

# STABILITY OF MIXED SHORTENINGS IN CRACKERS\*

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THE bulk of the work on the resistance to rancidity of fats and oils has had to do with the stability of the fats themselves rather than with the stability of products containing them. It has been known for some time that the comparative stabilities of the fats may not correlate with their stabilities in baked products. In a previous paper,\* it was shown that there is a poor correlation in the stability of various fats and their stability in the ordinary soda cracker. A theory was suggested to explain these perhaps unexpected findings, to the effect that both anti-oxidants and pro-oxidants in the fats used as shortenings disappear during the manufacture of crackers, and that the stability of the shortening in crackers is in general in fairly close agreement with the degree of saturation of the fatty acids.

It has also been rather well established in the past few years that the shortening value of the various fats is directly related to plasticity or stiffness (consistency) at room temperatures. This was shown by Fisher\*\* for pie crusts. While observations in plants do not usually constitute data acceptable for scientific purposes, it is the unanimous opinion of a score or so of biscuit superintendents that the softer the shortening the greater the shortening value. The experience in many plants, over a period of years, has proved rather conclusively that substantially less of a soft shortening than of a stiff one is required to produce the same tenderness and texture in a soda cracker.

Up to a few years ago, the comparative price differentials in the various shortenings available for biscuit and cracker use were much more constant than has been the case recently. The cracker baker usually standardized on one type of shortening for crackers and another type for sweet goods. The same two shortenings, in some cases a single shortening, were used for

months or years without change. This condition has changed. In recent years there have been not only new shortenings available for use in baked goods but several shortenings hitherto not widely used have justly become popular. This has come about for two reasons:

1. Our greater knowledge of rancidity has removed the prejudices surrounding certain shortenings.
2. Price differentials among shortenings have fluctuated so widely that it has been desirable for reasons of cost and quality to switch from one shortening to another from time to time.

Shortenings for crackers have three characteristics which must be considered: flavor, shortening value, and stability. It is not possible to have all three factors at their optimum in a single shortening. Most shortenings are outstanding in only one or possibly two of the desirable characteristics mentioned.

With this situation in mind, it is obvious that there are many cases where it would be desirable to mix two shortenings. This would be true particularly if the stability of a fat or oil of poor keeping qualities is improved by admixture with a stable fat.

It has often been assumed that a mixture of two shortenings of widely different stabilities would keep no longer than the poorer of the two shortenings. Since there were few data on this point, particularly if the mixed shortenings are used in soda crackers, the situation seemed worth investigating.

In our previous paper we described the method we use in testing shortenings for stability in soda crackers. The essence of the method is the making of laboratory crackers free from metallic contamination.

Mixtures of various shortenings were subjected to keeping tests in a cabinet at 145°. The same mixtures were made into laboratory crackers, and the crackers tested for resistance to rancidity. The individual shortenings themselves were tested similarly, of course. In addition, two tests of commercial crackers were made.

The data:

## LABORATORY TESTS OF SHORTENINGS AND CRACKERS

Lab. No.	Fat or Oil	Keeping Time In Days	Shorten-Crackers
4137	Lard	5	2
4549	Lard	6	3
4016	Cocoanut oil (76° re-fined)	51	30
4135	Cocoanut oil (76° re-fined)	152	69
4400	All-hydrogenated cottonseed oil	33	27
4550	Oleo oil	4	23
3923	Corn oil	5	8
4137	50% lard	18	14
4135	50% cocoanut oil		
4137	50% lard	9	4
4016	50% cocoanut oil		
4549	50% lard	20	17
4135	50% cocoanut oil		
4549	50% lard	6	13
4550	50% oleo oil		
3923	50% corn oil	11	12
4400	50% all-hydrogenated		
4549	50% lard	23	14
4400	50% all-hydrogenated		
4550	50% oleo oil	34	33
4400	50% all-hydrogenated		
4135	50% cocoanut oil	42	41
4550	50% oleo oil		
4549	25% lard	31	27
4400	75% all-hydrogenated		
4550	25% oleo oil	34	32
4400	75% all-hydrogenated		

## PLANT TESTS (COMMERCIAL CRACKERS)

Plant	Shortening	Keeping Time Crackers
Plant A—	Lard—100%	1½ days
	50% lard	13 days
	50% all-hydrogenated	
Plant B—	Lard—100%	2 days
	50% lard	11 days
	50% cocoanut oil	

Examination of the data proves conclusively that when two shortenings of widely different stabilities are mixed, the mixture shows more stability than the poorest shortening. This is true both for the mixtures themselves and for crackers containing them. In most cases the mixture is not as stable as the best shortening, of course, but is somewhere between the two. Usually the keeping time is a little below the average for the two components of the mixture, although no general rule may be laid down.

These results have a practical significance. For instance, many cracker bakers prefer lard as the shortening in crackers for reasons of texture and flavor. They hesitate to use it, particularly in summer, for fear of rancidity. A mixture of half lard and half very stable shortening, such as an all-hydrogenated cottonseed oil, shows

\*R. M. Bohn and R. S. Olson — Some Factors Affecting Rancidity. Oil and Soap, Oct. 1934, p. 210.

\*\*Jennie D. Fisher, Ind. Eng. Chem. Vol. 25, No. 10, p. 1171 (Oct. 1933).

\*A paper presented at the Fall Meeting, A.O.C.S., Chicago, October 8-9, 1936.

sufficient stability to be safe at all seasons of the year. There have also been many occasions in the past few years where it has paid to mix shortenings for reasons of economy, and the use of more than one shortening in a cracker dough is a fairly common practice at present.

**Dr. A. H. Gill**

The American Oil Chemists' Society has lost a distinguished and valued member in the death on No-

vember 11, 1936, of Dr. Augustus Herman Gill, professor emeritus of technical analysis, Massachusetts Institute of Technology. Dr. Gill leaves a widow, a son Paul H. Gill, and a daughter, Mrs. C. McK. Well-  
ing.

Dr. Gill was always interested in oil chemistry and analysis, his manual, "Oil Analysis," having appeared in 14 or 15 editions, and became a member of the Society some years ago. He has never been able

to attend our annual meetings, but did attend our fall meetings when they were first started in New York. He has been ever ready to cooperate in every way possible, and his advice and counsel as a member of the Olive Oil Committee have been very valuable.

As a former professor and teacher, the writer will miss him greatly; he was always a courteous, patient teacher, and a Christian gentleman.

—H. P. TREVITHICK.

# THE IDENTIFICATION OF MINOR COMPONENT FATTY ACIDS IN FATS AND OILS\*

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A DECADE ago chemists in the field of fats and oils concerned themselves primarily with relatively superficial analysis. Certain physical and chemical constants were determined. If the fat were a new one, these data would serve for future reference. If the fat had been previously described, the data would serve as a yardstick by which the fat could be compared with the one previously described. With many of the common fats definite limits were established for these constants; these served in identifying and in detecting adulteration.

Of course there were many more detailed investigations of the component fatty acids of fats and oils. The methods used permitted only gross generalization and approximate calculations of the amounts of the principal fatty acids.

In the past few years, there has been a decided tendency to a far more detailed investigation, not only of the fatty acids which make up the fat but also of the state of combination in which they exist originally in the fat. Fats and oils which have been examined critically by applying more modern methods of chemical investigation have been found to contain new and interesting fatty acids. Although many of these acids occur only in very small amounts, certain important properties of the fat in question such as stability, flavor and nutritional value have been found to reside in these so-called minor component acids. An excellent example of this is the in-

vestigation which has been in progress in our own laboratory on butter fat. Bosworth and I in 1933 (1) reported at least six new fatty acids in this fat in addition to the eleven which had been previously reported. While these acids occur in very small amounts, nevertheless they are certainly of importance to the nutritional value of butter fat. Incidentally the discovery of new acids in a fat serves to decidedly complicate its chemistry.

In addition to investigating the fatty acids of fats and oils the chemist is now directing his attention to the state in which these acids occur in the original fat or oil. This new interest is largely due to Hilditch and his co-workers in England (2) who have furnished us with a new attack on glyceride structure. By Hilditch's method of permanganate oxidation in acetone some idea at least may be obtained of the types of glycerides which occur. Other methods of attack on this problem are needed because none at present available is adequate to give a clear picture of the hundreds of compounds which are possible and which may be present. The problem would have been comparatively simple if nature had made up these fats and oils as mixtures of simple triglycerides, but we know that there is a general rule that the fatty acids are spread over as many molecules of glycerides as possible.

The purpose of this discussion is to discuss briefly methods that are available and which are now being used to identify fatty acids in fatty

acid mixtures. Although the emphasis is to be on the minor component acids, that is, those which are present in small amount, yet naturally the methods are of quite general value. The problem of separating fatty acid mixtures is a complex and difficult one. It is simplified in many cases by relative simplicity of composition. Most of the terrestrial animal fats and oils consist primarily of palmitic, stearic and oleic acids. Naturally it is much easier to investigate such fats than it is to investigate coconut oil, butter fat or a fish oil which are exceedingly complex. The great difficulty lies in the fact that we are dealing with mixtures of organic compounds which are very similar in nature so that almost no clear-cut separations are possible. As you well know, differences in these acids may be grouped roughly into two classes; length of the carbon chain and degree of unsaturation.

The first step in a detailed examination of a fatty acid mixture is to separate the constituent fatty acids so far as possible according to boiling point. To accomplish this it is necessary to resort to fractional distillation at reduced pressure and under the most favorable conditions. The fatty acids should never be employed for this purpose due to their tendency to interact with anhydride formation or, in the case of the unsaturated acids, to react between the double bond and the carboxyl group. Neither of these is important with single brief distillations, but in a fractionation covering many

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