Quality Control of Frozen Pastry

By
Eula Morris
Department of Home Economics Research

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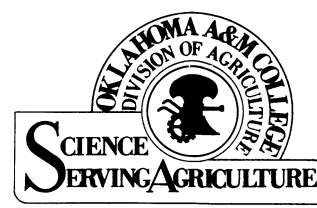

EXPERIMENT STATION

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Food storage in home freezers makes possible the preparation of large quantities of food at one time. Preparation of food in large quantities improves the efficiency of meal planning and management. For example, making several pies rather than one at a time represents savings in energy, time, and supplies.

Homemakers frequently encounter difficulties in obtaining pastries which store well over periods of time. Good pastry requires a relatively large amount of fat, and foods containing a high percentage of fat are particularly susceptible to changes in quality during storage. The study reported here was undertaken to determine the relative performance of a hydrogenated vegetable shortening and of three types of lard in pastry that was frozen unbaked and stored for varying periods of time.

Review of Literature

Triebold and Bailey ('32) report that an increase in the temperature at which fats are stored tends to hasten oxidation causing deteriorative changes of the quality of fats. Triebold, Webb, and Rudy ('33) explain that fats which contain glycerides of unsaturated fatty acids take up oxygen from the air. Rancidity produced in this manner is an autoxidative change.

Kerr ('18) and Kerr and Sorber ('23) found that corn and cottonseed oils become rancid less quickly than animal fats.

Hutchings and and Evers ('46) indicate off-flavors due to rancidity of fats may be retarded and in some instances prevented by using antioxidants.

Peters and Musher ('37) and Conn and Asnis ('37) compared the antioxidant effectiveness of soybean and oat flours. They found the soybean flour to be a slightly better antioxidant, but preferred the oat flour in pastry because it was more bland in flavor.

Overman ('47) made frozen pastry using proportions of soybean flour ranging from 5 to 20 percent. She found the protecting effect of the soybean flour to be equally efficient at each of the levels studied. It was stated that the distinct flavor of the soybean flour, used at the 15 and 20 percent levels probably would not be harmonious with the flavor of certain pie fillings. Increased tenderness, a quality of the pastry containing the soybean flour, agreed with findings reported by Gabel and Sunderlin ('43).

Consumer preference tests conducted by Faulkner and Simpson ('46) indicate that the pastries made with the low-fat and the de-fatted soybean flours were more acceptable because they were milder in flavor and lighter in color than the pastry made with the full-fat type of soybean flour.

Fenton ('46) found that pastry that had been frozen unbaked was more flaky after baking than that having had no freezing treatment. Flakiness was considered satisfactory in frozen pastry that was made using less shortening than the amount recommended for the standard or plain pastry.

Methods and Materials

The vegetable shortening used in these tests was a leading brand purchased from a local grocery store. The three lards were each from a different source and were identified as commercial, farm-type or non-commercial, and as blended lard. The commercial lard was a leading brand. The farm-type was a fresh product secured from a frozen food locker plant* The blended lard was prepared according to a formula developed by the Eastern Regional Research Laboratory ('47). It contained 6 parts of a hydrogenated vegetable shortening blended with 100 parts of farm-type lard.

Quality studies with the various shortenings were accomplished by making pastry wafers and storing them unbaked for varying periods of time. The study was divided into two trials. Six batches of wafers were made for the first trial. Four batches included the same ingredients of flour, salt and water but a different type of shortening. Two batches were made with two different shortenings and a pastry formula which included 10 percent soybean flour. The pastry formulas were as follows:

Formula 1		**Formula 2**
Flour, enriched all-purpose	880 grams	Same as formula 1, except that soybean flour replaced 10 percent (88 grams) of the all-purpose flour.
Shortening	468 grams	
Salt	24 grams	
Water	200 ml.	

The soybean flour was used to determine the extent the flour would inhibit oxidative rancidity of the fat.

*Appreciation is extended to the Simank Locker Company, Stillwater, Okla., for supplying the farm-type lard used in the experiments reported here.

Four batches of wafers were made for trial number 2. Two batches were made with each of the above formulas. Table I shows the number of wafers prepared by each formula for each trial and the method of handling.

Twenty-five wafers from each batch were baked soon after preparation and checked for quality. An additional 75 wafters from each batch were frozen unbaked and stored. Periodically at 4, 8, and 12 months, 25 of the frozen wafers were baked and checked for quality.

After early experiments indicated that qualities of flakiness and browning of the pastry containing the soybean flour supplement were not as satisfactory as desired, a series of five accessory ingredients were

Table I.—Plan of the Experiment, Including Two Flour Formulas and Four Shortenings.

	Formula 1 (all-purpose flour)	Formula 2 (10 percent soybean flour)
	Vegetable Shortening	
Trial 1	25 Wafers — Baked immediately after being prepared	25 Wafers — Baked immediately after being prepared
	25 Wafers — Stored 4 months before baking	25 Wafers — Stored 4 months before baking
	25 Wafers — Stored 8 months before baking	25 Wafers — Stored 8 months before baking
	25 Wafers — Stored 12 months before baking	25 Wafers — Stored 12 months before baking
Trial 2	(Same as above)	(Same as above)
	Commercial Lard	
Trial 1	(Same as Trial 1, "Vegetable Shortening", above)	(Same as Trial 1, "Vegetable Shortening", above)
Trial 2	(Same as Trial 1, "Vegetable Shortening", above)	(Same as Trial 1, "Vegetable Shortening", above)
	Farm Lard	
Trial 1	(Same as Trial 1, "Vegetable Shortening", above)	(No wafers prepared)
Trial 2	(No wafers prepared)	(No wafers prepared)
	Blended Lard	
Trial 1	(Same as Trial 1, "Vegetable Shortening", above)	(No wafers prepared)
Trial 2	(No wafers prepared)	(No wafers prepared)

included in the formula. The ingredients were granulated sugar (5% of weight of flour), egg yolk (4.5% of weight of flour, whole egg (4.5% of weight of flour), a combination of sugar and egg yolk and a combination of sugar and whole egg. This test was conducted in the same manner as the one described previously. Ten batches of wafers were made, five with farm-type lard and five with blended lard. Each of the five batches made with each lard included a separate accessory ingredient.

Pastry Mixing and Handling Techniques

All pastry was prepared using a conventional pastry mixing technique. When both the soybean flour and the all-purpose flour were used the two flours were sifted together three times to form a uniform mixture.

The shortening, salt and flour or flours were mixed to a coarse, meal-like consistency using 25 blending strokes with a household type wire pastry blender. Water was combined with a flour-fat mixture using 15 strokes of the blender. Then 10 molding strokes, by hand, were used to form the dough into a uniform ball. The dough was divided before rolling.

The pastry was rolled between squares of frozen food wrapping papers so no additional flour was worked into the dough. Cellophane was used on top and a polyethylene coated paper under the dough. Strips of hardwood served as gauges for keeping the pastry to a uniform 3/16-inch thickness during rolling.

After the pastry was rolled it was turned over so the heavier paper could be removed from it more easily. The rolled pastry, 3/16-inch thick, was cut into wafers 3 by 1½ inches. The wafers on the cellophane square were inverted on a baking tray and the wafers loosened from the paper. The wafers that were to be stored were frozen unbaked before packaging.

The trays of unbaked wafers were placed to freeze overnight in a chest-type home freezer in the laboratory. After freezing, the wafers were packed for storage in layers on a 4- by 7-inch cellophane-covered cardboard with cellophane strips separating the layers. Twenty-five wafers were put in each package, which was then wrapped with moisture-vapor-resistant cellophane and sealed.

Baking and Testing

The frozen wafers were not defrosted before they were baked. All wafers, the non-stored and the frozen ones, were placed in single layers on bake trays and pricked to prevent blistering during baking. A gas-

fired oven was used for baking. The oven was first preheated to 425° F. and the wafers baked at that temperature for 8 minutes.

Wafers that were the most uniform in color were selected for the various tests. A tasting panel judged the wafers for color, tenderness, flavor, and texture. Also, pastry tenderness was determined on the Bailey shortometer which registered in ounces the force necessary to break the wafer. Ten wafers were used in the breaking strength tests for each pastry. The breaking force is reported as an average for each set of ten wafers.

Peroxide values were determined on the fat extracted from the non-stored wafers immediately after baking and from the frozen wafers after each testing period. The Wheeler Method for peroxide determination, as modified by Watts ('47) was used on triplicate samples of each fat. The milliequivalents of peroxide per 1000 grams fat is reported

Results and Discussion

Keeping Quality of Pastry

Data on the pastry made with each formula and with each shortening are summarized in Table II. Analysis of variance showed significant difference in tenderness attributed to freezing and storage of the pastry.

Table II.—Qualities of Pastry as Determined by Breaking Strength.

Type of Shortening	Breaking Strength of Wafers According to Intervals of Storage Time for Pastry *Months*			
	0	4	8	12
	(ounces)			
Formula 1 (all-purpose flour)				
Vegetable Shortening				
Trial 1	7.9	7.2	5.9	6.1
Trial 2	7.7	6.6	5.8	6.2
Commercial Lard				
Trial 1	7.7	6.6	5.3	5.9
Trial 2	7.1	6.5	4.7	5.1
Farm-type Lard				
Trial 1	5.0	3.6	3.1	4.4
Blended Lard				
Trial 1	3.8	4.4	3.9	4.9
Formula 2 (soy-bean flour)				
Vegetable Shortening				
Trial 1	7.6	6.8	5.6	5.9
Trial 2	7.1	6.6	5.3	5.4
Commercial Lard				
Trial 1	7.2	5.8	5.3	6.2
Trial 2	6.7	6.0	5.1	5.4

The frozen wafers made with each shortening and containing the all-purpose flour were more tender at each testing time than were the non-stored wafers. The tenderizing effect which freezing gave to pastry agrees with results earlier reported by Fenton ('47).

There was an increase in tenderness of the pastry as the time of storage was increased to 8 months. At the 12-month testing period the wafers were less tender than at 8 months but the breaking strength of the wafers with this length of storage was less than for the non-stored wafers.

The wafers containing the soybean flour showed the same general trend of being more tender after 4 and 8 months storage than after 12 months for each of the two shortenings with which it was used. Analysis showed that a greater difference existed, however, between fats than between flours.

The pastry wafers made with the lard shortening were more tender than those made with the vegetable shortening. A comparison of the force used for breaking the wafers shows those made with the blended lard were more tender than those containing the farm-type lard and these in turn were more tender than those made with the commercial bland lard. All wafers were considered acceptable as to tenderness. In no instance was the pastry considered tough.

Table III.—Qualities of Pastry as Determined by Peroxide Tests.

Type of Shortening	Peroxide Values of Shortening According to Intervals of Storage Time for Pastry *Months*			
	0	4	8	12
	(meq/1000 gm.)			
Formula 1 (all-purpose flour)				
Vegetable Shortening				
Trial 1	3.06	3.71	5.90	7.28
Trial 2	3.71	4.02	4.39	5.03
Commercial Lard				
Trial 1	4.19	6.40	9.07	11.63
Trial 2	3.94	6.36	9.11	11.52
Farm-type Lard				
Trial 1	2.84	6.45	11.08	15.34
Blended Lard				
Trial 1	2.33	3.84	4.76	5.58
Formula 2 (soybean flour)				
Vegetable Shortening				
Trial 1	1.52	2.37	3.27	4.48
Trial 2	3.56	3.98	4.08	4.34
Commercial Lard				
Trial 1	1.37	2.68	5.31	6.92
Trial 2	3.73	4.11	5.15	7.74

The non-stored wafers containing the soybean flour and made with commercial bland lard were more tender than those made with the vegetable shortening. The soybean flour wafers made with each of these shortenings were more tender than the all-purpose flour wafers regardless of storage time. However, the tasting panel considered the soybean flour pastry less desirable for flavor and color than the all-purpose flour pastry. Also, the soybean flour wafers baked a less uniform brown and were less flaky than those made with all-purpose flour.

There seemed to be no relationship between the tenderness of the pastry and the ingredients added to improve browning (Table III). The wafers which tested the most tender were not the most satisfactory in color when baked. When egg or sugar was added the browning of the wafers was more desirable than when neither was used. It was evident that browning cannot be attributed entirely to the sugar. There was an improvement in browning when both egg and sugar were used. The rate of browning as well as the degree of brownness secured was similar when using whole egg as compared with that using the yolk portion of the egg.

Peroxide Value

The peroxide values for fats extracted from the non-stored pastry wafers are shown with those from frozen wafers, for each fat, Table IV. These values are expressed as milliequivalents per 1000 grams of fat and show a step-wise increase for each shortening as storage time is increased.

Table IV.—Quality of Pastry Containing Accessory Ingredients.

Shortening and Accessory Ingredient	Breaking Strength of Wafers According to Intervals of Storage Time for Pastry *Months* 0	4	8	12
		(ounces)		
Farm-type Lard				
Without accessory ingredient	5.0	3.6	3.1	4.4
With sugar	8.6	8.9	6.2	7.5
With whole egg	4.9	3.9	1.6	3.9
With egg yolk	2.8	2.4	1.4	2.7
With sugar and whole egg	5.7	5.9	3.7	4.5
With sugar and egg yolk	3.5	4.0	2.5	3.1
Blended Lard				
Without accessory ingredient	3.8	4.4	3.9	4.9
With sugar	5.3	6.8	5.2	6.5
With whole egg	4.2	4.7	3.4	5.5
With egg yolk	3.1	3.1	2.2	2.8
With sugar and whole egg	7.7	4.8	5.4	5.4
With sugar and egg yolk	3.5	5.2	3.1	3.4

The peroxide values of fat extracted from pastry wafers containing the soybean flour were lower at each storage period than were those of fat extracted from corresponding pastry wafers containing no soybean flour. The shortenings differed in the total amount of peroxide at each testing period. Although there is a step-wise increase in peroxide values there is no regularity of pattern shown by the increases either by a shortening or between shortenings.

In all instances the animal fat consistently had slightly higher values at each testing period than did the vegetable shortening. Percentagewise the increase in peroxide values was less for hydrogenated vegtable shorteninsg than for lard. Any change in flavor indicating development of rancidity of either of the shortenings used with soybean flour was too slight to be detected when the wafers were scored by the tasting panel.

The lower peroxide values for pastry containing soybean flour as compared with values for pastry with all-purpose wheat flour agree with results reported by Overman ('47). The flavor of the soybean flour, more than its color, tended to limited the acceptability of pastry containing it.

Pastry made with the commercial bland lard had higher initial peroxide values as well as higher values at each testing period than did that containing the vegetable shortening.

Pastry made with the blended lard and containing whole egg had slightly higher peroxide values at each testing period than did most of the other pastry of this series in which accessory ingredients were used (Table V).

Table V.—Peroxide Values of Wafers Containing Accessory Ingredients.

Shortening and Accessory Ingredients	Peroxide Values of Shortening According to Intervals of Storage Time for Pastry *Months* 0	4	8	12
		(meq/1000 gm.)		
Farm-type Lard				
Without accessory ingredient	2.84	6.45	11.08	15.34
With sugar	2.55	4.97	8.66	12.42
With whole egg	2.73	4.22	6.73	10.14
With egg yolk	2.47	4.35	7.68	9.57
With sugar and whole egg	2.81	4.27	5.89	7.52
With sugar and egg yolk	2.64	3.83	4.19	8.38
Blended Lard				
Without accessory ingredient	2.33	3.84	4.76	5.58
With sugar	2.04	3.09	4.30	5.84
With whole egg	2.58	4.02	5.52	6.27
With egg yolk	2.65	3.08	4.58	5.26
With sugar and whole egg	2.13	3.10	4.19	4.92
With sugar and egg yolk	2.71	3.74	4.26	6.18

The extent to which oxidation was retarded in the blended lard cannot be attributed entirely to the effectiveness of the hydrogenated vegetable shortening. Although the feeding ration of the hogs is not known, it is possible that a constituent of the ration may have had some effect on the keeping quality of the lard.

Summary

A hydrogenated vegetable shortening and three types of lard were tested to determine their relative performance in pastry when frozen unbaked and when stored for periods of 4, 8, and 12 months. Each shortening was tested with two pastry formulas, one including 10 percent replacement of a regular all-purpose flour with soybean flour.

Analysis of variance showed significant difference in tenderness attributed to freezing and storage of the pastry. Frozen wafers made with each shortening were more tender at each testing time than were wafers which were baked wihout storage. Pastry wafers made with lard shortenings were more tender than those made with vegetable shortening.

Peroxide values of fats extracted from wafers showed a step-wise increase for each shortening as storage time increased.

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