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BULLETIN NO. 32.

AN ACID TEST OF CREAM.

The sourness of cream is one of the things considered by many dairymen in making butter. They may not agree on the amount of acidity that cream should have when it is ready for churning, but many base their judgment on the taste or appearance of the cream.

The first record of a measurement of the acidity of cream before churning, so far as known to the writer, was reported in 1887 by John Sebelein, in *Versuchs-Stationen*, XXXIV, p. 94. He used an alkaline liquid of known strength (one-tenth normal) and by adding a few drops of a liquid indicator, phenolphthalein, to a measured quantity of cream (50 c. c., or about one-tenth of a pint) the amount of acid in the cream was estimated by measuring the quantity of the alkaline liquid that it was necessary to add to the 50 c. c. of cream in order to produce a pink color in the cream tested. The indicator, phenolphthalein, has the property of causing a pink color in some alkaline liquids, but does not change the color of acid solutions. This gives a means of measuring the amount of acid in milk or cream by noting the quantity of an alkaline liquid of known strength that will produce this pink color in a measured amount of cream. The strength of the alkaline liquid and the amount of cream taken for each test are constant, known quantities, always the same in comparative trials of different lots of cream. The amount of acid in the measured quantity of cream is unknown until, by testing, it is observed how much of the standard alkaline liquid it is necessary to use to produce the pink color. A one-tenth normal solution of an alkali is of a definite strength understood by chemists. The alkali may be caustic soda, potash, lime, or baryta. All these are efficient and results will be comparable, if a one-tenth normal solution of any one of them is used.

In the fall of 1889 this method of testing the acidity of cream was used by Dr. Manns, at the creamery of Gurler Bros., DeKalb, Ill., and also in churnings of cream which he made at this Station. He found that when cream was churned at a temperature of 58° to 62° F. too much acid in the cream injured the quality of the butter, and too sweet cream churned at this temperature caused a loss of butter in the butter milk. The butter was not all churned out unless the cream was sufficiently soured. The butter was of poor quality if the cream was too sour. These trials indicated that, so far as the acidity of the cream had an influence on the flavor of the butter and on the thoroughness of the churning at 58° to 62° , the best results were obtained when the acidity of 50 c. c. of cream was neutralized by about 40 c. c. of one-tenth normal alkali. This work was published in bulletin No. 9, of this Station, May, 1890. The "per cent of acidity" as given in that bulletin can be converted into c. c. of one-tenth normal alkali by multiplying the "per cent of acidity" by 5,000 and dividing by 87.

A Chicago dealer in dairy supplies put on the market the necessary outfit for testing the acidity of cream by the method already described, under the name of "Manns acid test." The apparatus is sold for \$5.00 and the "neutralizer," or one-tenth normal alkaline liquid, at \$1.00 per gallon. This amount of the liquid ought to make about 100 tests of cream. The liquid itself is not expensive, but its exact strength must be accurately determined by a person who has the necessary apparatus for testing it. In order to use this test it is also necessary to have a burette for measuring the alkaline liquid, a pipette for measuring the cream, and an alcoholic solution of phenolphthalein. The necessary manipulations in using the test are simple and the method has given good satisfaction to the writer and others in practical dairy work. The same amount of acidity in cream may not be universally adopted, but no one wants cream to sour until it spoils the flavor of the butter.

This acid test of cream has been extensively used by Gurler Bros., and at other places. Since it was first introduced, Mr. H. B. Gurler observed that the exhaustiveness of churning, or the complete separation of all the butter from the cream by churning, was largely influenced by the temperature at which cream was churned rather than by the acidity of the cream. The practice in his creameries during the past year or more has been to churn thick separator cream, contained 25 to 35 per cent of fat, at a temperature of 45° to 55° F., usually about 52° F. This is the temperature of the buttermilk when drawn from the churn immediately after the butter "comes," and not always the temperature of the cream when it is put into the churn. If the churning is done in a warm or cold room the temperature of the cream will gradually attain the temperature of this room, although it may have been warmer or cooler than the room when it was put into the churn, so that the temperature of each churning is the temperature at which the butter comes.

When cream is obtained by the gravity processes of setting milk, it

does not often contain much over 15 per cent of fat. Such cream is ordinarily too thin to be churned at this low temperature, but must be ripened and churned at about 62° F. The best separators, however, can be so regulated as to give cream of a desired thickness and at the same time skim the milk so thoroughly that only a trace of fat is left in the skim milk.

It has been found by Mr. Gurler in his practice and by observations made by the writer at his creameries, that thick cream containing about 30 per cent fat can be churned at about 52° F., so that there is only a trace of fat left in the buttermilk. This shows that under proper conditions the churn can be made to do as efficient work as the separator, and that within certain limits, the thickness of the cream and the temperature at which it is churned have more influence on the exhaustiveness of churning than does the acidity or sourness of the cream. Although this is true, an acid test of cream can be of great practical value especially for the purpose of indicating the proper degree of ripeness of cream to be churned; for if cream continues to ripen after it has reached a certain amount of acidity, another kind of fermentation seems to take place which injures the quality of the butter.

The fermentation or souring of cream is caused by bacteria. These are plants which are seen only by the aid of a powerful microscope. They multiply amazingly fast when kept at the proper temperature. Among plants which we can see without any microscope there are certain varieties which we call weeds. If weed seeds are in the soil they grow as well as the good seed which we plant. The same thing is true of the microscopic plants, bacteria. There are some which we are as anxious to keep out of cream as we are to prevent the growth of weeds in a corn field, and there are others which at present are considered to be the agents in producing a fine flavor in butter.

Dirt is the source of most all "bad" bacteria which find their way into milk, cream, and butter. If everything was clean through which the milk passes, from cow to caddy of butter, it would be a comparatively easy matter to plant a pure culture of bacteria in cream, and get that ferment alone, or in large excess over all others; but, like weed seeds in soil, we have to contend with bad bacteria, which grow up and choke the good seed and all the superior qualities thereof.

If great care were taken to keep the cows clean, the milker clean, and the milk dishes clean, there would be a greater certainty of producing a high flavored and high priced butter, because there are fewer weed seed bacteria in clean milk and cream.

The rate at which cream ripens in ordinary practice is not often uniform. It is not only influenced by the cleanliness of the milker and dairyman, as mentioned above; but the weather, the temperature at which the cream is set for ripening, and the amount of fat in the cream also influence the rapidity of souring. Hot or warm, muggy weather has a tendency to hasten souring, while a clear, bright atmosphere, as

well as cold, are not so favorable for the growth of the bacteria which cause cream to sour.

Since it is the milk sugar that ferments when cream sours, it is obvious that thin cream, with only ten to fifteen per cent of fat, contains more milk sugar and will sour faster than rich cream which contains more fat and consequently less milk sugar and casein.

These uncertain quantities, cleanliness, weather, and richness of the cream, which all have an influence on the rate at which cream sours, show the value of some simple test to indicate the amount of acidity in cream for churning; for, as said above, after cream has soured to a certain point, another kind of fermentation takes place that injures the quality of the butter.

A simple test that will indicate the amount of acid in cream can be used to show when cream is sour enough to suit the standard adopted by different men and markets. A uniformity in the sourness can thus be obtained by churning each lot of cream when the test shows a certain amount of acidity, and no lot of cream need spoil from over ripeness, as the test will show when the danger point is near.

In following up this line of work the writer has developed a method of

CREAM TESTING WITH ALKALINE TABLETS.

A formula has been worked out by which a definite amount of solid alkali can be made into a tablet containing both the alkali and the indicator necessary for testing the acidity of cream or milk.

Each tablet contains a definite amount of alkali which will neutralize as much acid as 4.66 c. c. of a one-tenth normal alkaline liquid. A test of a number of the tablets showed them to be very uniform in the amount of alkali contained in each tablet. The extreme difference amounted to three-tenths of one c. c. of the one-tenth normal liquid. One thousand tablets weigh about twelve ounces. Each tablet is about three-eighths of an inch in diameter and one-eighth inch thick, and they can be used instead of the one-tenth normal alkaline liquid and the liquid indicator mentioned on page 390.

The tablets can be used for testing the acidity of cream in the following way:

DISSOLVING THE TABLETS.

Label several clean 4 or 6 oz. white glass bottles, No. 1, No. 2, No. 3, etc. Put one tablet into each of the bottles numbered 1; two into each numbered 2; and three into each bottle numbered 3, etc.

The bottles can be labeled by roughening a place on the side of the bottle with a wet file. The number can be marked with a lead pencil on this rough surface.

Add to each bottle enough clean, soft water to completely cover the tablets and let them stand until the tablets are all dissolved. They

will dissolve faster in hot than in cold water. If the solution of the tablets is hastened by shaking the bottle or stirring the liquid, it should be done in such a way as to prevent any loss. As they do not dissolve immediately they should be put to soak about one-half hour before the cream is to be tested. The strength of the solution does not change perceptibly by standing four or five hours, but there is some change in a tablet solution which is a day or more old. The solid tablet will not change, and the only precaution necessary is to use a fresh solution of the tablets in testing the acidity of cream. Excepting the flocculent residue or settlings, which will not dissolve in water, the tablets should all disappear in the solution before it is added to the cream to be tested. When the solution is complete the bottles contain a reddish colored liquid, the alkaline strength of which is indicated by the number on the label of the bottle that shows how many tablets were put into each bottle.

TESTING THE CREAM.

The cream to be tested should be thoroughly mixed. Then measure 25 c. c. of the cream into a glass tumbler or a cup. If the cream is very thick, 25 c. c. of clean rain water may be mixed with it in the dish. The sourness of the cream is then ascertained by adding the reddish colored solution of the tablets to this measured quantity of cream until it retains a pinkish color. When the two liquids, cream and tablet solution, are thoroughly mixed, the pink color does not remain permanent until the acid of the cream is completely neutralized by the alkali of the tablets. An excess of the alkali causes the color to increase. The acidity of the cream is measured by adding just enough of the alkali to produce a permanent change of color from white to pink. No further addition of the alkali is necessary, as the first change of color indicates the point when the acid is all neutralized. A piece of white paper placed under the tumbler in which the cream is tested will help to show the change of color. It will be found to be more accurate to adopt as the end of the test the point when the first change of color appears and the cream is no longer white, rather than to try to get a certain shade of pink color every time.

The amount of alkali required to produce this change of color shows the sourness of the cream as indicated by this test. A change of color may be produced in 25 c. c. of sweet cream, by a solution of one or two tablets. As the sourness of the cream increases, 25 c. c. of it may require a solution of three, four, or five tablets to change the color.

The indications are that a cream which requires a solution of six or more tablets to change its color is too sour. The butter made from such cream will be "off flavor." The only general direction that can now be given as applicable to nearly all cream, is to churn it when 25 c. c. of the thoroughly mixed cream is not colored by a solution of four tablets but is decidedly colored by a solution of five tablets.

Some dairymen may prefer to churn a less acid cream and adopt the sourness of cream which will give a color with a solution of three tablets.

Comparative trials made by each person of the acidity of the cream and the flavor of the butter made from it will be a satisfactory guide to follow.

This test will show the sourness of each lot of cream so that a uniformity of acidity can be had in each churning. How much acidity each lot of cream should have, or whether cream should be churned sweet or sour, may be a matter of opinion with the butter maker. This test serves as an aid to show him when the cream is of the sweetness or sourness which he prefers. It will also show when the cream ought to be churned in order to prevent it from spoiling the butter by ripening too far and becoming too sour for the best results.

These tablets are made by Charles S. Baker & Co., Grand Crossing, Chicago, Illinois. The complete outfit, including one thousand tablets and one 25 c. c. pipette, costs \$2.50 delivered. One thousand tablets ought to make 250 tests of cream.

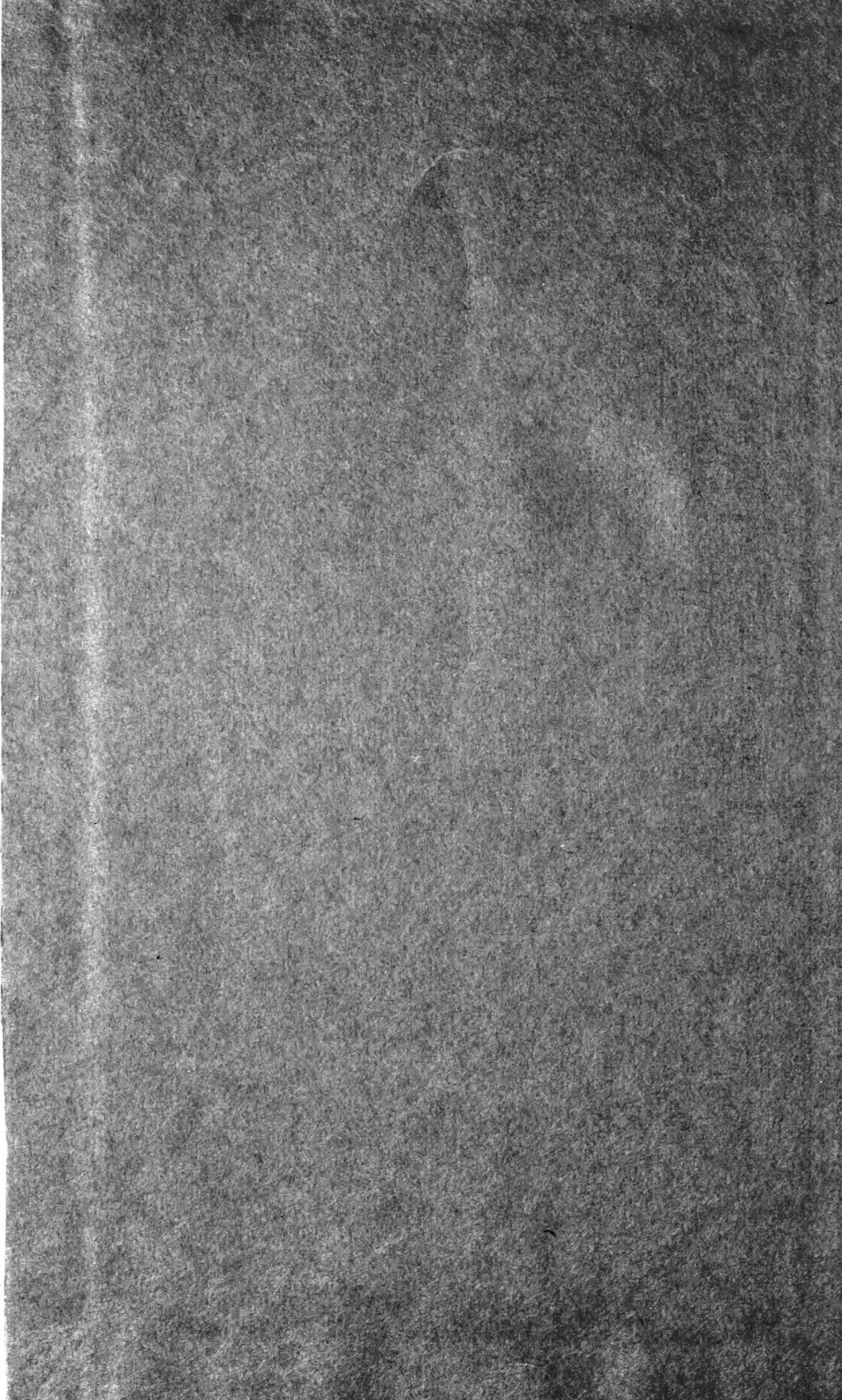
E. H. FARRINGTON, M. S., Chemist.

All communications intended for the Station should be addressed, not to any person, but to the

AGRICULTURAL EXPERIMENT STATION, CHAMPAIGN, ILLINOIS.

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