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GUIDE

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Testing Milk by the Babcock Procedure

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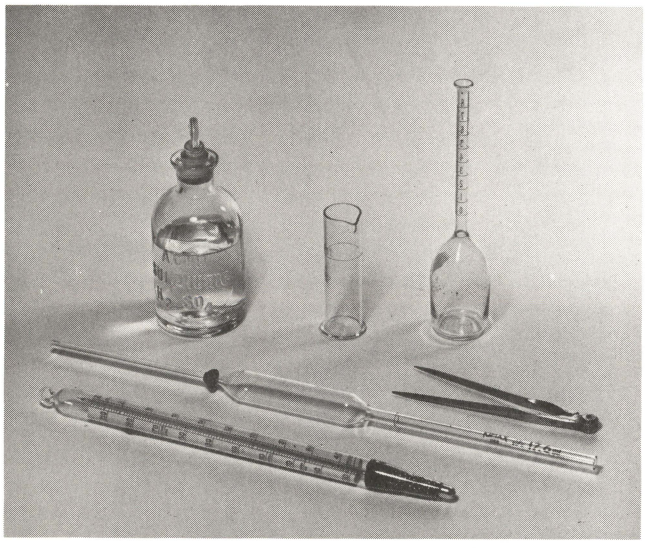
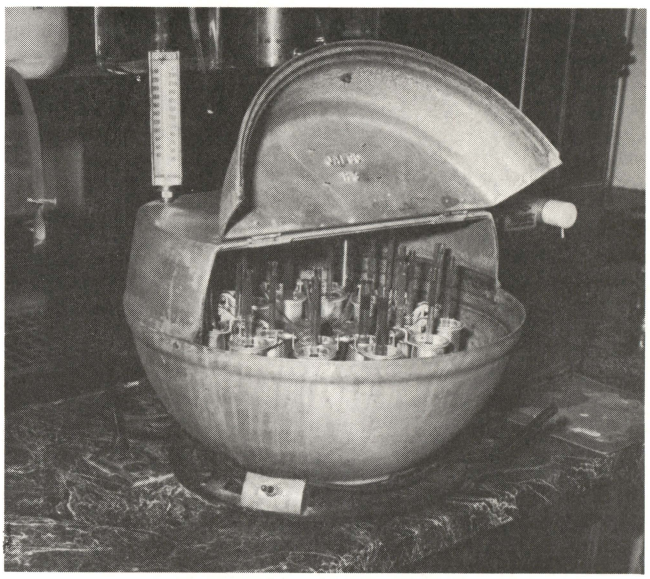
The Babcock test for butterfat is the legally recognized standard test for marketing milk and cream in Missouri. It employs the use of sulphuric acid to digest milk solids other than fat and to increase the specific gravity of the serum. Fat separates and comes to the top of the mixture when the specific gravity of the non-fat portion is increased; the butter fat is melted by heat from acid digestion of milk solids and by centrifugal force.

All calibrated glassware used in making the Babcock test must conform to official specifications prescribed in USDA Circular 434, National Bureau of Standards, Testing Volumetric Glassware, 1941, U.S. Government Printing Office, Washington, D. C.



Some equipment necessary for testing milk.



Babcock tester with heater and thermometer.

The cenrifuge should travel at sufficient speed to develop enough centrifugal force to separate the fat from the rest of the liquid. Below are the minimum speeds required for the different diameter centrifuge wheels:

Diameter - Inches	RPM of Wheel
16	849
18	800
20	759
22	724
24	693

Measure diameter of the wheel from the bottom of the horizontally extended cups across the center of the wheel to the bottom of the extended cups on the opposite side. The diameter is the straight line distance between these two points.

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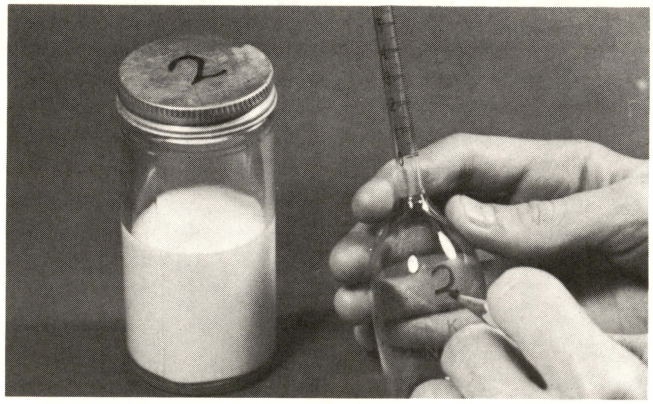
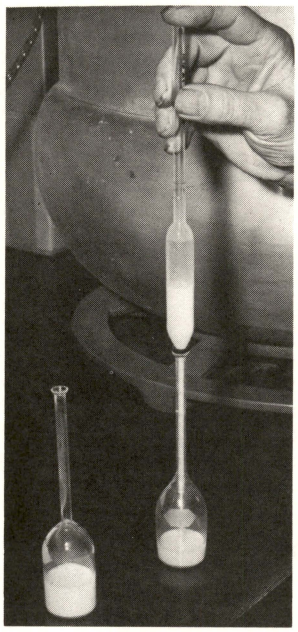
The steps for correct performance of the Babcock test are:

1. **Mark the sample bottles and test bottles plainly for identification.** Bottles must be clean and graduations clearly visible. The identification mark should not be easily removed.



Identifying the sample.

2. **Obtain a representative sample of milk; warm to 100°F (38°C) and mix thoroughly.** Mix by shaking horizontally back and forth six times in three seconds (each shake being a back and forth movement through a distance of about six inches). If the sample bottle is more than two-thirds full, mix by pouring the sample into another clean dry container and back again. Repeat this procedure at least twice (pouring a total of four times).



Transferring milk to test bottle. Insert pipette fully into the test bottle before releasing forefinger.

3. **Immediately insert a 17.6 ml Babcock pipette to approximately ½ the depth of the mixed sample and draw a sample.** This pipette will deliver approximately 17.5 ml of milk which will weigh close to 18 grams. Draw the milk well above the graduated mark of the upper stem of the pipette. Quickly place the dry forefinger over the upper end of the pipette and adjust the top-most surface of the milk exactly on the calibration mark of the pipette.

4. **Transfer the milk from the pipette to a Babcock milk test bottle** which is 6.5 inches in height, has a capacity of 18 g and is marked for 8%, graduated in 0.1% divisions. Insert the stem of the pipette all the way into the neck of the test bottle **before** releasing milk.

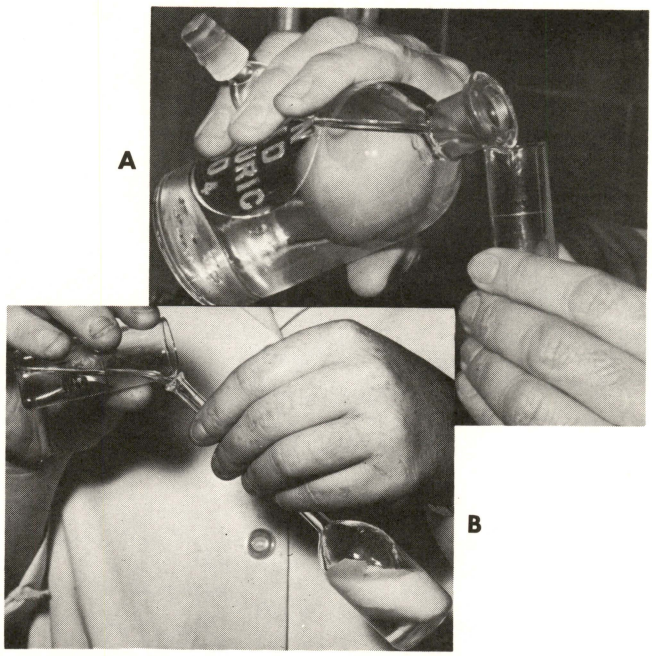
5. **Allow the pipette to drain until flow ceases. Blow the last drop from the tip.**

6. **Add 14 to 17.5 ml of sulphuric acid at the temperature of 65-75°F (18-24°C).** The acid and the milk should be at approximately the same temperature when mixed. Hold the test bottle at an angle and rotate it as acid is added to wash down milk clinging to the neck.

Avoid blending acid with the milk until such time as actual mixing is done. Don't pour acid directly through the milk, as this may cause charring and black particles that will obstruct reading of the test later. Use commercial sulphuric acid, specific gravity of 1.82 to 1.83 (preferably 1.825), at 68° F (20°C).

When not using acid, keep it closed. If left open, acid will absorb moisture from air.

Sulphuric acid is destructive to skin, clothing, wood, and most metals. If spilled, flood the area with water and soda, ammonia water, or other alkali to neutralize acid.



(A) Measuring acid and properly holding stopper, (B) adding acid to milk test bottle.

7. **Mix milk and acid by gentle rotation of bottle until curd disappears, and continue shaking for about one minute.** Start rotation gently, pointing the neck of the bottle away from yourself or other persons. Should any of the mixture get into the neck of the test bottle, pressure from the inside may blow it out, thus causing a loss of sample. Once begun, mixing must be continuous until completed.

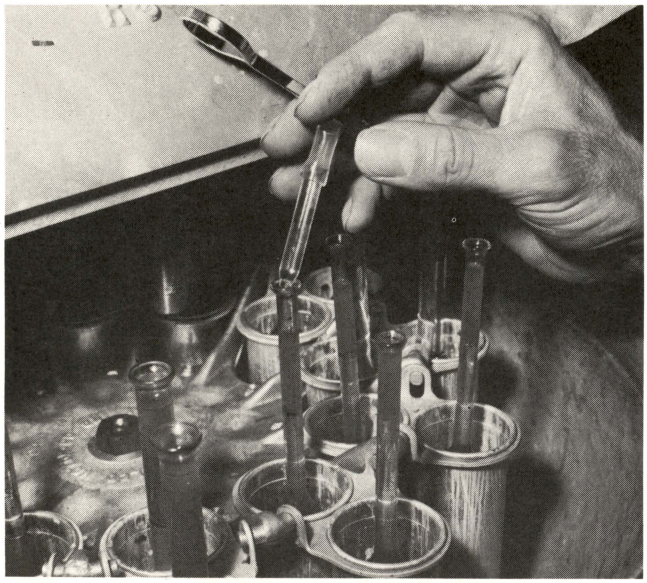
8. **Place the bottle in a heated centrifuge (Babcock tester) with a temperature of 140°F (60°C); cover and centrifuge for five minutes after proper speed is attained.**

The centrifuge must be loaded so that it will balance. This can be done by arranging the bottles equally on opposite sides of the centrifuge balance. If an odd number of samples is to be tested, a test bottle filled with water can be used to balance the load. Close the cover before starting the machine so as to prevent injury to the operator should a bottle break while whirling.

The centrifuge must be heated during operation to 130°-140°F (55-60°C).

9. **Add soft water at a temperature of at least 140°F (60°C) until the contents rise to the neck of the bottle.** Distilled or demineralized water is preferred. Hard water or water of high mineral content may cause foam or clouding at

the top of the fat column. If it is necessary to use hard water, add two or three drops of sulphuric acid per pint of hot water.



Adding water to test sample.

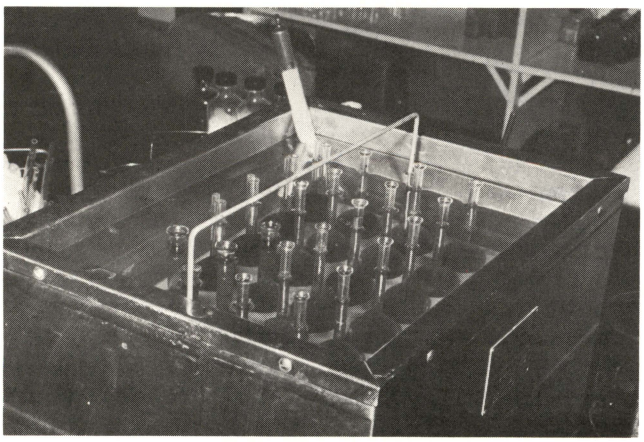
10. Centrifuge for two minutes.

11. Add water to bring the level to near the top of the graduated portion of the neck of the test bottle. If the bottle is overfilled, the test should be considered unreliable and must be performed again.

12. Centrifuge for one minute.

(An acceptable alternative is to completely fill the bottle with water the first time - step 9 - and to centrifuge only once for three minutes. Then proceed with step 13.)

13. Immerse test bottles in a water bath at 135-140°F (57-60°C). Allow the bottles to remain for at least three minutes. Three to five minutes are required for the lower meniscus (curved upper surface of the column of liquid) to assume final form. Water level in the bath should be slightly above the upper meniscus of the fat column. If water floods over the tops of the test bottles, tests must be performed again.

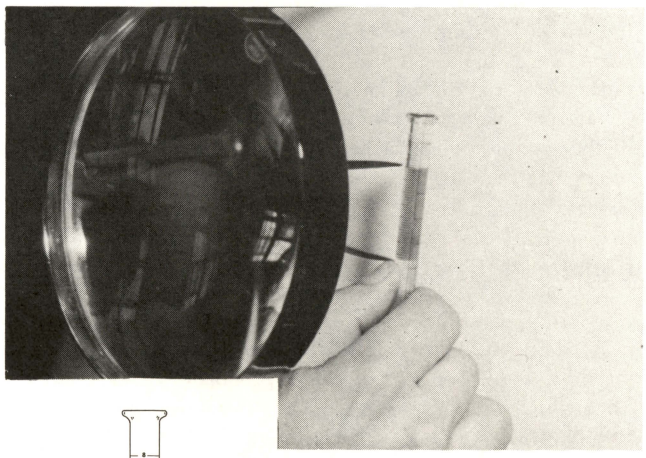


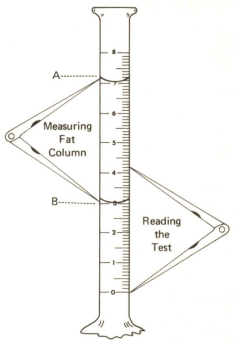
Water bath.

14. Read the test by directly measuring the length of the fat column from the lowest point of the lower meniscus to the extreme top of the upper meniscus. Remove bottles from the water one at a time, wipe, and with dividers or calipers measure the fat column, then compare this measurement with the graduated scale on the test tube. Read the results to the nearest 0.05%. Uniform temperature at time of reading is important. If test bottles are allowed to cool, the test results will be lowered.

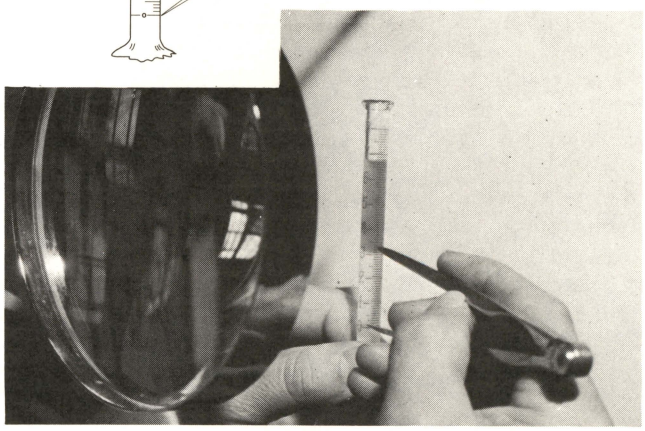
The fat column should be translucent, a golden yellow or amber color, and free from visible suspended particles. Reject all tests in which the fat column is milky or shows the presence of curd or charred matter or for which the reading is indistinct or uncertain.

When measuring the fat column, hold the test bottle in a vertical position. A magnifying lens and a source of diffused light will improve accuracy and ease of reading.





(Above) Measuring the fat column.
(Left) Read meniscus extremes.
(Below) Reading the test.



Obtaining and Preparing Sample

When sampling milk in cans or in containers of similar dimensions, a sampling tube is preferred to a sampling dipper because its use allows the removal of an amount proportionate to the total volume. This method is time consuming. It must be preceded by thorough mixing of the volume to be

sampled by pouring each container back and forth into an empty container or by vigorously stirring with a stirring rod. Agitation by using a sampling tube or dipper to stir the milk is not adequate.

Most sampling is now done from the farm bulk tank or from the weigh tank at the receiving plant.

In sampling a farm bulk tank, first measure the volume in the tank. Then operate the agitator for at least five minutes. A sample may then be taken with a sampling tube or dipper. It is a good practice to fill and empty the dipper or tube twice to remove residual sanitizing solution. Extract the sample on the third filling.

Weigh tanks at receiving plants may be equipped with an automatic sampling device. Take duplicate samples occasionally to check the adequacy of mixing to assure that a representative sample is being obtained. Check tests may be made by taking a sample in the regular manner, then agitating for one minute and taking sample. This should be repeated on 20 deliveries of milk. The average of the tests taken in the regular manner should agree within 0.2% with the test of samples taken following the one minute of agitation. This method should be used when a new tank is installed and every six months thereafter. Results should be available to interested parties.

Composite Samples

A composite sample is a mixture of single samples taken from two or more lots of milk. The amount taken from each lot must be representative of, and in proportion to, the amount from which the sample was drawn. Composite milk samples are frequently used as a basis for marketing milk. Though composite samples tend to test slightly lower than fresh milk samples, they are more economical to use because many more fresh milk samples must be tested to obtain a representative measurement for a 10 or 15 day period. The volume of a composite sample should be not less than 140 ml and no less than 10 ml should be taken at each sample.

Composite sample bottles must be kept clean. The bottle stopper must fit tightly and be of a non-absorbent material. Plainly identify the sample and store it at 35-50°F (2-10°C). Slightly rotate the samples after each fresh portion of milk has been added to mix the preservative with the fresh milk.

Preservatives used with composite sampling are corrosive sublimate (mercuric bichloride) and formalin. Add one corrosive sublimate tablet, not more than 0.5 g in weight, for an 8-ounce composite bottle. Add two drops of formalin, a 40% formaldehyde solution, for each ounce of milk one expects to preserve.

Composite samples should be warmed in a water bath at 110°F or less. Use thermometers in the water bath and in the composite sample bottle. Loosen stoppers and gently rotate bottles during warming. **Water must not be permitted to enter the samples.** When the samples reach 95-100°F they should be thoroughly mixed and are ready to be placed in test bottles with pipette.

Sampling Difficulties

If milk is slightly sour but not curdled, it can be thoroughly mixed and sampled in the usual manner. When milk is curdled, the fat is attached to the curd in an uneven distribution, and accurate sampling can't be achieved.

Securing a representative sample of milk is difficult if the fat has been partially churned. A reasonably accurate test can be secured only if the milk is heated to 100°F (38°C) to melt the fat, then agitated vigorously, and a sample taken immediately. Even then the oiled-off fat will tend to cling to the walls of the pipette.

Frozen milk should be melted and warmed to 100°F, thoroughly agitated, and then quickly sampled. The unfrozen portion of the milk is highest in fat.

Since it is difficult to obtain reasonably accurate results when testing sour, churned, or frozen milk, a notation should be made on the report as to the abnormality.

Imperfect Tests

Close adherence to the preceding directions will normally prevent testing failures. However, results will be imperfect occasionally. Some defects and probable causes are:

1. Foaming or bubbles in fat column. The cause is hard water which releases carbon dioxide upon coming into contact with acid. Treating the water with a few drops of acid should prevent this. If available, use soft water.

2. Black particles in fat column or obscuring lower meniscus:
   - (a) acid too strong
   - (b) too much acid
   - (c) acid at too high a temperature when added to milk
   - (d) milk too warm
   - (e) dropping acid directly into milk
   - (f) incomplete mixing of acid and milk
   - (g) allowing acid and milk to stand too long in test bottle before mixing
   - (h) mixing milk and acid too vigorously

3. light colored, cloudy or curdy appearance obscuring lower meniscus
   - (a) weak acid
   - (b) too little acid
   - (c) acid too cold when added to milk
   - (d) milk too cold when acid was added
   - (e) mixing was not continued long enough to dissolve all milk solids.

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. Carl N. Scheneman, Vice President for Extension, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.