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SOME NEW POINTS IN THE MANIPULATION OF THE BABCOCK MILK TEST.

Testing milk by Dr. Babcock's method has generally been considered a very simple process. The details of the method were so elaborately and carefully worked out by him, before publication, that no improvements in the chemical reactions have been suggested to make the process any more useful or successful than when first described. Beginners have found, however, that to make an accurate test of milk requires somewhat more attention than is necessary to turn the crank of a churn. Many who have used the process have had more or less trouble from foreign substances, either black or white, separating with the fat. These make an obscure reading of the per cent of fat because of the indistinct separation of the liquids. The common remedy suggested for this difficulty has been a change of acid. If there is "black stuff" in the fat, get a weaker acid; if a white curd separates in the fat column, change to a stronger acid. That a too strong or a too weak acid may cause this trouble is undoubtedly correct in many cases, but not always. The manipulation of the test may also cause these defects.

It was found by the writer that nearly if not all the acid sold in Chicago for this purpose was made at one factory, and by conversation with the manufacturer it was learned that the still making this acid was running day and night, turning out the same quality of acid without change.

It has generally been supposed to be easier to test a mixture of the milk of several cows than the milk of one cow, and that possibly there might be found a cow's milk which could not be successfully tested. The observations given in this article are the results of a great many experiments made with the milk of each of the seventy-five cows now in the dairy test at the World's Columbian Exposition.
Since May 1st we have made at least 150 tests of milk every day. During this time samples of a great variety of milks have been tested. There have been great variations in the composition of these milks and in the characteristics and health of the cows. We have been able to test successfully any milk yet received, and by proper manipulation, to get a very clear separation of the fat.

A bad separation is not always caused by the strength of the sulphuric acid. Our work has demonstrated that, by slight changes in the manipulation, at least three kinds of tests can be made of one sample of milk with the same acid.

First, a test giving a very clear separation of fat; second, a separation of fat which contains more or less of a black, flocculent substance, especially at the bottom of the fat column; and, third, a test very much like the second, except that a white, instead of a black, substance interferes with a clear measurement of the fat.

The black substance that appears is probably charred fat and indicates too strong an action of the acid on the milk. The white adulteration of the fat shows either too weak a reaction or an incomplete separation by the centrifuge. Each of these defects can, of course, be produced by acid either very much too strong or too weak. They can also be brought out, by different manipulation, when acid having the correct strength is used.

If the acid is so poured into the milk in the test bottle that it passes through the milk, instead of following down the inside walls of the test bottle, a portion of the milk is thus acted on by the strong acid before it becomes diluted with the water in the milk. This makes a more intense action of the acid on a small part of the milk, and the fat it contains is somewhat decomposed and blackened. This black substance is then separated with the fat by the usual method of finishing the test and makes the measurement of the fat uncertain.

Another cause of the "black stuff" in the fat is too warm milk. Sulphuric acid, sp. gr. 1.82, may work all right for testing milk when both acid and milk are at a temperature of 60° F.; but if the weather changes, or the testing is made in a warm room where the temperature is up to 80° or 90° F., a great deal of black stuff may be found in the fat.

The action of the acid on the milk will be more or less intense, according to the temperature of the liquids. Persons who have tested milk throughout the year, at creameries or other places, may have noticed that in winter the fat is often light colored or whitish, while in summer it is deeper yellow. This variation in color is caused by the difference in the temperature of the milk and acid as well as the strength of the acid. Cooling the milk in the test bottles, before adding acid, will often prevent the formation of the black substance which appears in the column of fat.

The white, curdy substance that sometimes separates with the fat can be destroyed either by adding the hot water necessary to bring the
fat into the neck of the test bottle, in two portions, and whirling the test bottle in the centrifuge after each addition of the water, or by warming the milk in the test bottles, so that it will be about 80° F. when the acid is added.

It is my opinion that returning the supply of acid to the party from whom it was bought is often unnecessary. Any person who has trouble from either the black or white substance separating with the fat can probably remedy the difficulty by some changes in the manipulation, provided the acid is anywhere between 1.82 and 1.83 sp. gr. at 60° F.

No exact experiments have been made yet to determine the relation between the temperature of the milk and acid, and the sp. gr. of the acid, but I will venture to guarantee an entirely satisfactory working of the Babcock milk test if, in addition to the elaborate details which the originator of the method has already worked out, the following precautions are observed:

First—An acid having 1.82 sp. gr. should be used with milk at 60° to 70° F. If the acid is stronger, cool the milk to a lower temperature. Somewhat weaker acid can probably be made to work all right by warming the milk.

Second—When measuring the acid into the test bottles, hold the bottle at an angle that will cause the acid to follow the inside walls to the bottom of the bottle and not drop through the milk in the center of the bottle. If properly poured into the test bottle there will be a distinct layer of milk and acid with little or no black color between them.

Third—Thoroughly mix the milk and acid as soon as measured into the test bottle. A better separation of fat is obtained by mixing at once than by allowing the two liquids to stand unmixed in the bottle until enough tests have been measured out to fill the centrifuge.

Fourth—After five minutes whirling of the test bottles in the centrifuge, add hot water until the test bottle is filled up to the neck only; run the centrifuge one minute, then fill the neck of the test bottle with hot water and run the centrifuge another minute. Adding the necessary hot water in two portions is often a great help in getting a clear separation of fat. When the test bottles are taken from the centrifuge they are put into water at 140° to 160° F., and the per cent of fat read at that temperature.

Fifth—Too low results will be obtained if the centrifuge does not have sufficient speed. The machines have to be watched, as constant use wears some of them so that the speed designed by the manufacturer is not obtained.

Sixth—When testing skimmilks or buttermilks which have a very small per cent. of fat (two-tenths of one per cent or less), the reading of the per cent of fat should be made immediately on taking the test bottle from the centrifuge. If this is not done, and the test bottle cools before taking the reading, the contraction of the liquid in the bottle will often leave the fat spread over the inside surface of the
measuring tube so that it is not seen but has the appearance of being only a dirty tube. If read when taken from the machine, the small globules of fat can be seen and estimated.

It has been stated by foreign critics that one reason why they did not use the Babcock milk test was because their work in the dairy line had been done for years by the old methods long in use, and in order to make their present and future work compare with the past they must use the same old methods of their fathers. Our work for the past two months has given each day triplicate proof of the accuracy of the Babcock method for testing milk. The milk of each of the three herds of twenty-five cows is creamed and churned daily. The skimmilk and buttermilk are tested, and the butter from each herd analyzed every day. The butter fat, found by testing the milk of each of the twenty-five cows in each herd, is nearly all accounted for by the analyses of the skimmilk, buttermilk, and butter.

The records show that from June 1st to Aug. 3rd there has been an average loss in fat of 0.166, 0.161, and 0.153 per cent of the total milk produced by the three herds. This small loss of fat by the manufacture of milk into butter demonstrates that if this method is correctly used in dairy experiments, and the results of such investigations are not comparable with those of the past, it is not the Babcock milk test which is wrong. There is some other cause for the discrepancy.

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