MILK and FOOD SANITATION

PROCEDURES FOR SAMPLING AND TESTING MILK BY THE BABCOCK METHOD


For several years, committees of the American Dairy Science Association have been working on various aspects of the Babcock Test for milk. In 1947, one committee reported on the diversity of the procedures recognized by the different States in the United States. This report has been amplified and made current as of June 1, 1953, by Herrred. Another committee recommended that the volume of milk pipetted be increased and glymol added to the fat column before reading the test. This procedure has been approved by the American Dairy Science Association and is now under consideration by the Association of Official Agricultural Chemists.

The following Committee has also been approved by the American Dairy Science Association, the action having been taken in June, 1953. It is presented here as a recommended set of procedures for sampling and testing both fresh and composite milk samples for butter fat to the end that the Babcock Test may become standardized in the United States.

The construction of the weigh tank is important from the standpoint of securing an accurate sample. The care of composite samples is likewise very important. For these reasons, the first three sections have been included in a report dealing primarily with the Babcock Test.

I. Weighing Milk

1. The weigh tank shall be of such size and shape as to accomplish complete mixing of all the milk added. If it is not of this type, it shall be equipped with a mechanical agitator. It shall be maintained in a satisfactory mechanical and sanitary condition, free from dents or bulges which may prevent adequate draining.

2. Scales shall be checked daily with test weights. Twice each month scales shall be checked for accuracy at the maximum capacity from the weigh tank.

II. Sampling Milk from the Weigh Tank

A. Mixing or stirring before sampling
1. The milk shall be thoroughly mixed to insure the withdrawal of a representative sample for testing.
2. Verification of mixing efficiency.
   a. The method of securing a representative sample shall be verified at least monthly on several shipments of milk.
   b. When a weigh tank is used, the efficiency of the sampling procedure shall be determined by testing samples of the same lot of milk taken from five different portions of the weigh tank. When the tests of these samples differ by more than 0.1% fat, the mixing efficiency shall be considered unsatisfactory.
   c. If the mixing efficiency is not satisfactory as indicated by results secured in the above paragraph, each lot of milk shall be stirred vigorously with a hand stirrer for one minute prior to sampling.
   d. The accuracy of sampling milk which is not to be dumped in a weigh tank shall also be verified monthly by taking 5 samples at different time intervals of mixing or from different sampling locations of the same lot of milk.
   e. Abnormal milk
      a. All milk dumped into the weigh tank shall be sampled unless it is severely frozen. The producer, however, shall be notified if his milk is frozen, churned, or otherwise unsuitable for thorough mixing and corrective measures taken.

III. Care of Composite Samples

1. Preservative
   a. A preservative containing color shall be added to milk samples if they are to be tested more than 24 hours after taking. Formalin (30% solution of formaldehyde) may be added at a rate to not exceed 0.1% per 100 ml for each 30 ml of 2 drops per fluid oz or tablet. Tablets containing a preservative of proven efficiency may be used provided that the weight of the tablet or tablets does not exceed 0.5 gm per 8 oz bottle.

2. Period of composite sampling
   a. Composite samples shall be collected over a period not to exceed 16 days.
   b. Composite samples shall be tested within 24 hours after the last addition thereto, except where other arrangements have been made with the local regulatory agency.

3. Quantity of milk to be taken
   a. A minimum of 10 ml shall be taken from each producer's delivery of milk. The quantity removed shall be the same for each day during a composting period.
   b. The total composite sample at the time of testing shall be not less than 100 ml. If, for example, a producer delivers milk only two days during a composting period, then a minimum sample of 50 ml must be taken on each of the two days.

4. Size of sample bottle
   a. Composite sample bottles shall have a capacity of not less than eight ounces, free from cracks, and tightly fitted with a sanitary rubber stopper.
   b. Each bottle shall be identified with a legible, permanently attached mark of identification.
   c. Every sample bottle shall be clean and dry before the addition of a preservative and maintained in such a manner as to prevent the accumulation of moisture which may dilute the sample.
   d. Each milk plant shall be provided with at least two complete sets of sample bottles.

5. Method of sampling
   a. When a dipper, thief, or similar machine is used, it must be rinsed once with the milk which is to be sampled.
   b. When an automatic device is used, evidence must be available to verify the accuracy of the device with the milk to be sampled.
   c. If the weigh tank does not hold all the milk from one producer, the milk may be split into two equal portions and the same size sample taken from each portion. This practice must be followed during the full length of the composting period even if the volume of milk delivered daily should drop to a point where one weigh tank would hold it all. This procedure requires the use of two composite sample bottles. These samples may be mixed prior to testing or each bottle may be tested and the tests averaged for pay purposes.
   d. The composite samples should be gently rotated after the addition of each daily sample. Violent handling of trays or bottles should be avoided. Breakage or spillage should be avoided but if either occurs, a permanent record must be made showing date of accident and the identity of the sample.

6. Storage conditions
   a. The composite samples shall be stored away from strong light, in a clean, sanitary cabinet maintained at a temperature between 35°F and 50°F. The samples shall not be kept at room temperature for longer than one hour each day during the composting period.

7. Period held after testing
   a. All milk samples from completed and recorded tests shall be held at 50°F or under for at least five days after testing.

IV. Preparing Both Fresh and Composite Samples For Testing

1. Tempering
   a. Place the sample bottles in a tempering bath with the surface of the
Babcock Method

water slightly above the level of the milk in the bottles.

b. The temperature of the bath should not exceed 110°F at the time of placing the bottles in it. Shortly after, the temperature may be adjusted as the temperature of the milk rises, so that the final temperature of both baths and samples lies between 90° and 100°F. Two baths may be used; one for heating and one thermostatically controlled for holding at 90° to 100°F. Do not shake or mix the milk in the sample bottles until it has reached a temperature of 90°F.

d. Any sample bottle which may have a specific gravity of between 1.002 and 1.004 (g per g) should be discarded and a permanent record made of the date of accident and the identity of the sample.

3. Pipetting

a. Pipette immediately after mixing

b. The temperature of the milk at the time of pipetting shall be between 90° and 100° F.

c. The sample for testing shall be pipetted immediately after mixing.

4. Temperature of milk for pipetting

a. The temperature of the milk at the time of pipetting shall be between 90° and 100° F.

5. Pipetting

a. The composite sample, after reaching 90° F to 100° F, is poured into a mixing container and mixed with two round trips are made. The mixing container shall be drained at least 15 seconds prior to re-use.

b. If the bottle is not over 2/3 full, the sample may be mixed by shaking horizontally and forth with six round trips through a distance of about six inches within a period of three seconds. Care must be used to avoid churning which this procedure is used.

c. The sample for testing shall be pipetted immediately after mixing.

3. Temperature of milk for pipetting

a. The temperature of the milk at the time of pipetting shall be between 90° and 100° F.

4. Pipetting

a. The tip of the milk pipette (calibrated to contain 17.6 ml water at 20°C) should be at level approximately equal to the height of the milk in the sample bottle. The pipette is then filled up to the marked surface of the pipette, is even with the graduation mark on the pipette. The milk is then discharged into a test bottle by inserting the whole length of the long delivery tube of the pipette into the neck of the test bottle before releasing its contents. The lip of the test bottle must be vented to permit air to escape readily from the bottle, preferably by means of a grooved rubber washer at the base of the bulb of the pipette.

b. When the charge has drained, usually about 10 to 15 seconds after free flow has stopped, blow out the last drop or remove the pipette from the test bottle with a quick upward movement in order to remove the last drop from the bottom tip of the pipette. Two pipettes, used alternately, may be found advantageous.

V. Testing Milk For Butterfat

1. Sulphuric acid

a. The sulphuric acid used for the test shall have a specific gravity of between 1.82 and 1.83 at 60° F. (This amount shall not be less than 14 ml.)

b. Adding acid to the milk

a. The temperature of the milk at the time of addition of acid shall not exceed 90°.

b. The test bottle shall be held at an angle and the acid added slowly all at one time. The blending of milk and acid should be avoided until such time as actual mixing is begun.

c. The mixing of milk and acid should be started gently by rotating the test bottle until visible curd disappears. Continue shaking for an additional period of at least 30 seconds. The length of the time of shaking is very important in obtaining accurate tests. If formaldehyde is used as a preservative, a total mixing time of three minutes is recommended.

d. The bottles should be placed in a heated centrifuge as soon as possible after mixing milk and acid.

3. Centrifuging

a. The temperature within the operating area of the centrifuge shall be thermostatically controlled at 140° to 150° F while in operation. An accurate thermometer shall be permanently attached to the centrifuge in such a manner that it will indicate the temperature in the general area wherein the test bottles are being whirled.

b. The centrifuge shall be mechanically driven, free from vibration, and at the following speeds:

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<thead>
<tr>
<th>Diameter of Wheel</th>
<th>Minimum RPM</th>
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<tbody>
<tr>
<td>16 inches</td>
<td>848</td>
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<tr>
<td>18 inches</td>
<td>800</td>
</tr>
<tr>
<td>20 inches</td>
<td>759</td>
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<td>22 inches</td>
<td>724</td>
</tr>
<tr>
<td>24 inches</td>
<td>693</td>
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</tbody>
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4. Pipetting

a. Pipette the test bottles shall be transferred to the water bath immediately after the final centrifuging period.

e. At the time of reading: the entire fat column must be within the graduated neck of the test bottle.

5. Tempering baths

a. The temperature of the water in the bath shall be between 130° and 140° F, preferably 135° F.

b. The water shall be maintained at a level equal to the top of the fat column in the test bottles.

c. The test bottles shall remain in the water bath for a period of not less than three minutes.

d. Tests shall be read immediately after removal from the water bath.

6. Reading tests

a. Sharp needle-pointed dividers or calipers shall be used for measuring the fat column.

b. The bottle shall be held vertically and at eye level in front of a source of indirect light at the time of measuring. One type of illumination is the "Fluorescent Titrating Illuminator" manufactured by the Fischer Scientific Company.

c. The use of a five-inch magnifying lens as an aid in reading the top and bottom meniscus is recommended.

d. The fat column shall be measured in its entirety from the bottom of the lower meniscus to the top of the upper meniscus. (The word "meniscus" refers to the saucer shaped surface at each end of the fat column. The bottom of the meniscus would correspond to the bottle of the saucer and the top of the meniscus would correspond to the outer rim of the saucer.)

e. The fat column shall be measured on the ungraduated side of the neck and the test read from the graduated scale.

f. The fat test shall be read to the nearest 0.1.

g. Tests in which the fat column is foamy, burnt, or curdy shall not be read.

VI. Glassware

a. Calibrated glassware used in making the Babcock test shall conform to the minimum standards set forth in the latest edition of the Official Methods of Analysis of the Association of Agricultural Chemists or any supplement thereto.

NOTE

In the event that the American Dairy Science Association Modification of the Babcock Test [Jour. Dairy Sci. 33, 685, (1950)] is adopted by the Association of Official Agricultural Chemists, the following changes in this report are necessary.

1. Pipette (Section IV-4-a).
   The A.D.S.A. modification requires a pipette calibrated to contain 18.05 ml of water at 25° C.

2. Reading the fat column (Section V-8-d).
   The A.D.S.A. modification requires the addition of two drops of glymol before reading the test. The fat column is then measured from the bottom of the lower meniscus to the fat-glymol line.

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products received at the frozen dessert manufacturing plant. Raw milk is checked for off odor, and occasional sediment tests are made. Cream may be tested for acidity where thought to be suspicious. Samples of any dairy product may be sent to the State Food Laboratory where the product appears to deviate from the normal in any way. On rare occasions, due to a complaint, an inspection of the dairy barn and equipment where the milk is produced may be made. However, a very large percentage of the cream, milk, and condensed milk produced from New York State dairies and used in frozen dessert manufacture is surplus from dairy farms and plants under municipal inspection.

We do not have, at the State level, a bacteria standard for dairy products entering into frozen dessert mix or for the finished product. We do think that consideration should be given to the study of proper bacteria standards for frozen desserts and dairy ingredients entering therein.

In conclusion, we have not done very much work on the dairy products entering into the mix, but have concentrated on proper pasteurization of the mix, on plant sanitation and proper handling of the product during and after manufacture, and checking to make sure the frozen desserts meet the standards as set up in Article 4-A of the Agriculture and Markets Law.

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In Pennsylvania, the milk used in the manufacture of ice cream must be produced and processed under the same requirements as fluid milk.

I believe Pennsylvania is unique, as it is the only state, as far as I can ascertain, that requires the inspection of all dairy farms at least twice a year by an Approved Inspector, sometimes called plant inspectors. The reports must be filed at the plant of the permit holder, for the inspection and approval of the Secretary of Agriculture. The permit holder shall not receive milk in the plant from any farm unless the farm has been inspected by an Approved Inspector.

This procedure makes the permit holders responsible for the supply, and they can take on new dairies or exclude dairies without contacting the official enforcement agency.

This system of making permit holders responsible for their supplies eliminates a great deal of work for the state enforcement officials, as we only check a percentage of the farms before issuing a permit. In fact, when we inspect farms, we are actually checking on the efficiency of the Approved Inspector to determine if he is scoring the farms properly, so we can get an accurate picture of the total supply by analyzing the reports filed at the plant.

Pennsylvania has used this method of enforcement for about twenty-five years and has found it to be effective as the results of bacteriological analyses have shown that our milk supply is of good quality and safe for human consumption.

At the present time a committee, comprised of local and state enforcement agents, is attempting to develop a farm inspection report that can be used and accepted by all enforcement agencies in this milk shed.

We appreciate and encourage the co-operation of all state and local agencies in working out this program, as we believe the co-operation of all is necessary to accomplish the results that we are all attempting to attain.

Paul M. Richards graduated from Pennsylvania State College with a B.S. Degree in Agricultural Chemistry. He was employed by the Pennsylvania Department of Agriculture for about three (3) years, and then went with the Keystone Chocolate Company in a supervisory capacity. From 1934 to 1940, he has been field representative of the Pennsylvania Department of Milk Sanitation, Assistant Director of the Bureau of Milk Sanitation from 1940 to 1943, and since April 1, 1953, has been Director of the Bureau of Milk Sanitation.

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**DAIRY FOODS SERVED**

If you wanted coffee at the recent Minneapolis Farm Forum you had to ask for it.

The event sponsored by the Minneapolis Chamber of Commerce, featured dairy foods at two luncheons. Half pints of milk were served at each place along with generous amounts of butter and cheese.

The dairy products had been contributed by Land O'Lakes Creameries, Inc., Minneapolis, in an effort to encourage other civic luncheons to follow suit.

The gesture gained the attention of Governor C. Elmer Anderson, who told a joint meeting of the Minnesota Farm Bureau and Minnesota Dairy Industry Committee that he recommended the practice at all similar functions.