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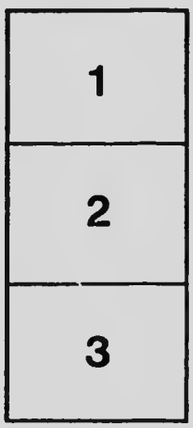

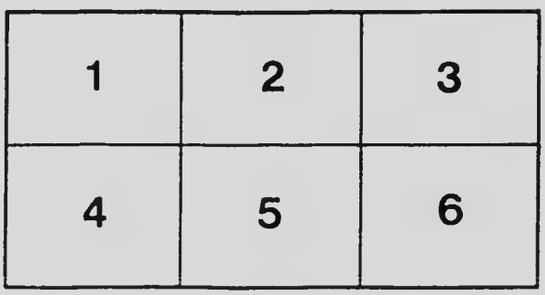

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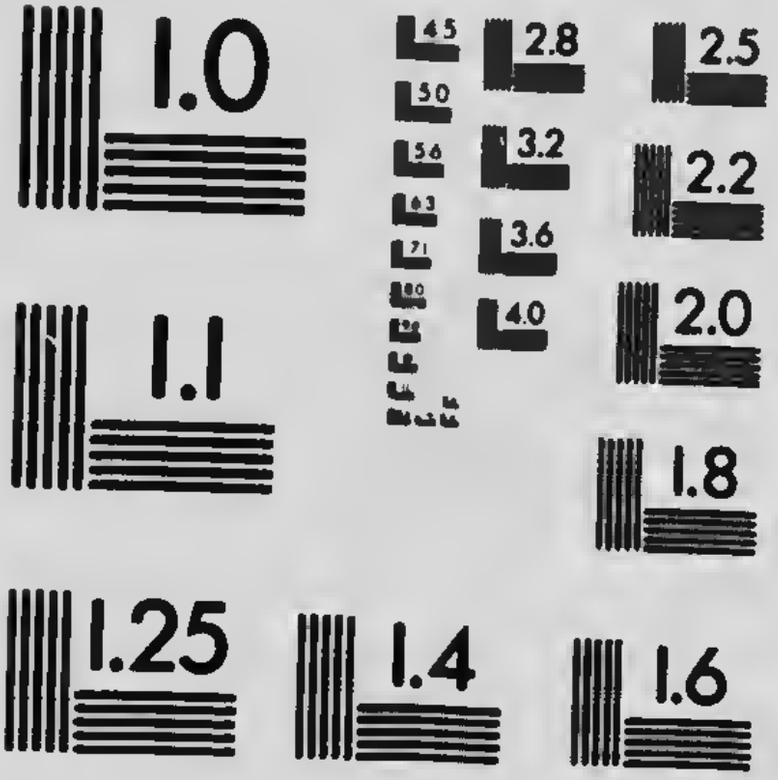

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UNIVERSITY OF SASKATCHEWAN
COLLEGE OF AGRICULTURE

Milk and Cream Testing

By

Professor K. G. MacKAY
Assistant Professor of Dairying

SASKATOON, SASKATCHEWAN
1915

MILK AND CREAM TESTING

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K. G. MacKAY, Assistant Professor of Dairying

PREVIOUS to the introduction of the Babcock Test for the determination of fat in milk and cream no simple, accurate method was commonly known. Milk was purchased by measure or weight irrespective of its quality. Cream was purchased on the basis of the amount of butter it would produce as determined by the oil test churn.

The test now known and used in almost every part of the world where dairying is an important inductry is the one known as the Babcock Test. This test was invented by Dr. S. M. Babcock of the Wisconsin Agricultural Experiment Station and was first described in a bulletin issued in July 1890. The Babcock Test, because of its simplicity and cheapness, has replaced other more complicated and expensive tests. It is speedy, accurate, and applicable to whole milk, sweet and sour cream, skim milk, buttermilk, condensed milk. and whey.

Principle of the Babcock Test

The separation of the butterfat from the other constituents of milk or cream is made possible because:

(1) The specific gravity of the butter fat is less than that of the other constiuents;

(2) The solids other than fat are dissolved by the strong acid used;

(3) The centrifugal force generated causes the heavier constituents to separate from the fat, which is the lightest constituent of the milk.

Making the Test

Sampling—The sample for testing must be representative of the milk. It should be taken after thorough stirring and before there is time for the cream to rise to the surface. The sample to be tested should be thoroughly mixed by pouring back and forth from one bottle or vessel to another. A composite sample will usually require to be heated to about 110 degrees F. in order to secure thorough mixing.

Measuring the milk.—To test milk use a 17.6 c.c. (cubic centimeter) pipette and draw the milk some distance above the mark around the stem. Quickly place the forefinger over the end of the pipette then slightly release the pressure of the finger and the milk will be seen to run slowly down the stem. When the surface of the milk comes exactly to the mark, the right quantity of milk has been secured and is ready for adding to the test bottle. (The forefinger should be dry to facilitate the work.)

Emptying the Pipette.—The end of the pipette is placed in the neck of a test bottle. The bottle should be held somewhat out of line with the pipette so that when the pressure of the finger is released slightly, the milk will flow gently down one side of the neck until all is discharged, rather than fall directly to the bottom. If the bottle is held directly in line with the pipette, when the milk is being discharged air forced from the test bottle is very liable to force back some of the milk. When any milk is spilled the work of measuring will have to be performed again for the accuracy of the test is dependent upon the right quantity of milk being used.

Adding Acid.—Commercial sulphuric acid having a specific gravity of 1.82—1.83 is filled to the 17.5 c.c. mark on the acid measure. This amount is then added to the milk in the test bottle. The bottle should be held at an angle as when adding the milk, so that the acid will run down the neck and wall of the bottle and not into the center of the milk. The test bottle should be slowly turned to remove the milk which has adhered to the neck. When the acid has been properly added, if the test bottle be examined it should reveal two distinct layers, one of milk the other of acid, without much of a black band between.

Mixing.—The acid should at once be mixed with the milk by giving the test bottle a rotary motion, care being exercised not to get any of the precipitated curd up into the neck of the bottle. The bottle should be held throughout the operation so that the neck points away from the operator. The mixture in the test bottle becomes hot, due to the action of the acid on the water in the milk. Rotation is continued until all the curd has been dissolved and the resulting liquid is uniformly dark in color.

Whirling.—When the acid and the milk have been thoroughly mixed the test bottle can be at once placed in the centrifuge or tester. Care should always be taken to have the machine properly balanced before starting. Whirl for five minutes at the speed indicated on the machine or in the directions accompanying it. Stop the machine and add hot water (140 degrees to 145 degrees F.) to each bottle with a pipette or other convenient device until each is full to the base of the neck. Whirl again for two minutes, then stop. Add hot water to each bottle a second time until the lower part of the column of fat comes well within the scale on the neck of the bottle. Water added this second time should fall directly on the column of fat. This water tends to wash down any light flocculent material which might otherwise remain and render a reading uncertain or too high, if water were added only once. A final whirling for one minute will complete the separation of the fat.

Reading the Test.—The neck of the standard milk test bottle is usually graduated into ten large divisions and each of these into five or

Fig 2 Measuring the column of fat in a Babcock test bottle

ten smaller divisions. Each large division is one per cent and each smaller division will be .2 (two tenths) or .1 (one tenth) of one per cent, depending upon whether there are five or ten subdivisions in each of the large divisions. When reading the amount of fat in the neck of the test bottle, the fat should be measured from the extreme top to the bottom of the fat column. The smaller of these figures subtracted from the larger gives the per cent of fat in the milk. Dividers can be used for measuring the amount of fat in the neck of the bottle, and then by placing one point at the bottom of the scale of figures the other point will rest on the scale at a mark indicating the per cent of fat in the sample tested.

Readings should be made when the temperature of the fat is about 140 degrees F. If the fat cools down or solidifies it can be heated by placing the bottles in hot water.

Color of the Fat.—The color of the fat column at the time of reading should be a bright golden. If the color is dark or contains black particles the acid used has probably been too strong or too much has been used. Incomplete mixing or delay in mixing the milk and acid may also cause burnt or cloudy readings. If the fat column contains white or light colored particles resembling curd, or is too light in color, the acid used is weak or the amount was insufficient, or the milk and acid were too cold when mixed. If duplicate tests of the same sample of milk be made and a difference of over .2 is shown in the results the work should be done over again. A smaller quantity than 17.5 c.c. acid can be used when the acid is too strong, a larger when the acid is below normal strength.

Cleaning the Test Bottles.—Having read and recorded the test shown by each bottle, the bottles should be emptied while still hot. Shake while emptying in order to remove the white sediment which has collected at the bottom. Wash each bottle thoroughly with hot water containing washing powder, washing soda or soap, then rinse with clean water. A brush may have to be used at times to remove particles adhering to the inside of the neck of the bottles.

Theory of the Babcock Test

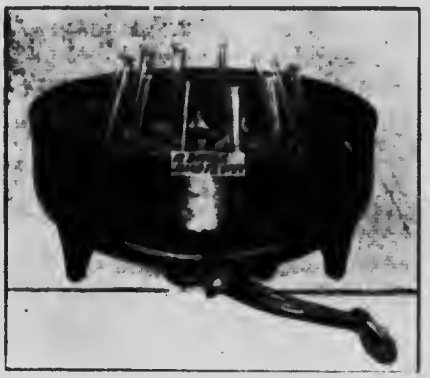
A 17.6 c.c. pipette will deliver practically 17.5 c.c. of milk the remainder or .1 c.c. adheres to the glass. The average specific gravity of milk is 1.032. The 17.5 c.c. of milk delivered will therefore weigh 1.032 × 17.5 or 18.06 grams and 18 grams is the weight of milk or cream required for a test. The volume of the neck of a milk test bottle graduated from zero to ten is 2. c.c. The specific gravity of pure melted butter fat is .9, therefore the weight of the 2 c.c. of fat in the neck of the test bottle is 2 X .9 or 1.8 grams. But 1.8 grams is exactly 10 per cent of 18 grams, the weight of milk used for a test. The scale on the neck of the bottles therefor should show the actual per cent of fat present in any sample of milk tested.

Composite Samples

Samples of milk or cream which are taken from day to day and mixed together form collectively a composite sample. Bottles for composite samples should be provided with caps or corks to prevent evaporation. Some chemical which will prevent or check fermentation should be added to preserve the milk or cream Bichromate of potash (potassium bichromate) and mercuric chloride (corrosive sublimate) are two substances commonly employed for this purpose. They are now put up in tablet form and one is sufficient for a bottle. Dissolve the tablet in the first sample of milk or cream added to the bottle by shaking. Each time an additional sample is added mix with the former sample or samples by giving the bottle a rotary motion.

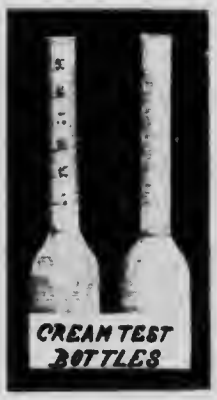
Cream Testing

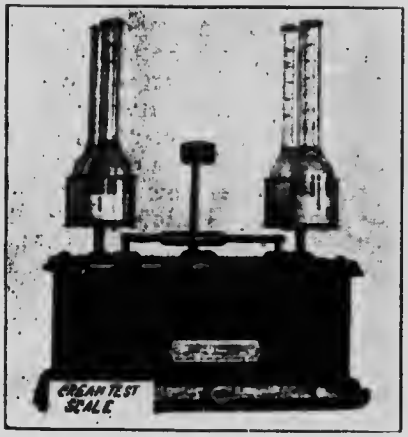
Cream may be tested in a Babcock tester in much the same manner as milk and accurate results are obtained when the work is carefully performed.



Reasons for Weighing.—The composition of cream varies greatly and also its physical condition. A sample measured with a pipette cannot be relied upon to weigh exactly 18 grams. A pipette which would deliver 18 grams of milk might deliver from 15 to 17 grams of cream, depending upon its richness. Much cream will also adhere to the inside of a pipette. Fresh separator, or old cream which has fermented, may contain many air or gas bubbles. Samples of cream for testing must therefore always be weighed to secure accurate results. Cream scales, accurate to .1 gram, to weigh 9 or 18 gram samples should be used. Cream, in almost every instance, will test more than 10 per cent, the maximum which can be read on the scale on a milk test bottle.

Cream Bottles.—Special forms of bottles have in consequence been devised for testing cream and will test cream containing up to 30, 40 or 50 per cent fat. A cream test bottle holding 18 grams having a scale reading up to 50 per cent is the one recommended for use in an ordinary creamery or cream buying station, Occasionally samples may have to be tested containing more than 50 per cent fat. When this occurs, part of the 18 gram sample may be poured into a second bottle either before or after adding the acid, care being exercised to prevent the loss of any during the transfer. The sum total of the fat will then represent the amount of fat in the sample.





Weighing the Sample.—The making of a cream test demands more care than does that for fat in milk. The cream test bottles should first be placed on opposite pans of the cream scales and then be exactly balanced. The sample to be tested must be thoroughly mixed and will require more vigorous stirring or shaking, longer continued than for milk. A sample is then immediately taken in a pipette and allowed to flow into a cream test bottle on the scale, rapidly at first, but when the desired amount has been reached, by drops until an 18 gram weight is shown to be exactly balanced.

When the samples have all been weighed, acid in the same quantities and in the same manner as for milk, is added. The acid and cream should be mixed at once, after which samples will be ready for whirling. The time required for whirling and method of adding water is exactly the same as for testing milk and the reading should be made at about 140 degrees F.

Reading the Test.—The reading of the fat column is slightly different in the cream test bottle from what it is in the milk bottle. The reading in the cream test bottle should be made from the bottom of the fat column to the bottom of the meniscus or curve in the surface of the top of the fat column. The uncertainty as to this exact point to which to read may be removed by the use of certain liquids which do not mix with the fat in the column but change the curved surface into a straight line. Fat saturated alcohol colored to facilitate the reading or glymol colored red with alkanet root can conveniently be used.

The liquid beneath the fat column in a completed cream test may sometimes appear white and cloudy. This can usually be overcome by placing the test bottles in hot water for about 10 minutes previous to whirling or by allowing the fat to solidify, then remelt and read at about 140 degrees F. Duplicate tests of samples of cream should not vary more than .5 of a per cent.

Fig 1. Measuring the fat column in the neck of a cream bottle. Reading should be made from A to C not to B or D

Variations in Cream Tests

Considerable dissatisfaction among patrons of creameries or buying stations frequently is caused by the variation which they observe in tests of their cream. While errors occur in sampling and in the making of tests, more frequently if no variation occurs in the test of cream from a hand separator, a farmer has greater reason to doubt the accuracy of the tests than where variations occur.

Variations occurring in cream tests may be due to one or more of the following common causes:

(1) Change in the speed of the separator. The greater the speed of the separator the smaller the amount of the cream and consequently the higher the per cent of fat. A machine set to skim a 40 per cent cream when the handle is turned is 60 revolutions per minute, if turned 45 revolutions may only skim a cream testing 32 or 33 per cent.

(2) Variation in temperature of the milk separated. Variations in cream tests due to differences in temperature of the milk separated are different for different makes of separators, but in no separator is the variation as great as those caused by speed.

(3) Rate of milk flow into the bowl. The rate of inflow into the bowl of a separator is partially regulated by the float, but a variation in the amount of milk in the supply can will cause a variation in the amount of milk passing into the bowl. This will cause a variation in the quality of the cream separated. When the supply can is kept full there is the maximum pressure and the largest milk flow into the bowl. If there is less milk there is less pressure and a tendency for the fat in the cream to increase.

(4) Richness of milk separated. The per cent of fat in the milk separated may have a marked effect upon the percent of fat in the cream. The test of the cream will be highest when the milk is richest in fat. The majority of cows freshen in the spring and in general it may be said that the milk from those cows tend to increase in richness as the season advances. The per cent of fat in mixed milk might therefor run from 3.5 to 4 per cent fat which will change the test of the cream very considerably.

(5) Amount of water or skim milk used for flushing the bowl. A variation in amount of water or skim milk used for flushing the bowl at the end of a run is a common cause of variation in the cream test. When a small amount of cream is being separated a marked difference may be made by a change in the amount of skim milk or water added. A pint additional water or skim milk may change the fat content of the cream from 2 to 5 per cent.

(6) Adjustment of the cream screw. Reference need hardly be made to the adjustment of the cream screw as a cause of variation in the cream test. Almost everyone is aware of the fact that the cream

screw is a device adopted by separator manufacturers for regulating the richness of the cream. Changing the cream screw will therefor cause a variation in the test. The owner has sometimes set the screw as he imagined to skim a richer, but in reality to skim a thinner cream and the mistake is not evident until a test is made of the cream.

Questions and Answers

Q. 1. What is the composition of average milk?

Ans.

Water	87.10 per cent
Fat	3.90 per cent
Casein	3.00 per cent
Albumen	.40 per cent
Sugar	4.85 per cent
Ash	.75 per cent
	100. per cent

Q. 2. How should a sample of milk or cream be taken?

Ans. The milk or cream should be emptied from the can and thoroughly stirred until of uniform consistency throughout. A sample is immediately taken and placed in a sample bottle.

Q. 3. How should the sample be preserved?

Ans. A bottle with a tight cap or cork should be used. A corrosive sublimate or other preservative tablet is added to the first sample put in the bottle. The tablet is dissolved by shaking and each time an additional sample is added, the bottle is shaken thoroughly to mix it with the former sample or samples.

Q. 4 How is the sample prepared for testing?

Ans. The contents of the sample bottle are thoroughly mixed to secure uniform distribution of the fat by pouring rapidly from one bottle to another or by vigorous shaking. Heating the sample to about 110 degrees F. facilitates the mixing.

Q. 5. How can sour curdled milk be prepared for testing?

Add as much caustic soda or potash as will lie on the point of a knife Shake well then allow the sample to stand until the curd is dissolved.

Q. 6. How much milk is used for a test?

Ans. 17.6 cubic centimeters.

Q. 7. How should the pipette and test bottle be held when adding the milk?

Ans. Draw a diagram.

Q. 8. What quantity and what kind of acid is used?

Ans. 17.5 cubic centimeters sulphuric acid having a specific gravity of 1.82 to 1.83 .

Q. 9. What indicates the acid is too strong. ?

Ans. A dark column of fat or black particles through or below it

when the milk and acid are about room temperature and the mixing has been done immediately.

Q. 10. What indicates the acid is too weak?

Ans. A light fat column or the presence of white particles resembling curd where the work has been properly performed.

Q. 11. What can be done if the acid is too strong or too weak?

Ans. If slightly too strong use less acid; when much too strong dilute the acid with water. This should be done by pouring acid into water, never water into acid. When too weak add more acid.

Q. 12. How many minutes are the bottles whirled in the tester?

Ans. First whirling, five minutes then water is added; second two minutes, then more water; third, one minute, after which the fat is ready for reading.

Q. 13. At what temperature should the test be read?

Ans. At about 140 degrees F. This can be insured by placing the bottles in water at 140 degrees F. up to the top of the fat column and allowing to stand for five minutes.

Q. 14. How should the test be read in milk bottles, cream bottles?

Ans. Draw diagrams showing the proper reading in each.

Q. 15. Why should the cream sample be weighed instead of measured?

Ans. The composition of cream varies greatly, as does also its physical condition. The correct quantity (18 grams) can only be secured accurately by weighing.

Q 16. What causes bubbles of air on top of a fat column?

Ans. Air bubbles are usually due to the use of hard water. When the water which is used is hard, soften it by boiling or by the addition of a few drops of sulphuric acid. When possible use distilled or rain water.

Q. 17. How should glymol or other liquid used to remove the meniscus be added?

Ans. Allow the glymol to run slowly down the side of the neck of the bottle. When poured direct on the top of the fat column it tends to mix with the fat and make the surface indistinct and ragged.