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THESIS

A Simple Test For Sour Milk

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Tressie Bristol

A SIMPLE TEST FOR SOUR MILK.

In nearly all forms of dough mixtures a supply of CO_2 gas is necessary for the leavening or "raising" of the mass. This is obtained in various ways, but the ordinary housekeeper is limited to the use of yeast, baking powder, or soda, and for the preparation of many articles of food the last two only are practicable. Baking powder, when pure, is a neutral mixture of cream of tartar, soda, and starch, containing about twelve percent of CO_2 gas, which is liberated by simply dissolving the powder in the batter, dough, or whatever it may be. Since baking powder is of itself a neutral substance, i.e., neither acid nor alkali, it cannot be combined with an acid one, e.g. sour milk, if the resulting compound is to be neutral, but it must be used in combination with water or sweet milk. The action of soda (sodium bicarbonate, $NaHCO_3$) is very different. It is an alkaline salt, containing over fifty two percent of CO_2, which is liberated by the following chemical process: Sour milk contains a varying proportion of lactic acid, and this lactic acid unites with the bicarbonate to form sodium lactate, CO_2 gas being liberated at the same time.

In comparing the use of soda and sour milk with the use of baking powder there are two points in favor of the former. In the first place, it is more economical, in that it disposes of a quantity of material which would be useless for other purposes. Secondly, the amount of chemicals remaining in the mixture is much less with soda than with baking powder. It has been stated that pure baking powder contains only twelve percent of carbon dioxide, while soda contains fifty two percent. A level teaspoonful of soda contains 2.2 grams of

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CO_2, while a rounding teaspoonful of baking powder contains only .696 grams. One even teaspoonful of soda is sufficient for one pint of sour milk, but to produce an equal amount of CO_2 it would be necessary to use three rounding teaspoonsful of baking powder, or six times the bulk to the same amount of liquid. It is easy to see from this that the double tartrate of potassium and sodium (Rochelle salts) which is left behind from the baking powder must be present in much larger quantity than the sodium lactate which is formed in the other case. The same thing is true in a greater degree when the equivalent of baking powder i.e. soda and cream of tartar, is employed. This chemical mixture known as Rochelle salts is used in medicine for its cathartic properties, and the question has recently been raised as to the healthfulness of consuming so much of it in baking powder mixtures. Whether its effect is injurious or not, the presence of such a quantity of foreign substance is certainly not an advantage.

But while the use of sour milk and soda is preferable in the ways noted, it has also a disadvantage. The housekeeper finds, for example, that it is a very easy matter to make buscuits"according to [illegible]" and a very difficult one not to have them yellow and unappeti[illegible]. The trouble lies in the fact that an excess of soda has been used. [illegible] purpose, as before explained, is to neutralize the lactic acid and [illegible] the mixture light by the consequent liberation of CO_2. If more [illegible] present than is sufficient to accomplish this purpose, the heat [illegible] oven causes the amount remaining to undergo a chemical change, [illegible] become sodium monocarbonate (sal soda, Na_2CO_3) with a further [illegible]ion of CO_2. This [illegible] soda [illegible] the yellow color, becoming

greenish if a very large excess has been added, owing to ignorance of the exact amount of acid present in the milk. This amount varies in milk ordinarily used for cooking, from one fourth to three fourths of one percent. Much higher than this it cannot go, owing to the death of the germ which produces the acid. Hence if the strehgth of the acid present is not known it is impossible to use exactly the corresponding amount of alkali. The object of the experiments undertaken in this thesis was to devise some comparatively simple means, which should be available to the ordinary cook, for determining the degree of acidity in sour milk, thus enabling her to use the correct amount of soda to neutralize this acid,without using an excess.

Since the idea was, in some respects, an original one, it was ecessary to have a working foundation, based upon some hypothesis. It s assumed that, if a piece of porous paper, such as blotting paper or lter paper, were dipped in an alkaline solution of known strength, lowed to dry, then dipped in an acid solution of corresponding rength, the alkali on the surface would be exactly neutralized by the id with which it came in contact. A series of experiments were rried on, based upon this assumption.

Sodium carbonate, Na_2CO_3, was the alkali selected, bedause of its solubility in water, and permanence upon exposure to air. .5888 rams of this dissolved in one hundred cubic centimeters of water gives a solution whose strength is just sufficient to neutralize a one per-cent solution of lactic acid. For three fourths, one half, and one fourth percent solutions take the corresponding fraction of .5888. In ... that ... change ... apparent, should the acid h... ery

effect, it became necessary to color the paper with an indicator before dipping it into the alkaline solution. Cochineal and methyl orange were tried, but with unsatisfactory results. Litmus, however, proved to be much more sensitive.

A blotting paper of exceptionally loose texture was first experimented with. Strips of this, colored by litmus, were dipped into sodium carbonate solutions of varying strength, dried, and dipped into acid solutions of corresponding strength. It was found, however, that the weakest acid solution produced the change in the strongest and weakest papers alike. This was doubtless due to the fact that, on account of the loose texture of the paper, the alkali was immediately diffused through the liquid, and the paper lost its strength. A thicker sort with a firmer texture was next tried, but with no more satisfactory results, for, because of the compact nature of the paper, the alkali was not distributed evenly, and the acid affected some spots, while others remained unchanged. Ordinary thin filter paper was free from either of the foregoing difficulties, but the texture was uneven, being thicker in some places than in others, hence it also was unavailable.

Since the use of test papers had proven a failure for the various reasons described, it was necessary to cast about for some other medium which should combine firmness and evenness of texture with thinness. A fine, firm quality of cloth was selected as possessing these requisites, and the previous experiments were repeated with far more gratifying results. It was found that the distinction between the one fourth and one half percent solutions of lactic acid, and between the half [illegible] to be clearly shown. Other test [illegible]

made, using m... instead of acetic acid solutions, and the results were verified by titration with standard alkali, the ordinary laboratory means for determination of acidity.

In making this test it is necessary to observe several precautions. In the first place, the cloth strips must not be allowed to remain in the milk more than an instant, otherwise there will be diffusion of the alkali, with consequent weakening of the strength of the testing strip. For the same reason the surplus liquid on the surface should be immediately removed by wiping the cloth with a piece of filter paper, or something similar. Thirdly, the correct result is not fully apparent until the expiration of several minutes. The acid, no matter how weak, may change the color of the surface immediately, but at the end of five minutes the acid and alkali will have come in contact throughout the strip. If the cloth now has a decided red color the acidity of the milk has at least a percent corresponding to the amount of alkali on the cloth. If it is still blue, however, try one having the next lower percent of alkali. There will sometimes be a few red spots on the surface of the cloth, owing to the fact that not all of the surplus liquid was removed, but these should be disregarded.

This test was tried repeatedly on different samples of milk with very satisfactory results, considering the necessarily crude nature of the experiments. No sample tested more than three fourths percent, and the majority of those taken from milk designed for cooking purposes had an acidity of not over one half percent. This proves that, while the rule of " a level teaspoonful of soda to a pint of milk" is ...arly cor... ...r ... with the maximum acidity, that amount ...

ordinarily be too great. Two thirds of a teaspoonful is sufficient for a pint of milk at one half percent, and one third of a teaspoonful when the acidity is one fourth percent. The test is one which is very easily applied, and even the manufacture of the testing strips by the ordinary person is not impossible. A further explanation of this last point would perhaps be advisable:

The atomic[1] weight of sodium carbonate is 106, that of lactic acid is 90, and since sodium carbonate is a divalent, and lactic acid a monovalent, compound, 90 grams of lactic acid will neutralize half of 106 grams of sodium carbonate, or 53 grams. A one percent solution of lactic acid is practically one which contains one gram of lactic acid to 100 cubic centimeters of water, and to neutralize this it is necessary to have a solution of sodium carbonate containing 53 / 90, or .5888 grams to 100 cubic centimeters of water. In the ordinary system of weights and measures this is equivalent to .7853 ounces to a gallon of water for the three fourths percent solutioh, or .4888 ounces for the one half percent solution. The sodium carbonate (salsoda) as ordinarily obtained is not dry, but will become so by leaving in a warm place for several days. Any firm cloth of a fine quality will answer. Dry litmus may be obtained at a drug store, which should be crushed and dissolved in water until a strong enough solution is obtained to make the cloth a decided blue. Dip the cloth first in the litmus solution, dry it, then in the solution of sodium carbonate, hang up and dry. It is then ready to cut up for use after a strip around the edge has been removed, [illegible] an excess of the carbonate is likely to [illegible] collected.