The acids were recovered from portions of the ester fractions and the undistilled residue by saponifying them with alcoholic potash and decomposing the soaps with hydrochloric acid. The acids were collected and completely separated from potassium chloride and any free hydrochloric acid by remelting them with hot distilled water in the usual manner, and in each case they were subjected to fractional crystallization from ethyl alcohol. Arachidic acid was found only in the undistilled residue, which also contained a small quantity of stearic acid. On account of the rather high saponification value of the oil, it was expected that some myristic or lauric acid might be present, but none was found in the two samples of oil examined. This high value is probably due, in part if not entirely, to the presence of volatile acids which are indicated by the Reichert-Meissl and Polenska values. The acids from the ester fractions, which were isolated and identified in each case, confirmed the deductions previously made from the mean molecular weights of the esters of the saturated acids.

The composition of the oils in terms of glycerides is given in Table IV.

TABLE IV—GLYCERIDES OF

| Acids | Chinese Per cent in Oil | American Per cent in Oil |
|---|---|---|
| Oleic | 10.9 | 8.0 |
| Linoleic | 51.9 | 58.5 |
| Linolenic | 26.4 | 25.5 |
| Palmitic | 6.2 | 4.6 |
| Stearic | 2.8 | 1.5 |
| Arachidic | 0.15 | .35 |

## REFERENCE LIST

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# WHAT THE BAKER WANTS IN A SHORTENING

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THE remarks in this short paper will be limited to shortenings for yeast raised products.

Although the purpose of this paper is to enumerate what the baker wants in a shortening, it is felt that it is necessry first to discuss briefly the different types, the amounts used, and the effects.

**Common Types of Shortenings:***

The common types of shortenings used in yeast raised products are as follows:

1. Open kettle rendered pure lard
2. Steam rendered pure lard
3. Vegetable oil compound type shortenings
4. Vegetable oil-animal fat blended type shortenings
5. Hydrogenated shortenings
6. Butter
7. Oleomargarine
8. Oleo oil
9. "Dry shortening"

It might be well to point out that types 1 through 5 are most commonly used. The only exception to this would be Danish pastry, where much of the oleomargarine type shortening is used.

**Amounts of Shortening Used in Various Products:**

The percentage of shortenings used in various yeast raised products varies considerably as is shown in the following table. The figures given are average ones, and the percentage shortening for any one type of product will vary from baker to baker. For instance, in bread today bakers use varying amounts, ranging from 2 to 10 per cent, with the majority using possibly 4 per cent when based on the flour weight. It is interesting to note how this majority figure has increased since 1928 (see Table I).

TABLE I*

| Type of Yeast Raised Product | Average % Shortening Based on Flour as 100% |
|---|---|
| French bread | None |
| Pan bread 1928 | 2 |
| Pan bread 1938 | 4 |
| Soft rolls | 8 |
| Sweet rolls | 12-15 |
| Special breads | 15 |
| Danish pastry | 50-65 |

**The Effects of Shortening:**

Considering the average amounts of shortening used in bread (4 per cent) and the way in which it is used, the primary effect of shortening in bread is a lubricating one. One can picture this as the lubrication of the individual gluten strands and starch particles; thus enabling them to slide over each other more easily. The results of this action are as follows:

(1) The fermentation period is slightly shortened in amounts up to approximately 3%.
(2) The crust is more tender due to "shortness": i.e., it has better eating qualities.
(3) The volume of the loaf is improved in amounts up to approximately 3%.
(4) The symmetry of form is improved.
(5) The grain of the bread is improved.
(6) The texture becomes finer and more silky.
(7) The crumb becomes "shorter," softer, and the development of crumbliness is delayed.
(8) The life of the bread is increased. This is probably due to a delay in the loss of moisture due to the coating of shortening around the individual particles.

Now, there are some effects which are simply due to the presence of the shortening. These are:

(1) The crust has more lustre.
(2) The crumb color is more brilliant.
(3) The energy value of bread is increased since fats or oils yield 2¼ times as much energy as carbohydrates.
(4) The flavor and taste are improved.

The above effects apply specifically to bread; however, they can be applied with modification to all yeast raised products in which larger percentages of shortening are used, such as coffee cakes and sweet rolls.

**Effects of Too Much Shortening:**

The effects of too much shortening are:

(1) Loss of volume resulting in a compact, soggy loaf.
(2) Greasy grain and texture.
(3) Greasy taste.

It must be pointed out here that these characteristics do not become pronounced unless very large quantities of shortening are used.

**Shortening in Relation to Flavor:**

In the percentage of shortening normally used in bread, the average consumer is not able to tell whether the loaf they are using contains lard, hydrogenated shortening, dry shortening, or in many cases even butter. Some bakers believe that there are definite flavor differences between bread produced say with lard and hydrogenated shortening.

*At the Fall Meeting (1938) of the American Oil Chemists' Society, William Walmsley presented a paper on "The Procedure of Bread Making" as an introduction to the present paper. The common types of shortenings used and the amounts in which they are used were included in Walmsley's remarks.

This might be true with the person who is skilled in determining bread flavor; however, with the average person the difference is not great enough to make it detectable.

You know, flavor is a very elusive factor. Hand a person a slice of bread and say, "My, doesn't that have a nice butter flavor?" Chances are that he will agree with you. If you had simply asked, "What is the flavor in this bread?" no telling what the answer might have been; probably anything but a butter flavor.

We have been studying bread flavor for some time, and we find that differences must be large before definite preferences with judges can be established. Thus, differences must be very great before the public will detect them; and, remember, the public buys the products.

Nevertheless, of all shortenings, butter and lard are preferred by a few bakers because of flavor, while the vegetable shortenings are usually considered to have an absence of flavor. When high percentages of shortening are used in bread (a few bakers are using high percentages) and in other products where high percentages are used, the factor of flavor becomes of major importance. Thus, in sweet yeast raised products, much butter is used.

**Shortening in Relation to the Rate of Staling of Bread:**

That shortening prolonged the life of bread was mentioned before. From observations of the baker and the consumer, shortening not only produces a more silky texture and a "shorter," softer crumb, but its presence maintains the texture and crumb in this condition for a longer time; thus, delaying crumbliness. This is all simply due to its lubricating action and to a delay in the loss of moisture by its coating around the individual particles.

However, according to the chemist, this softness and loss in moisture has nothing to do with staleness. Then what is chemical staling? Simply expressed, it is the change in the form of the starch. According to recent x-ray studies, as bread or other yeast raised products leave the oven, the starch has both a crystalline and amorphous component. As the product ages, the amorphous component disappears and finally all of the starch exists in the crystalline form. This change takes place in approximately 24 hours.

So far researches have failed to show that shortening delays the aforementioned aging of the starch granules of the crumb. Yet it cannot be doubted that it has the above mentioned advantages. The consumers can see these advantages and it is the consumers' opinions that count.

**The Characteristics of a Preferred Shortening:**

The preferred shortening should have the following characteristics:

1. Long plastic range which will insure proper distribution even at lower temperatures. A review of the literature shows that lard has the longest plastic range of any shortening mentioned and may be used even at icebox temperatures. On the other hand, lard becomes rather soft at high temperatures, and for this reason may prove less desirable if the baker stores the product at temperatures of 90° to 120°F. Compound type shortenings seem to stand up better at the higher temperatures because they have a firmer body.

Hydrogenated shortenings become very hard and brittle at temperatures near freezing, although they are quite plastic at 70° to 90° F. Manufacturers of hydrogenated shortening very often vary the plasticity of the shortening according to season in order that it may be neither too soft nor too hard. Butter has a good plastic range. Cocoanut oil margarines have a rather small plastic range, but the new domestic margarines (most of them made from cottonseed oil) have about the same range of plasticity as butter itself.

2. Pleasing flavor. The above discussion of flavor will suffice here.

3. High shortening power which will give maximum tenderness per pound of fat used. Shortometer tests show that lard has greater shortening power than other fats. An approximate listing of fats and oils according to their shortening power is as follows:

Lards
Hydrogenated shortenings
Compound shortenings
Cottonseed oil
Butter
Cocoanut oil
Edible Mineral Oil

It is realized that this listing may vary slightly depending on the shortening in question. It must be pointed out that these results on shortening power have not been obtained from bread or other yeast raised products. They have been obtained by means of a shortometer on crackers, cookies, and pie dough. In the case of bread it is almost impossible to determine small differences in the shortening power of the shortening used.

4. Good keeping quality at room temperature. The baker should be able to store the shortening for a reasonable length of time without it "oiling out" or becoming rancid.

5. Free from foreign odors.

6. Color must be such that it does not detract from the color of the baked product.

7. Perform well throughout the baking procedure, and make a pleasing product for the consumer, which, after all, is the final test.

Throughout this paper it has been attempted to put the facts in a brief and concise form and it is hoped that they may prove of some value.

# LIST OF A. O. C. S. REFEREE CHEMISTS FOR 1938-39

The following have certificates reading on all cottonseed products and similar materials covered by the official methods of the A. O. C. S.:

D. C. Picard, The Picard Laboratories, Birmingham, Ala.

G. K. Witmer, The Battle Laboratories, Inc., Montgomery, Ala.

L. B. Forbes, L. B. Forbes Laboratories, Little Rock, Ark.

Thos. C. Law and J. D. Evans, Law & Company, Inc., Atlanta, Ga.

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