collins. Copies of the state dairy laws may be obtained from the Commission.)

In section 9 of the Colorado Dairy Laws provision is made requiring that any person desiring to sample or test milk, cream, or other dairy products for the purpose of determining the value of such products when bought and sold, must hold a license granted by the state dairy commissioner.

All newly employed operators, whether samplers or testers, must have their applications in to the state dairy commissioner's office

not later than seven days from the date of starting operations, provided they do not already hold a license of this state.

How to Make Applications for and Take Examinations.—Write to the State Dairy Commissioner, Fort Collins, Colorado, giving the name and address of a Justice of the Peace or Notary Public, before whom the required examination can be taken. As soon as an application so made and directed has been received at the commissioner's office, a notice will at once be sent to the applicant to appear before the justice or notary named not later than seven days from the date given upon said notice.

As soon as the examination has been taken and the same returned to the justice or notary giving the examination, the papers will be gone over carefully and graded. If a passing grade is earned, a license will be issued and a notice of issuance of license and grade made will be sent on the same day the permit is mailed. If the grade is below passing, a notice of failure will be sent to the party failing, giving reasons and causes of failure. Another examination for testers license will not be given the same individual within 90 days of the date of failure.

Wherever a license has been issued, inspection may be expected to follow at a later date for the special purpose of gaining a knowledge of the operator's actual knowledge of the practical side of his work and methods used. Should such inspection show that the operator does not thoroughly understand his business, and that the station is unsanitary, or if the permit held is not in a conspicuous place, or if other provisions of the dairy law are violated, the permit will be cancelled and the station closed.

All applicants for examination must be at least sixteen years of age, and must have tested, prior to the time of their application at least twelve samples of milk or cream under the supervision of a person holding a license or a field superintendent and according to the directions printed in this bulletin.

Licenses are good for one year and may be renewed at the end of that time by application.

All applications for renewals of licenses must be accompanied by the number of the license held.

Licenses are not transferable; neither is it lawful for any person to sample and test under another person's license.

Examination questions will cover the contents of this bulletin.

Substitutes.—Whenever substitutions are made, the station operator is held responsible for the sampling and testing done, and in no case shall a substitute be allowed to test or sample for more than seven days from the date of starting operations without having his application for a license in the dairy commissioner's office within that time limit.

The best way of solving the substitution problem when substitution is made necessary by sickness or important business at a distance, is to have some member of the family or helper hold a license so that they may readily fill the vacancy made by such unexpected absence.

No fee is charged for the granting of a license.

Inspections.—Provision is made by law for the inspection of all places where dairy products are handled or produced. In making inspections of cream stations, a written report of conditions found, with recommendations, will be given the operator, a second copy of the inspection report will be sent the creamery or company represented, and a third will be kept on file in the commissioner's office.

As soon as possible a plan of scoring stations will be followed, similar to that now in use in many other states.* Following are the points considered in scoring:

I. External Appearance. Points allowed, 10.

The outside portion of the station should be neat and clean in appearance and provided with some sort of porch and platform. If a frame building, it should be painted.

*Kansas Bulletin No. 3.

II. Neatness of Surroundings. Points allowed, 10.

The surroundings of a cream station should be sanitary in every sense of the word, as cream readily absorbs any undesirable odors, and decayed substances harbor flies. Stations should not be located within fifty feet of chicken yards, hog pens or other objectionable buildings or open into rooms in which oils, poultry, eggs or other strongly flavored products are handled.

III. General Equipment. Points allowed, 10.

All necessary equipment for making lawful tests shall be provided for each station, and operator's license must occupy a conspicuous place on the wall.

IV. Freedom from Flies. Points allowed, 10.

Stations must be provided with protection against flies.

V. Neatness of Interior. Points allowed 10.

A well arranged, neat station facilitates the operator's work. Suitable places must be provided for bottles, scales, etc., and articles kept therein.

VI. Walls and Ceilings. Points allowed, 10.

Walls and ceilings should be finished with a hard surface cement when possible. Tight fitting boards painted in some light color are next in desirability. The surface must be kept clean and free from dirt.

VII. Cleanliness of Floors. Points allowed, 10.

The desirable station floor should be of cement, which can easily be kept clean. Tight-fitting, well painted boards are satisfactory, and must be kept free from dirt at all times.

VIII. Cleanliness of Utensils. Points allowed, 10.

All station utensils must be kept scrupulously clean at all times. No excuses will be accepted. Stirring rod, sample jars, bottles, and all vessels coming in contact with the cream must be washed thoroughly each day. The personal appearance of the workmen also figures here.

IX. Ventilation and Light. Points allowed, 10.

A station should have at least one-fifth as much window as floor space. Sunlight is an excellent disinfectant, and light is necessary if the operator is to do efficient work. Whenever possible the building should have openings on at least two sides. A cool room is essential for keeping good cream.

X. Drainage. Points allowed, 10.

A station should be located on a well drained, slightly elevated spot, sloping away from the station in all directions.

By the above method of scoring and inspection, which will also take into consideration the examination for license passed, cream stations will be graded into three classes. A clean, attractive station, provided with a full equipment and scoring 85 per cent or better at the time of inspection, will be graded "A Class", and the letter "A" will be so stamped in bold face type beside the seal upon the license.

If the station scores between 70 per cent and 85 per cent, it will be graded second class, or in class B, and the letter "B" will be stamped upon the license in the same position as given for letter "A." Should the station score less than 70 per cent, or show evidence of neglect or carelessness on the part of the operator, but show no violation of law, it will be rated third class, and the letter "C" will be stamped in bold face type upon the license.

All stations rated in C class will be given a written notice of a time limit set for them to make the A or B class. If, upon inspection after the time limit has expired, they do not make either of these two classes they will be closed.

Where the station is unsanitary, the license held is not posted in a conspicuous place, or other provisions of the dairy law are violated, the license will be cancelled and the station closed.

The purpose of this system is to improve the quality of Colorado cream by raising the standard of cream production and cream handling.

The dairies furnishing the cream going into these stations will be scored in much the same manner, and by building up the places of handling and the places of production of cream together, a far superior product of butter will be produced. The production of a high grade butter in this state means an increased demand, and in turn increased demands mean larger profits for all concerned in supplying such a market.

ACKNOWLEDGMENT

Acknowledgment is hereby made to The Wagner Glass Works, The Creamery Package Manufacturing Company, E. H. Sargent & Co., J. G. Cherry & Co. and A. H. Reid Creamery and Dairy Supply Company, for their kindness in supplying most of the electrotypes for this bulletin.

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