The Use of Fats in Baking*

Various Types of Baked Goods Present Different Shortening Problems

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THE chemistry of the fats and oils is an old subject to us. The methods of manufacture and refining, of packaging and distribution, are familiar to all of us. Some of us possibly have an idea that we know something of the use of fats in soap making and are well versed in the values and properties of the fats for this purpose.

The soap making industry is an old one, but so is the baking industry. Soap making apparently passed from the position of an art to that of an organized industry, and then to a science, long before baking began to take the same trend. Recent years have seen baking change from an art to a tremendously organized business. We watch its present struggle to get organized on a scientific basis. In the baking industry today the terms "scientific, technical, research and investigation" are flung about with the utmost abandon.

Flour Most Important

In baking, wheat flour is unquestionably the basic ingredient and one of first importance. Hence, the very important and advantageous position of the cereal chemist in the industry. At the same time, the fats play an important part in most baked goods—to say nothing of sugar, milk, eggs, yeast, baking powder or other chemical leaveners, etc. In these days of specialization, a cereal chemist is not supposed to know much about fats. As a result, the interest of the fat and oil chemists has been developing in this interesting field.

It is our purpose to touch upon some of the problems presented by the use of fats in some varieties of baked goods—and there is a large field—rather than to undertake to present the solution of any of the problems. As this is the first paper of it kind presented to this society, it is more important to get a view of the field.

It is possible to present a fairly clear classification of bakery products, but we prefer to take them up in a fairly logical order and discuss each one as we go along.

Shortening in Bread

Take the production or manufacture of bread. This is the branch which has become the most highly organized, the most highly mechanical of any bakery line. The raw ingredients are introduced at one end and the wrapped loaf delivered at your home with scarcely a touch of human hand, and under remarkably well controlled conditions. The quantity production is almost appalling.

Fat in bread, however, is a very minor ingredient. It is used in the proportion of only a few per cent of the flour. Two and one-half or three pounds to 100 pounds of flour, with a few pounds of milk, malt, salt and yeast and some 60 pounds of water will make up a bread dough.

Bread is judged or scored organoleptically. Reduce the shortening below 2½ percent or raise it over 3 percent and an expert scorer, on a number of loaves of each,

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will give an average lower score on either side of those limits, other conditions remaining the same.

You will say this should be easily solved. So it should, but with varying shop conditions, varying temperature, humidity and time of fermentation, varying flours and formulæ, and varying tastes and judgment, all of it has not yet been completed.

Pie Baking Difficulties

Take another class of baked goods, the great American pie. Although 80 percent of the bread baked in our country comes from the bakery, a much smaller percent of pies come from the bakery. There are three reasons. Some bakers cannot bake a good pie, some bakers will not bake a good pie, and those bakers who do make good pies have difficulty in overcoming the effect of the other two classes and the difficulties of distribution. Nevertheless, pie baking is going on in some very large units.

What are some of the problems connected with making a good pie crust? Of course, here again comes in the question of what is a good pie crust. But putting that aside, we have a problem.

If we mix oil with flour in ordinary pie crust proportions, say one of fat to two of flour, we get a soggy mass which will hardly take up enough water to make a dough or a good crust.

If we take the plastic fats, we may by proper manipulation get several varieties of tender pie crust. There is nothing very complicated about it, and a little care in handling, and sometimes of temperature control, will always give a tender edible crust.

A characteristic of flour, however, is very evident in this case. The tendency for the gluten to develop when wet with water and handled, and in this way produce a tough crust, is a serious problem. Balancing the character of flour, the character and quantity of shortening, the quantity of water and time and temperature make an interesting study.

Pie crust, with its simple composition and its simple manipulation, should be a good place to study shortening values. Its susceptibilities to slight variations in handling and baking, and the difficulty of measuring the effects after baking greatly reduce its possibilities.

Similar to pies, but influenced still more by the physical manipulation, are the pastries. These products indicate to us that the effect of shortening is the separation of the strands or layers of gluten and other body forming materials to keep them from matting together into a solid mass. The patty shells and puff pastry, and the Danish pastry rolls and material of that kind are the result of developing a gluten mass and then rolling it out in thin sheets alternating with layers of fat.

The physical properties of the fats are of great importance in producing the right kind of pastry and pie shells. The melting point has much to do with the edibility of the pastry. The chemical composition and the care used in preparation have much to do with its flavor. An off flavored fat or one which readily oxidizes in handling or baking will have a very bad effect on the finished product. We have discussed only the crusts and not the fillings of pies and pastries.

Cakes and Cookies

Turn to another line of bakery products known as sweet goods. This includes cakes and cookies and other products containing a noticeable quantity of sugar.

In these doughs we have much more complicated formulæ or systems. Besides the flour, the sugar, eggs and milk play an important part rather than being just minor ingredients. The sugar is frequently equal to the flour, and the eggs and milk at least half as much. With other material, such as molasses, glucose, invert sugar, cocoa or chocolate, and occasionally glycerin, there are many factors to evaluate.

The use and function of the shortening in most of these is of very great importance. Some of them require more than others.

We have the rich heavier cakes of the pound cake type in which originally the fat or butter was about one-fourth of the dough. This is generally cut now so that the shortening is only about half as much.

Strange as it may seem, in this type of cake the shortening is also used to produce a leavening effect. If the shortening has the proper consistency and is properly used, it is possible to incorporate into the shortening-sugar mass of the mixture sufficient air finely distributed throughout the mass to give the rise, expansion or volume required. This means the lightness of the cake. The beating of the eggs carries in some air, but most of it is incorporated with the fat. It seems probable that the production of a light aerated mass of sugar and shortening produces a very fine cellular structure of all the ingredients in the cake dough. When subjected to the heat of the oven all of the ingredients expand, but chiefly the moisture and air in the fine cells cause the dough to swell. If the formula is properly balanced and the temperature is properly regulated, the eggs and flour will coagulate when the maximum expansion has taken place and the cake retains its size, shape and internal structure. There are several of these qualities by which the cake is judged. After its external appearance is the smoothness and evenness of its grain and texture when cut. Upon these depend its tenderness and edibility.

A very simple and yet edible cake can be made by creaming two parts of sugar with one of shortening, adding one part of whole eggs to this mass, preferably before the creaming is finished, then stirring in one part of skim milk and two parts of flour. A little salt and flavoring completes the dough which bakes to a very nice, light, tender cake.

From this kind of a cake the formulæ grade down with less and less fat into the class of sponge cake with very little or no fat at all. The importance of the fat as a carrier of air becomes less and its function is more simply that of a shortener or to produce tenderness. The baker takes advantage as far as possible of the creaming quality of the fat, but is compelled to depend more and more upon baking powder or other mixtures which produce gaseous compounds upon heating, to leaven the mass, as the amount of shortening is reduced.

Another effect of the fat in cake, along with that of tenderness is in the enhanced keeping quality or apparent freshness. A cake with plenty of good fat in it does not appear or taste as dry as one with less fat.

When we pass over to the cookie type of cake we add a few more problems to the use and action of the fats. In this type we may include the problems of the biscuit and cracker manufacturer.

In the great variety of small cakes known as cookies or biscuits, probably the one most important

function is to produce tenderness or shortness. There has been some work done on the problem of measuring shortening value, but there is so much concerned in the technique of such an investigation that there still remains much to be done. When an investigation is completed on one type of biscuit the question arises as to whether these results fit other types and conditions of production.

The cookies of the small shop have many of them, complicated formulæ in which the shortening plays a minor part. There are the sugar and spice cookies of an infinite variety and the shortening may help in the spread of some, the shape of some and the tenderness of all.

Biscuit and Crackers

In the biscuit plant there are a few classes which may be distinguished.

Take the cakes of the wafer type. These are made with a soft batter, which can be dropped through the die of a machine and cut with a wire, falling upon the pan moving below on a continuous belt, and are put right into the oven. The shortening has a distinct effect upon the character of this piece. If the baker takes advantage of the creaming quality of the shortening, he gets a very different dough and cookie than when he throws in a soft oily shortening and the other ingredients. We have seen the results of such difference not only in the finished cake but in added difficulty and labor cost of handling.

Take another type of biscuit known as short bread. This is a much stiffer dough but in mixing it is possible to make use of the consistency of the shortening. In this type the consistency as well as the chemical composition probably has much to do with the tenderness or shortness of the cookie. This stiff dough is frequently run by forcing it into molds on a roller in such a way as to take the imprint of the mold, and then a flat steel band pulls the shaped dough out and deposits it on the pan.

There are the hard sweets in which the stiff dough is rolled and compressed to produce a close compact mass before being run out in a thin sheet and stamped or embossed with the name and design. Some of these doughs are terribly abused before being baked by being run several times through heavy rollers or breaks. In these the chief function of the shortening is to keep them tender, but its ability to stand the working and rolling without squeezing out is of importance. The character of the shortening also probably plays an important part in the finish of this type of goods.

The biscuit may be followed in this way through a gradual reduction in sugar content, and we finally reach the unsweetened cracker, frequently called the soda cracker. Without touching on the intermediate lines the soda cracker presents an interesting problem in the use of shortening. This, like bread, is a yeast-raised dough, but it takes a much longer fermentation and a higher percentage of shortening.

There is from 8 to 12 per cent of shortening in a soda cracker ordinarily, depending upon the quality of the cracker. Upon this shortening depends the tenderness of the cracker to a marked degree, although this may be influenced by the time and temperature of fermentation and the character of the flour. The doughs are generally rather stiff and the care with which the shortening is incorporated has an influence upon its proper functioning.