A COMPARISON OF THE QUALITY, ACCEPTABILITY, AND COST IN TIME AND MONEY, OF FROZEN CHOCOLATE CREAM PIES

by

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INTRODUCTION

The use of convenience foods has increased rapidly during the last decade. Convenience foods found on the market today include such products as mixes, partially prepared and precooked or ready-to-serve frozen foods. It was estimated by Schoenbrun (1960) that precooked foods represented between one-third and two-thirds of the total dollar volume of frozen foods. Olmstead (1961) pointed out that the consumption of packaged convenience foods accounted for 10 to 20 percent of the food budget for the average family during 1960 and was expected to increase to from 20 to 40 percent during 1961.

One of the relatively new products among the packaged precooked or ready-to-serve foods is frozen chocolate cream pie. It appeared that the packaged, partially prepared and/or the frozen precooked ready-to-serve pies would be time and energy savers, though generally higher in cost than similar pies prepared from a home recipe. If cream pies can be prepared from a home recipe or from a commercial mix and frozen to produce acceptable quality products, homemakers might simplify meal preparation for busy days by making and freezing pies in advance.

The present study was undertaken: (1) to determine the quality and acceptability of three types of frozen chocolate cream pies: namely, pies made from individual ingredients (home recipe), those made from commercial mixes and commercially precooked and frozen pies; (2) to compare cost, in time and

money, of the three types of pies and (3) to determine whether or not there was any difference in the quality and acceptability of the commercially precooked frozen chocolate cream pies, attributable to lots.

REVIEW OF LITERATURE

Use of Commercial Mixes and Individual Ingredients in Pies

Morr (1951) compared the cost and quality of products made from commercial mixes and from home-prepared recipes. One product studied was pastry which was baked from several mixes and from a basic recipe. The average cost of pastry for two crust, 9-inch pies made from commercial mixes was 17 cents, whereas pastry made from a basic recipe using lard averaged 10 cents and that using hydrogenated fat 13 cents. Since pastry generally is used with pie filling, the cost and quality of complete pies were studied. Commercially-frozen and commercially-baked pies were compared with home baked pies made both from commercial mixes and from a basic recipe. The average cost of commercially-frozen pies was 69 cents; of commercially-baked pies, 75 cents; of pies made from the commercial mix, 39 cents; of pies made from a basic recipe, with lard, 44 cents; and with hydrogenated fat, 47 cents. The pies made from the mix averaged the least in cost but did not have the best flavor nor the flakiest crust. Commercially-frozen and commercially-baked pies were acceptable, although not considered worth the extra

money cost. The acceptability of crusts made from individual ingredients and from mixes was reported by Asp et al. (1957). They stated that in general, pie crusts made from individual ingredients were accepted better than those made from the commercial mixes.

Asp and co-workers (1957) also reported on money and time costs in making pie crusts. They found that the commercial-mix pie crust cost about one and three-fourths times that of the products made from individual ingredients. However, the preparation and cleanup time for the commercial-mix products took only about three-fourths as long as that for products made from individual ingredients.

In another study reported by Williams-Heller (1953) it took twice as long to prepare pie crust from individual ingredients as it did to make it from a mix. A similar study of relative costs in time and money, for foods at various stages of preparation was conducted by Kolmer and Gartner (1961). These workers reported that the cost of commercially-frozen chocolate pie was 89 cents, of the pies made from the prepared mix 67 cents, and of pies made from a basic recipe 58 cents. They also reported the total time spent in making chocolate pies included preparation time, cooking, baking or thawing time and cleanup time. The total time required for preparation of the commercially frozen chocolate pie for serving was 60 minutes 30 seconds, 60 minutes of which was thawing time; for pies made from the prepared mix 41 minutes five seconds; and for pies

made from a basic recipe 60 minutes 57 seconds.

Freeman (1951) stated, that for institutions, commercially prepared pie crust mixes saved time and labor and were easy to use. It was reported by Cline (1949) that preparation time was reduced as much as 66 percent with the use of mixes in restaurants, and in some cases products made from mixes were less expensive than those made from individual ingredients. Premixes were thought to be valuable to operators with limited experience, according to an anonymous article (1951). Since the ingredients in the premixes were carefully measured and blended, there was less chance for error in the kitchen and more uniform products were assured.

Factors Affecting Stability of Starch-Thickened Frozen Foods

With an increasing number of prepared frozen foods being thickened by flour or starch the problem of liquid separation has received considerable attention. Osman and Cummisford (1959) cited literature that showed as early as 1844, Scharling recognized the instability of frozen starch-containing systems, upon thawing. He observed that freezing and thawing of a starch thickened product resulted in a well defined separation of a clear solution and an insoluble spongy material.

Thickening Agents. Some factors that seem to affect the stability of starch thickened foods, such as sauces and gravies, have been reported by various workers. Kite et al., (1957)

stated that starches from the common cereals such as wheat and corn contain 23 to 28 percent of unbranched, linear chain molecules whereas waxy cereals contain less than one percent of linear chains. The differences in behavior of the two types of thickening agents were attributed to the differences in starch structure. Since the linear portion of the molecule is responsible for formation of gel, wheat flour or cornstarch will form a gel whereas waxy rice flour will not. However, Whistler and Corbett (1957) stated that amylose molecules, having a linear nature, can coalesce and, therefore, retrograde much more readily than branched amylopectin molecules. Retrogradation was defined by Kite, Schock, and Leach (1957) as the tendency of linear starch molecules to attract and associate with one another. The effect may show up in one of two ways, by the gathering together of the linear molecules into insoluble aggregates of submicroscopic size, or by the ends of linear molecules associating to give an interlacing network extending through the paste. The first reaction increases the paste opacity and the second produces a rigid gel. The instability of frozen white sauces was attributed to retrogradation of starches (Osman and Cummisford, 1959). Hanson, Campbell, and Lineweaver (1951) indicated that the thickening agent used is directly related to the stability of sauces subjected to freezing. Differences in the ability of starches to produce a stable-frozen-precooked product depends on the structure of starch molecules.

In a study of Osman and Cummisford (1959) various kinds of

starches and flours were used in preparation of white sauces, with final viscosities of 30 g-cm each when measured on a Corn Industries Viscosimeter. All white sauces contained equal amounts of shortening, skim milk and salt. The sauces were cooked until five minutes after reaching maximum viscosity, if any, and then samples were frozen and stored at -20 $\pm$ 1°C. for varying periods of time. The samples were thawed and tested for liquid separation, turbidity and nitrogen content. Upon thawing there was a clear, watery liquid separation from sauces prepared from wheat flour and those from cornstarch. White sauce using wheat flour had a liquid separation of 39 percent of the total weight, whereas the white sauce using cornstarch had a liquid separation of 50 percent of the total weight after one week of frozen storage. Albrecht et al. (1960b) studied white sauces in which wheat flour and cornstarch were used as thickening agents. Palatability scores (ranging from one to five, with five as high) averaged 2.1 for liquid separation in white sauces made using wheat flour and 1.6 for those using cornstarch, after two weeks of storage at 0°F. General acceptability scores averaged 1.7 for wheat-flour sauces and 1.1 for cornstarch sauces.

Other Ingredients. The effect of other ingredients such as milk, fat, egg, and salt on freeze-thaw stability was reported by Osman and Cummisford (1959). Their study indicated that generally a white sauce appeared to be slightly more stable than a starch-water paste when the same thickening agent was

used in both products. Albrecht et al. (1960b) also found this to be true and pointed out the complicated interaction between the thickening agent and added ingredients and the effect upon the stability of white sauce.

The influence of moisture on texture and stability of frozen sauces has been studied by several workers. The findings, however, have not always agreed. Woodroof and Atkinson (1945) indicated that the stability of both thick and thin white sauces was equally satisfactory. Hanson, Fletcher, and Campbell (1957) found greater stability of frozen pudding-type desserts was obtained by reducing the proportion of egg yolk (from six to four percent) and liquid (from 80 to 70 percent) and increasing the proportion of waxy rice flour (from three to six percent) and sugar (from 10 to 20 percent).

The effect of egg on the stability of frozen custard-type and cornstarch pudding-type desserts was reported by Hanson et al. (1953). Puddings containing egg yolks were somewhat more stable than puddings containing whole egg. The dessert containing egg yolk could be held in frozen storage for approximately two to four months at 0°F., whereas that made with whole egg and waxy rice flour could be stored for approximately one to two months without visible change in the thawed product. Woodroof and Atkinson (1945) found that whole egg substituted for egg yolk and flour gave a sauce with less yellow color and less creamy texture, but one that was satisfactory for freezing.

Two reports pointed out that fat exerted some effect on the stability of sauces subjected to freezing. Fenton (1951)

found that sauce with a large proportion of fat tended to separate during freezing and thawing. Albrecht et al. (1960b) observed that white sauce containing fat, milk, and salt was much more stable than a starch-water system using the same thickening agent, if homogenized before freezing. He stated that the improved stability may have occurred when the smaller fat molecules formed a tighter and more uniform protective coating around the starch granules during homogenization and thus made it more difficult for molecular alignment to take place during the freezing and storage.

A high concentration of sugar interferes with the thickening power or gelatinization of the starch (Johnson, 1950). This worker recommended that the starch should be pasted with a small amount of sugar prior to the addition of all the sugar required. Pyler (1952) stated that in order to obtain satisfactory gelatinization temperature and sweetness the ratio of starch to sugar should be one to three or one to three and one-half.

The type of milk used may affect the quality of starch puddings. Hanning et al. (1955) reported that puddings made with 100 percent nonfat dry milk were more opaque and firm and retained more moisture but had less desirable appearance, flavor and smoothness than puddings made using whey for the liquid. Separation of liquid in frozen sauces was noticeable especially when homogenized milk was used (Fenton, 1951).

Processing. Albrecht et al. (1960a) made a study of the effect of processing variables on the stability of a simple

starch-water system after thawing. They found that so long as cornstarch slurries were not heated above the critical gelatinization temperature (163°F. or 72.8°C.) the pastes remained unchanged after freezing and thawing. However, when heated above 163°F. severe retrogradation took place.

Instantaneous freezing eliminated sponge formation from samples of pregelatinized, regular, untreated cornstarch (Albrecht et al., 1960a). In simple systems, the samples frozen instantaneously, by direct immersion in liquid nitrogen, maintained their original properties after storage at 0°F. for one week, and there was no indication of retrogradation. However, there was no benefit in rapid freezing of white sauces (Albrecht et al., 1960b).

Ramstad et al. (1950) reported certain effects of freezing rate on cooked starch pastes. They showed that the extent of physical change in the thawed product depended on freezing rate. Fast freezing resulted in the least change from the original state. In the starch pastes, thawing rate as well as freezing rate was important. Slow thawing caused changes similar to those favored by slow freezing. Albrecht et al. (1960a) stated that rapid thawing in the electronic range did not have any appreciable advantage over thawing in a water bath at 100°F.

Various storage temperatures between -10° and 20°F. were found to affect the stability of frozen gravy or sauces (Hanson, et al., 1951). As the storage temperature increased, the amount of liquid separation in sauces thickened with wheat flour

became greater. Later Hanson, Fletcher, and Campbell (1957) studied the effect of fluctuating storage temperature on the stability of white sauce and custard pudding. A fluctuation from 10° to -10°F. was less damaging than storage at the highest constant temperature (10°F.) but was considerably more detrimental to texture stability of frozen foods than was a constant temperature of 0°F. However, Albrecht, Nelson, and Steinberg (1960a) found that there were no essential differences in the appearance of a gelatinized cornstarch slurry stored at various temperatures, between 20° and -40°F., for 30 days.

Homogenization was reported to have some effect on the stability of frozen white sauces and gravies (Tressler and Evers, 1957). Hanson et al. (1951) found that homogenization of white sauce before freezing decreased the liquid separation of the sauce after thawing but not enough to be statistically significant. Fenton (1951) stated that liquid separation could be prevented by beating the sauce just before freezing or by beating the sauce to a smooth consistency during or after reheating.

Factors Affecting the Quality of Frozen Pie Crusts

Food can not be improved by freezing, but much of the original quality of the fresh food can be preserved if it is of good quality, and well-selected packaging and processing procedures are combined with properly maintained storage conditions (Gilpin, 1959).

In order to obtain a good quality frozen pie crust, the crust must be prepared properly before freezing. Briant and Snow (1957) reported that the quality of pastries was affected little by freezing storage. When baked pie shells were frozen and stored six to eight weeks, equally tender crusts were obtained from both frozen and freshly prepared shells. The panel could not detect any significant difference in tenderness of pastry due to freezing when frozen baked crusts were freshened by reheating for five minutes at 425°F., even though the shortometer test showed decreased tenderness on similar frozen pastry. Morris (1956) found that tenderness was increased when the time of storage was increased to eight months. In a study made by Fenton (1947) frozen pastry also was found to be more tender than similar fresh pastry. However, she did not give an explanation for the results. The effect of various freezing storage temperatures on pie crust was reported by Weir et al. (1960). They found no appreciable change in the stability of the products when stored at 20°, 0°, or -10°F. during periods of two to 36 weeks.

Types of Crusts. Tressler and Evers (1957) recommended the flaky type crust for freezing. They stated that though a mealy crust is tender and has a low shrinkage property, it is not crisp, is difficult to brown and has little or no color. Therefore, the mealy type crust was not considered well-suited for freezing. The extra-flaky crust has a large volume, puffs considerably and is light. However, since the crust requires

a high proportion of shortening, it tends to shrink during baking if not mixed properly but does brown well and is tender and crisp. The extra-flaky crust was not recommended for freezing although no specific reasons were stated.

Ingredients. Ingredients used in preparing frozen pie crust are thought to affect the quality of the product. The essential ingredients in a pie crust are flour, shortening, liquid and salt.

Flour. Briant and Snow (1957) found that the type of flour had significant effect on the flakiness of the crust. They compared frozen pie crust made from all-purpose flour and pastry flour. Both frozen and freshly baked pies had flakier crusts when produced with all-purpose flour rather than with pastry flour. These workers found that crusts made from pastry flour soaked more than those made from all-purpose flour. However, other workers (Pratt, 1960; Pyler, 1952; and Tressler and Evers, 1957) suggested that unbleached soft wheat flour was best suited for pie crust because soft wheat flour has low protein content, about eight percent, and requires less proportion of shortening to obtain a light flaky crust. In flours with a high protein content, the proportion of shortening should be increased. Bisno (1950) indicated that pie crusts using red wheat flour not only required more shortening but also took a longer baking period than those made from the white winter wheat flour. The influence of particle size of flour on the quality of frozen pie crust, as well as the influence of the amount of

damaged starch particles was reported by Pratt (1960). He stated that damaged flour particles have an affinity to absorb the fat and the effectiveness of the fat is thereby lessened as the crust becomes mealy.

Shortening. Another ingredient that influences the quality of frozen pie crust is shortening. It should have a melting point high enough to prevent the fat from becoming too soft during the mixing (Pratt, 1960). It was reported by Tressler and Evers (1957) that Carlin et al. believed fat also should be pliable at low temperature since pastry is best manipulated at low temperature. Lard is one of the most plastic shortenings at low temperature but becomes oily at a temperature of 80°F. or above. Most hydrogenated shortenings have a relatively short plastic range but can be used with good results in pie crusts at temperatures of 65° to 85°F. Another property essential to pie crust shortening is a "clean" flavor (Tressler and Evers, 1957). Since baked pie crust contains approximately 35 to 40 percent shortening, flavor of shortening must be free from off-flavor tastes. Hydrogenated vegetable oil shortenings are usually flavorless.

A high stability of the fat is essential to retard development of rancidity during frozen storage (Pratt, 1960). Mahon and Chapman (1955) studied the fat stability of frozen pastry and found that baked pastry was less stable than raw. This was attributed to the destruction of antioxidant in the fat during baking. However, a study by Weir et al. (1960) indicated that

the stability of the fat system in pastry was not affected by baking before frozen storage, by differences in ratios of flour to fat, or by storage temperatures between -10° and 20°F. When stored at temperature (10°, 0° and 20°F.) pastry made with vegetable shortening was more stable than that made with lard. This was attributed to antioxidant properties of the tocopherol in the hydrogenated vegetable shortening.

Briant and Snow (1957) reported that more tender pastries were produced with a high proportion of fat than with a low proportion. They also found that frozen pastries made using lard were slightly more tender than those made using hydrogenated vegetable shortening. However, Morris (1956) found that in freezing, the crust containing lard had more formation of peroxides than that made with vegetable shortening. Furthermore, Lowe (1959) indicated that lard is low in natural antioxidant and consequently may become rancid easily.

Methods of Freezing, Packaging and Thawing of Frozen Pies

The proper techniques and methods used in freezing, packaging and thawing of frozen pies are important in obtaining satisfactory end products (Hutchings and Evers, 1946). Logan et al. (1951) indicated that sanitary handling and speed prior to quick-freezing of precooked food were essential to insure a wholesome product. Similarly according to Hutchings and Evers (1946) precooked foods subjected to freezing, are susceptible to contamination and spoilage since they are partially broken

down during the cooking processes. Therefore, such products should be handled as quickly as possible during cooling and packaging because this is the period when they are most vulnerable.

In freezing soft pies, Franklin (1955) stated that pies should be thoroughly cooled and frozen before wrapping. However, Fenton (1951) said that pies may be wrapped before or after freezing.

The functions of a food package as pointed out by Charlton and Delong (1956) are to maintain the quality of the product as well as to physically contain the food. In freezing, good packaging material must be moisture-vapor-proof (Gilpin, 1959 and Tressler and Evers, 1957). Gilpin (1959) stated that aluminum freezer foil is a moisture-vapor-proof material and is particularly useful for wrapping foods with irregular shape. Franklin (1955) recommended wrapping cream pies with aluminum foil tightly against the surface of pie filling and the edge of the crust, and then overwrap it with MST cellophane which was heat sealed or taped. No explanation for this recommendation was stated.

In an anonymous article (1945) it was stated that when frozen pies were thawed at room temperature, and then baked the crust was soggy and undesirable. Thawing in the oven gave much more acceptable products. Similar findings on thawing in the oven were reported by Meyers (1955). Franklin (1955) recommended the thawing of the unwrapped cream pies in a slow oven at 300°F., for 10 to 15 minutes.

EXPERIMENTAL PROCEDURE

Statistical Plan for the Study

The quality, acceptability, preparation time and cost of three types of chocolate frozen cream pies were compared. The pies were: (A) prepared from a home recipe using individual ingredients, (B) prepared in the laboratory from commercial mixes, and (C) commercially precooked and frozen. Each type of pie was evaluated 12 times. Table 1 shows the randomized block design for the order of preparation and for the presentation of the pies to the palatability panel.

Table 1. Design used for preparation and presentation of frozen chocolate cream pies[1] to the palatability panel.

Periods											
1	2	3	4	5	6	7	8	9	10	11	12
Pies											
B	C_{4b}	B	A	B	C_{4d}	C_{2a}	C_{2d}	B	B	B	C_{1b}
A	B	A	B	C_{3d}	B	A	B	C_{1f}	C_{2e}	C_{1e}	B
C_{3b}	A	C_{4c}	C_{3a}	A	A	B	A	A	A	A	A

[1] Three types of pies.
A - pies made from individual ingredients.
B - pies made from commercial mixes.
C - commercially precooked and frozen pies.
Arabic subscript number - number of case lot.
Arabic subscript letter - pie sample within one case lot.

Procurement and Preparation of Frozen Pies

Procurement. All necessary ingredients except eggs, for type A pies (prepared from individual ingredients) were purchased

at one time from a local market. The eggs were purchased each week from a common source. The commercial pie crust and filling mixes for type B pies (prepared from commercial mixes) were purchased at one time from a local market. Homogenized milk for the type B filling was obtained from a common source each time the pies were made. Type C pies (commercially precooked and frozen) were shipped by the manufacturer in four case lots of six pies each to Manhattan and held in frozen storage until evaluated.

The dry ingredients, including mixes, together with the shortening and vanilla were stored in the laboratory until used. Laboratory temperature varied only from 70° to 77°F. with an average of 72°F. Egg yolks and margarine were kept in a refrigerator at 35° ± 1°F.

Preparation. Preliminary work was performed on the home recipe to determine formula and method of procedure. The following formulas were used for the crust and filling of a type A pie:

Filling			Crust	
Sugar	100	gms.	Flour, all-purpose	90 gms.
Flour, all-purpose	24	gms.	Shortening	53 gms.
Salt	3	gms.	Salt	1.5 gms.
Nonfat dry milk solid	36	gms.	Water	20 ml.
Egg yolk	36	gms.		
Margarine	14	gms.		
Chocolate	42.5	gms.		
Vanilla	2.5	ml.		
Water	330	ml.		

The procedure for the preparation of type A pie filling was as follows:

Melt chocolate over a double boiler that contains two cups of water in the lower pan.

Weigh sugar, flour, salt, nonfat dry milk solids and margarine.

Beat egg yolks for one minute with egg beater and weigh.

Measure water.

Mix sugar, flour and salt by sifting three times, add one tablespoon of this flour mixture to the melted chocolate and mix thoroughly. Then add the remainder of the flour mixture and stir 100 times.

Add reconstituted milk to the chocolate mixture and stir until smooth.

Place mixture over a double boiler and stir 40 times per minute with a wooden spoon until thickened ($85^{\circ} \pm 1^{\circ}C.$).

Remove from double boiler and add one tablespoon of hot chocolate-starch mixture to beaten egg yolks. When mixed add this egg mixture to the remaining chocolate mixture while stirring.

Add margarine to the filling mixture and place back over the double boiler. Heat the mixture to $81^{\circ}C.$ (about two minutes with a cover). Stir three times when about half of the cooking time has elapsed.

Remove from heat and cool two minutes.

Add vanilla, stir in quickly, and continue to mix for one minute.

Pour 350 grams of filling into a baked pie shell and cool at room temperature for 10 minutes. Place in the refrigerator for two hours.

Cover pies with heavy duty aluminum foil, crimping edge of foil.

The procedure for the preparation of type A pie crust was as follows:

Preheat oven to $450^{\circ}F.$

Weigh flour, shortening and salt, and place into a bowl.

Measure water at 18°C.

Sift flour and salt together three times to mix.

Cut fat into flour mixture with a pastry blender, using 100 strokes to cut fat in pieces about the size of coarse corn meal.

Sprinkle water evenly over the flour-fat mixture.

Combine water and flour-fat mixture with 40 strokes of the pastry blender, running it along the bottom of the bowl with a lifting motion.

Allow the covered dough mixture to stand at room temperature for five minutes.

Form a ball between the palms of the hands and press the dough together lightly eight times.

Rub flour (1 to 2 grams) into a pastry cloth and into the cover of the rolling pin.

Roll the dough, using metal guides (1/8 inch thick) placed 10 inches apart. Roll out pastry as round as possible.

Cut pastry about one inch wider than an eight-inch pie pan and line the pan with the dough.

Press out the air so that no air bubbles are formed.

Crimp the dough around the edge of the pie tin and trim off excess dough with a knife at approximately a 45 degree angle.

Press the dough tightly around the edge of the pan.

Prick the pastry evenly with a fork to keep bubbles from forming under the crust.

Bake in an oven at 450°F. for 10 ± 2 minutes.

Cool to room temperature.

The procedure for the preparation of type B pie filling was, in general, that given in the directions on the package of the commercial chocolate pudding mix:

Empty the mix into a saucepan and add two cups of fresh milk gradually, while stirring with a wooden spoon, until it becomes smooth (about 50 strokes).

Place over direct heat, 225°F., on thermostatically controlled burner.

Cook for about five minutes while stirring 40 times per minute with a wooden spoon until bubbles start to form (85° ± 1°C.).

Remove from heat, stir for one minute and cool two minutes.

Pour 350 grams of filling into a baked pie shell and allow to cool at room temperature for 10 minutes. Then place in the refrigerator for two hours.

Cover pies with heavy duty aluminum foil, crimping the edge.

The procedure for the preparation of type B pie crust was, in general, that given in the directions on the package:

Crumble a stick of pie crust mix into a mixing bowl.

Add two tablespoons of boiling water and mix with a fork until all water is absorbed and dough handles easily (about 30 strokes).

Allow the dough to cool for two minutes.

Flour pastry cloth (rub in 1 to 2 grams) and prepare crust in the same manner as those made from individual ingredients.

Storage and Defrosting of Frozen Pies

Storage. Type A pies and type B pies were prepared during each of the 12 periods, and stored for one week at 0° to -10°F.

Type C pies were coded after they were received from a commercial firm and stored in the original container in a laboratory freezer at 0° to -10°F. Four lots of commercially

frozen pies were prepared at the factory between the dates of February 22 and March 31, 1961. Table 2 gives the dates of preparation and evaluation. At the time of scoring, the pies had been in frozen storage, either by the commercial firm or in the laboratory, for from 88 to 120 days or approximately three to four months.

Table 2. Storage of four case lots of commercially precooked and frozen chocolate cream pies.

Sample[1] code	Prepared (year - 1961)	Evaluated (year - 1961)	Stored (days)
1_b	March 31	July 5	90
1_e	"	July 3	94
1_f	"	June 29	90
2_a	"	June 27	88
2_d	"	June 28	89
2_e	"	June 30	91
3_a	February 22	June 22	119
3_b	"	June 18	117
3_d	"	June 23	120
4_b	March 8	June 20	104
4_c	"	June 21	105
4_d	"	June 26	110

[1]Arabic number - number of case lot; lower case letter - pie sample within one case lot.

Defrosting. Defrosting of type A and B pies was determined as the result of preliminary work. Pies were removed from the freezer and placed in a slow oven (300°F.) for 20 minutes. The aluminum foil cover was not removed, but one-inch slits were made in the foil to retard drying out of the surface of the pie, and at the same time to release the moisture. Pies were then placed in the refrigerator for one and one half hours to complete the defrosting. Type C pies were defrosted in the manner suggested by the manufacturer. The pies were removed from the package, placed on a wire rack and allowed to stand for 45 minutes at room temperature. The topping was removed since only the crust and filling of the three types of frozen pies were compared in this study.

Evaluation of Frozen Pies

Quality and Acceptability. The quality of the pies was judged by a panel of nine who scored the crust and filling on a range of one to five and evaluated the overall acceptability. The score card used is presented as Form I (Appendix). Data from the taste panel were subjected to analysis of variance, and when appropriate least significant differences were calculated according to Fisher's test (Fisher, 1949).

Time and Money Costs. Preparation and cleanup time required in making type A and B pies were recorded on Form II (Appendix). The data were analyzed by the G-test. Type C pies were ready-to-serve food, and only defrosting was required.

The initial cost of pies (six servings, each) based on the retail prices on the local market were compared. The fuel cost for preparing and thawing type A and B pies was calculated from meter readings on the range obtained before and after the baking of the crust, the cooking of the filling, and the thawing of the pies. The rate per kilowatt hour was based on the local rate of seven cents. The fuel required to preheat the oven was included in figuring the cost.

RESULTS AND DISCUSSION

Quality and Acceptability of Frozen Chocolate Cream Pies

Quality of Pies. The mean palatability scores were subjected to analysis of variance, and when appropriate least significant differences were calculated according to Fisher's test (Fisher, 1949) to determine difference in palatability and acceptability of the three types of frozen chocolate cream pies. Differences in quality factors were all significant at the 0.1 percent level as shown in Tables 3 and 4.

Table 3. Mean squares and significance obtained from analysis of variance of palatability scores for pie fillings.

Source of variance	D/F	Appearance	Color	Texture	Consistency	Flavor
Type of pie	2	4.254***	0.4525***	11.43***	1.161***	7.6222***
Error	33	0.0465	0.0455	0.0447	0.0753	0.0722
Total	35					

*** Significant at the 0.1% level.

Table 4. Mean squares and significance obtained from analysis of variance of palatability scores for pie crusts.

Source of variance	D/F	Appearance	Color	Moisture content	Tenderness	Texture	Flavor
Type of pie	2	18.38***	12.59***	11.44***	16.88***	23.02***	15.38***
Error	33	0.471	0.1218	0.0481	0.0623	0.0368	0.0331
Total	35						

*** Significant at the 0.1% level.

Mean palatability scores for three types of frozen chocolate pie fillings are shown in Figure 1. Detailed palatability scores are recorded in Tables 15 through 19 (Appendix). The order of rank, based on mean palatability scores, for the three types of filling was determined (Table 5). Appearance of type A filling ranked first, and was significantly ($P < .05$) better than type C, which was significantly ($P < .05$) better than B. Neither type A nor C had any evidence of clearly defined liquid separation, but type B had syneresis (Plate 1). Although, in the order of rank, type A was first in appearance, it was noted that when cut, the filling tended to slip from the crust, especially at the point of the wedge. However, type C did not show this tendency to slip from the crust. This slipping characteristic was also observed by Jordan (1961). She reported that when frozen white sauce, in which wheat flour was used, was thawed and removed from the jar, it slipped out leaving the wall of the jar clean. The low appearance score for type B filling, because

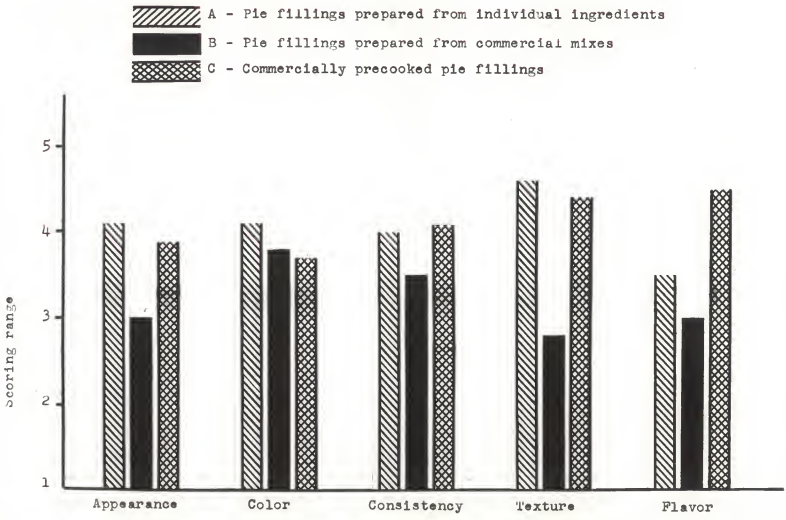

Figure 1. Mean palatability scores for three types of frozen chocolate cream pie fillings.

EXPLANATION OF PLATE I

The photograph shows the characteristic appearance of three types of defrosted chocolate cream pies. Type A (1), made from individual ingredients, tended to soften slightly especially at the point of the wedge. Neither type A (1) nor type C (3), commercially precooked and frozen, had any evidence of clearly defined liquid separation, but type B (2), made from commercial mixes, had syneresis.


1
2
3

of syneresis noted by the judges, probably was partially attributed to the use of homogenized milk, coupled with absence of fat and the complete gelatinization of the cornstarch pie filling. Fenton (1951) stated that separation of liquid was especially noticeable when homogenized milk was used in white sauce.

Table 5. Order of rank for mean palatability scores of three types of pie fillings.

Characteristics	Order of rank for mean scores						lsd*[1]
Appearance	A	>	C	>	B		
	4.12	*	3.88	*	2.99		0.18
Color	A	>	B	=	C		
	4.08	*	3.80	ns	3.70		0.18
Consistency	C	=	A	>	B		
	4.14	ns	3.95	*	3.53		0.23
Texture	A	=	C	>	B		
	4.56	ns	4.45	*	2.82		0.18
Flavor	C	>	A	>	B		
	4.53	*	3.53	*	2.96		0.22

[1] lsd* - Least significant difference at 5.0% level.
* - Significant at the 5.0% level.
ns - Nonsignificant.
A - Pie fillings made from individual ingredients.
B - Pie fillings made from commercial mixes.
C - Commercially precooked and frozen pie fillings.

Differences in freeze-thaw stability in the three types of frozen chocolate cream pie might be attributed to differences in ingredients used and/or method of preparation. The main ingredients that differed for each type of pie were thickening

agent, milk and possibly the fat. The thickening agents used in type A pie fillings were all-purpose flour and egg yolks, in type B pie fillings, cornstarch alone, and in type C pie fillings gelatin and emulsifier. Type A fillings included reconstituted nonfat dry milk solids, type B had homogenized milk, and type C contained both nonfat dry milk solids and evaporated milk. Margarine was included in type A fillings but was eliminated in type B as the directions did not call for it. Type C fillings contained shortening but the kind was not specified. Unsweetened chocolate was used in type A but cocoa was employed in types B and C.

Albrecht et al. (1960b) reported that white sauce, prepared with all-purpose flour as the thickening agent, was slightly better than that made from cornstarch when the sauce was preheated to 185°F., or completely gelatinized, prior to freezing. However, when white sauce containing cornstarch was preheated only to a temperature of 145°F., it was more stable for freezing than the completely gelatinized white sauce made using cornstarch or wheat flour. Although ungelatinized white sauce was better for freezing, it was limited to use in products that were reheated before serving. Therefore, it appeared that ready-to-serve food such as chocolate cream pie filling should be completely gelatinized before freezing, as was done in the present study.

The color of type A fillings was ranked best and the mean score was significantly ($P < .05$) higher than for either type B

or C. However, the mean score for color of type B was not significantly better than C. Fillings, type B and C, were lighter and less truly chocolate-colored than type A.

There was no significant difference between the mean scores for consistency of types A and C fillings. However, mean scores for both types were significantly ($P < .05$) higher than for type B. Types A and C fillings were judged to have a creamy consistency and held shape somewhat but type B filling appeared to be slightly stiff.

There was no significant difference in texture scores between types A and C fillings. They both ranked higher and were significantly ($P < .05$) better than B. The texture of type B filling appeared to be somewhat curdled and spongy, and type C seemed to have a whipped texture. Some panel members did not consider the texture of type C filling to be typical of that of a cream pie.

Flavor ranked best in type C filling and the mean scores were significantly ($P < .05$) better than for the other two types. Type A filling ranked second and was significantly ($P < .05$) better than type B. The flavor of type A fillings was judged to be slightly salty and bitter by some of the panel. However, the flavor of type C fillings was judged to have the sweetest flavor but was considered to be not typical of a home-made chocolate cream pie.

Figure 2 presents the mean palatability scores for crusts of three types of frozen chocolate cream pies. Detailed

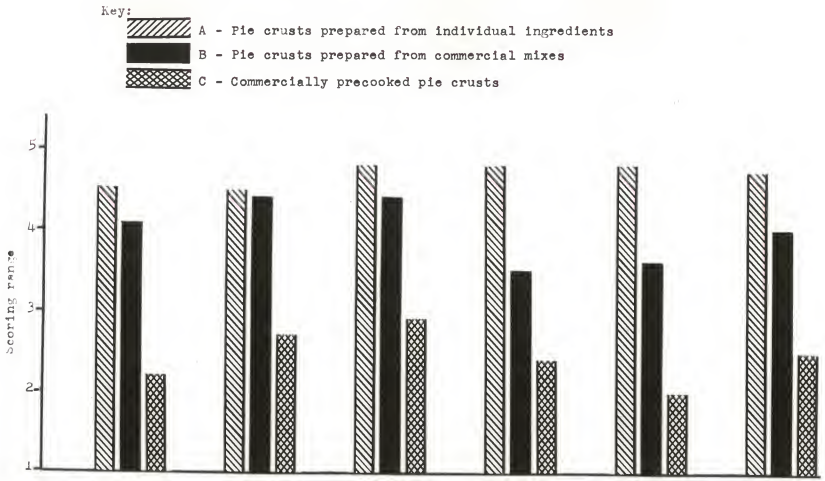

Figure 2. Mean palatability scores for three types of frozen chocolate cream pie crusts.

palatability scores are recorded in Tables 16 through 20 (Appendix). In Table 6 the three types of pie crusts were ranked according to mean scores. Type A crusts ranked first and were significantly ($P < .05$) better than the other two types of crusts in all characteristics scored except color. No significant difference was shown between mean scores for color of types A and B. The mean scores for type B crusts were significantly ($P < .05$) higher than for type C. The scores for type B crusts were closer to those of type A than to those of type C. Judges commented that tenderness and texture of type B crusts were

Table 6. Order of rank for mean palatability scores of three types of pie crusts.

Characteristics	Order of rank for mean scores						lsd*[1]
Appearance	A	>	B	>	C		
	4.48	*	4.12	*	2.18		0.18
Color	A	=	B	>	C		
	4.53	ns	4.35	*	2.68		0.29
Moisture content	A	>	B	>	C		
	4.76	*	4.40	*	2.90		0.18
Tenderness	A	>	B	>	C		
	4.82	*	3.91	*	2.45		0.21
Texture	A	>	B	>	C		
	4.78	*	3.62	*	2.02		0.16
Flavor	A	>	B	>	C		
	4.73	*	3.98	*	2.51		0.15

[1] lsd* - Least significant difference at 5.0% level.
* - Significant at the 5.0% level.
ns - Nonsignificant.
A - Pie crusts made from individual ingredients.
B - Pie crusts made from commercial mixes.
C - Commercially precooked and frozen pie crusts.

slightly inferior to crusts of type A. The crusts of type A were flaky and tender, and the flavor was pleasant, whereas the crusts of type C were considered to be thick, compact, smooth surfaced, and lacking in tenderness (Plate 1).

Acceptability of Pies. Tables 7 and 8 present the percentage acceptability of the three types of pies. An average of 82 percent of the panel decided that type A frozen chocolate cream pies were acceptable and that they would serve them at meal time. The average acceptability of type B pies and of type

Table 7. Percentage acceptability of two types of frozen chocolate cream pies.

Replications	Pies	
	Type A (made from individual ingredients)	Type B (made from commercial mixes)
1	78	56
2	78	44
3	78	56
4	78	56
5	78	44
6	78	56
7	88	50
8	88	38
9	88	44
10	100	67
11	78	56
12	78	44
Av.	82	51

Table 8. Percentage acceptability of four lots of commercially precooked and frozen pies.

Lot number	Type C (commercially precooked and frozen) Replication number 1	2	3	Average
		Percent		
1	78	78	78	78
2	67	67	78	71
3	88	62	78	76
4	78	67	78	74
Av.	78	68	78	75

C pies was 51 and 75 percent, respectively. The mean percentage acceptability of type A pies was significantly ($P < .05$) higher than type C which was significantly ($P < .05$) higher than type B (Table 9).

Table 9. Order of rank for mean percentage of overall acceptability of three types of pies.

Order of rank	Pies	Mean percent acceptability
1	A	82
2	C	75 *
3	B	51 *
		$lsd^{*} = 6.3$

lsd^{*} - Least significant difference at 5.0% level.
* - Significant at 5.0% level.
A - Pies made from individual ingredients.
B - Pies made from commercial mixes.
C - Commercially precooked pies.

On the average about half of the judges said that they would not serve type B frozen pies because of syneresis and a somewhat curdled appearing filling. The type C pies were not acceptable to an average of 25 percent of the panel. The main objection expressed was the poor quality of the crusts. The crusts of type A were liked best although the fillings of type C were preferred to those in the other types of pies.

Palatability and Acceptability of Four Lots of Commercially Precooked and Frozen Pies. Type C pies were obtained in four case lots of six each. Three pies from each case lot were chosen at random for sampling. Table 2 presents the dates on which each case of frozen chocolate cream pies was made and evaluated. The percentage acceptability and palatability scores of the four lots of pies are recorded in Tables 8, 21 and 22 of the Appendix. Differences, attributable to lots, were analyzed statistically (Tables 10 and 11). Analysis of variance revealed that only two factors differed significantly; appearance of the fillings ($P < .001$) and color of crust ($P < .01$).

Table 10. Mean squares and significance obtained from analysis of variance of palatability scores for four lots of commercially precooked and frozen pie fillings.

Source of variance	D/F	Appearance	Color	Texture	Consistency	Flavor
Lot	3	.0586***	.0911 ns	.0189 ns	.0986 ns	.0289 ns
Error	8	.0033	.0433	.0767	.0492	.0425
Total	11					

*** - Significant at the 0.1% level.
ns - Nonsignificant.

Table 11. Mean squares and significance obtained from analysis of variance of palatability scores for four lots of commercially precooked and frozen pie crusts.

Source of variance	D/F	Appearance	Color	Moisture content	Tenderness	Texture	Flavor
Lot	3	.0100 ns	.3097**	.0278 ns	.0300 ns	.0100 ns	.0275 ns
Error	8	.0433	.0292	.0492	.0400	.0158	.0408
Total	11						

** - Significant at the 1.0% level.
ns - Nonsignificant.

The mean score for appearance of fillings in lot two was significantly ($P < .05$) greater than for any other lot (Table 12). Differences in mean scores between lots one and three and lots one and four were nonsignificant. The color of crusts for pies in lot two had a significantly ($P < .05$) higher mean score than had crusts in lots one, three and four, but the color for lot three was not significantly better than lot four. The mean score for lot one was significantly ($P < .05$) better than lot four, but not significantly better than lot three.

Least significant differences among lots for other factors scored, as well as for percentage acceptability, were not calculated since analysis of variance was nonsignificant at the 5.0 percent level.

Table 12. Mean palatability scores for appearance of fillings and color of crusts for four lots of commercially precooked and frozen pies.

Factor scored	Mean scores for lots				lsd*
	1	2	3	4	
Appearance of fillings	3.83 *	4.07 *	3.87 *	3.73	0.11
		ns			
		ns			
Color of crusts	2.70 *	3.10 *	2.57 ns	2.33	0.32
		ns			
		*			

lsd* - Least significant difference at the 5.0% level.
* - Significant at the 5.0% level.
ns - Nonsignificant.

Preparation of Pies and Cleanup Time

The average time spent in preparation of the crusts and fillings for pies made from individual ingredients and for those made from commercial mixes was analyzed by the G-test and presented in Table 13. Detailed data are given in Tables 23 and 24 (Appendix). Type A crusts required a significantly ($P < .001$) longer time for mixing than type B. There were no significant differences between the time used in rolling and panning or baking the crust for each of the two types of pies prepared. The mixing time for the fillings and time required for cooking the fillings of type A were longer than for type B. Differences were significant at the 1.0 and 0.1 percent levels, respectively.

Table 13. Average preparation and cleanup time, in minutes and seconds for type A and B pies.

Time spent for:	Type A (made from individual ingredients)		Type B (made from commercial mixes)	
Crust preparation:				
Weighing[1]	4:12		-	
Mixing	5:49	***	3:19	
Standing[1]	5:00		2:00	
Rolling and panning	13:05	ns	14:14	
Baking	10:39	ns	10:22	
Total	38:39		29:55	
Filling preparation:				
Weighing[1]	8:16		-	
Mixing	6:17	**	3:44	
Cooking	9:06	***	5:06	
Total	23:39		8:50	
Entire pie preparation[1]:	62:24			38:45
Cleanup[1]:	18:28			10:50
Total preparation and cleanup[1]:	80:52			49:35

*** - Significant at 0.1% level as determined by G-test.
** - Significant at 1.0% level as determined by G-test.
ns - Nonsignificant.
1 - Factors not analyzed by G-test.

When a mix was used, the weighing of ingredients was eliminated and fewer utensils were required. Thus, on the average cleanup time was shortened about seven and one-half minutes. No preparation or cleanup time was considered for meringue of types A and B pies, since the topping of type C was removed before pies were scored. No preparation or cleanup time was calculated

for type C pies since they were ready-to-serve after defrosting at room temperature.

Cost

Initial Cost. The average cost per pie for type A was 28 cents, for type B, 37 cents, and for type C, 69 cents (Table 14). The average initial cost per pie for type C was about two and one-half times that of type A and approximately two times that of type B. The cost of two egg whites and four tablespoons of sugar per pie for meringue was included in the cost of types A and B for comparing the cost of the pies, because the homemaker probably would prepare a meringue for the pies.

Table 14. Average costs of three types of pies.

Pies	Entire pie (six servings)			One serving
	Initial cost	Fuel cost	Total cost	Total cost
	cents	cents	cents	cents
A	28	10.5	38.5	6.4
B	37	8.5	45.5	7.6
C	69	-	69.0	11.5

A - Pies made from individual ingredients.
B - Pies made from commercial mixes.
C - Commercially precooked and frozen pies.

Fuel Cost. An average of one and five-tenths kilowatts of electricity was used for preparing and thawing type A pies, whereas one and two-tenths kilowatts was needed for type B pies.

The average fuel cost per pie for preparing and thawing type A pies was 10.5 cents and for type B pies, 8.5 cents. The baking and thawing times used for each of the two types of crust were essentially equal. However, since the cooking time required for filling A was longer than that required for filling B, the amount of fuel used in preparing the entire type A pie was increased slightly. No fuel cost was involved in thawing type C pies because the pies were thawed at room temperature as specified by the manufacturer.

Total Cost. The average cost of type A pies was 38.5 cents, of type B pies, 45.5 cents, and of type C pies 69 cents when both the initial and fuel costs were considered. Since six servings could be cut from each pie, the cost per serving of type A pie averaged 6.4 cents, of type B pie 7.6 cents, and of type C pie 11.5 cents.

SUMMARY

The purposes of this study were: (1) to determine quality and acceptability of three types of frozen chocolate cream pies; (2) to compare cost, in preparation time and money, of these pies and (3) to determine the degree of variation, in the quality and acceptability of the commercially precooked frozen chocolate cream pies, attributable to lots.

Each type of pie was evaluated 12 times, using a randomized complete block design for the order of preparation and for the presentation of the pies to the palatability panel. Type A and

B pies were prepared and stored in the freezer for one week, whereas type C pies were procured commercially and stored in the laboratory freezer until evaluated. Palatability scores and percentage acceptability of the three types, as well as the data for preparation time for crusts and fillings of type A and B pies were analyzed statistically. The analysis of variance indicated that differences in all quality factors for both fillings and crusts were significant at a 0.1 percent level.

The results of the palatability tests revealed that, in general, type A was best of the three types of pies, except for the flavor of the filling. The flavor of type C pie filling was scored significantly ($P < .05$) better than either of the other two types. However, the crusts of type C were scored significantly ($P < .05$) lower than either type A or B. Type B pie fillings were scored significantly ($P < .05$) lower than types A or C in all characteristics except color. There was no significant ($P < .05$) color difference between types B and C. Mean scores for all characteristics of type B crusts were significantly ($P < .05$) greater than type C and significantly ($P < .05$) less than type A except for color. There was no significant difference in color of crusts for types A and B. Percentage acceptability for type A pies averaged 82 and was significantly ($P < .05$) higher than types B and C that averaged 51 and 75, respectively. Type C filling was the most preferred, whereas type A crust was most preferred.

Differences in type C pies, attributable to lots, showed

that appearance of the fillings and color of the crusts were the only palatability factors that varied significantly. With regard to all other characteristics of the pies and to percentage acceptability, differences in lots were nonsignificant.

The G-test revealed that type A crusts required a significantly ($P < .001$) longer time for mixing than type B. The mixing time for the fillings and time required for cooking the fillings of type A were longer than for type B, the differences were significant at the 1.0 and 0.1 percent levels, respectively. However, there were no significant differences between the time used in rolling and panning or baking of the crust for types A and B.

Fuel costs were computed and included with the initial cost of ingredients for total cost of types A and B pies. No preparation or cleanup time was calculated for type C pies. Only the initial cost was considered for them, since they were ready-to-serve after defrosting at room temperature. Each pie provided six servings. The average cost per serving of type A was 6.4 cents, of type B, 7.6 cents and of type C, 11.5 cents.

In general, type A pies were most acceptable and cost less than any of the three types evaluated. Type B was least acceptable and intermediate in cost, whereas type C was intermediate in acceptability and cost the most.

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APPENDIX

FORM I

Score Card for Chocolate Pie

Name_____

Date_____

	Key for Scoring 1	2	3	4	5	Samples 1	2	3
FILLING								
Appearance:	Separation of liquid, glossy			Homogeneous, dull				
Color:	Too dark or grayish			Chocolate color				
Consistency:	Too stiff, runny, sticky, watery			Creamy, hold shape somewhat				
Texture:	Lumpy, curdled grainy			Smooth				
Flavor:	Raw taste, not sweet enough, starch, flat, too much flavoring			No raw taste, pleasing, free from cereal taste				
CRUST								
Appearance:	Smooth or large blisters, broken edges			Rough with small blisters, not greasy, good edge				
Color:	Dark brown or pale			Delicate brown				
Moisture:	Soggy or underbaked			Dry				
Tenderness:	Tough or hard			Tender, crisp				
Texture:	Compact or crumbly			Light and flaky				
Flavor:	Unpleasant fat flavor, flat, raw, burned			Pleasing, no raw or burned taste				

Would you consider this pie an acceptable product to serve at a meal? 1. 2. 3.

PREFERENCE (Filling_____

(Crust_____

COMMENTS:

FORM II

Time record for chocolate cream pie

Date_____

	Sample_____	Sample_____
Crust preparation:		
Weighing ingredients	_____	_____
Mixing (sifting and cutting in fat and water)	_____	_____
Standing	_____	_____
Rolling and panning	_____	_____
Baking	_____	_____
Total crust preparation time	_____	_____
Filling preparation:		
Weighing ingredients	_____	_____
Mixing (sifting and combining with liquid)	_____	_____
Cooking	_____	_____
Total filling preparation time	_____	_____
Total pie preparation time	_____	_____
Cleanup:		
Put away excess food and containers		
Clean preparation table		
Wash and put away utensils		
Total cleanup time	_____	_____

Table 15. Palatability scores of fillings for type A pies prepared from individual ingredients (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Consistency	Texture	Flavor
1	4.0	3.6	3.6	4.2	3.2
2	3.7	3.7	3.7	4.7	3.9
3	4.3	4.2	3.8	4.6	3.8
4	4.1	3.9	4.1	4.6	4.1
5	4.4	4.0	4.6	4.7	3.9
6	3.9	4.2	3.8	4.6	3.6
7	4.2	4.1	4.1	4.4	3.3
8	4.1	4.3	4.1	4.6	3.3
9	4.1	4.2	3.7	4.6	3.1
10	4.3	4.1	3.9	4.9	3.6
11	4.4	4.3	4.2	4.1	3.2
12	4.0	4.3	3.8	4.7	3.4
Av.	4.1	4.1	4.0	4.6	3.5

Table 16. Palatability scores of crusts for type A pies prepared from individual ingredients (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Moisture content	Tenderness	Texture	Flavor
1	4.2	4.8	4.6	4.9	4.8	4.9
2	4.3	4.4	4.7	4.4	4.6	4.6
3	4.3	4.8	4.7	4.8	4.7	4.8
4	4.6	4.2	4.8	4.9	4.8	4.8
5	4.6	4.6	4.7	4.9	4.8	4.6
6	4.4	4.8	4.7	4.6	4.6	4.6
7	4.7	4.3	5.0	4.9	4.7	4.8
8	4.6	4.4	4.8	4.9	5.0	4.8
9	4.1	4.1	4.4	4.9	4.9	4.8
10	4.6	4.6	5.0	4.9	4.7	4.6
11	4.7	4.7	4.9	4.9	4.8	4.8
12	4.7	4.7	4.8	4.8	4.9	4.7
Av.	4.5	4.5	4.8	4.8	4.8	4.7

Table 17. Palatability scores of fillings for type B pies prepared from a commercial mix (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Consistency	Texture	Flavor
1	2.9	3.9	3.8	2.5	2.8
2	2.8	3.7	3.7	2.9	2.4
3	3.0	3.8	3.3	2.7	2.8
4	2.8	3.5	3.2	3.0	3.0
5	2.8	3.7	3.3	2.8	2.9
6	2.6	3.6	3.9	2.8	2.9
7	2.9	3.9	3.4	2.8	3.0
8	3.1	3.8	3.6	2.9	2.8
9	3.2	3.8	3.0	2.6	3.1
10	3.0	3.9	3.6	2.9	3.3
11	3.1	3.9	3.7	2.9	3.1
12	3.7	4.1	3.9	3.0	3.4
Av.	3.0	3.8	3.5	2.8	3.0

Table 18. Palatability scores of crusts for type B pies prepared from a commercial mix (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Moisture content	Tenderness	Texture	Flavor
1	4.0	4.8	4.5	3.5	3.8	3.9
2	4.3	4.7	4.8	4.0	3.9	4.1
3	4.4	4.7	4.6	4.0	3.9	4.0
4	4.1	4.1	4.6	3.9	4.0	4.5
5	3.8	3.8	4.0	3.3	3.6	3.7
6	4.1	4.6	4.3	3.1	3.2	3.7
7	4.2	4.2	4.6	3.6	3.3	4.2
8	3.8	4.3	4.2	3.3	3.3	4.0
9	3.8	4.2	4.6	3.0	3.6	3.8
10	4.2	4.8	4.3	3.4	3.6	4.1
11	4.2	3.4	4.4	3.1	3.3	3.9
12	4.6	4.6	3.9	3.7	3.9	3.9
Av.	4.1	4.4	4.4	3.5	3.6	4.0

Table 19. Palatability scores of fillings for type C pies which were commercially precooked and frozen (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Consistency	Texture	Flavor
1	3.8	3.1	3.6	3.9	4.1
2	3.8	3.8	4.1	4.4	4.6
3	3.7	3.4	4.0	4.4	4.3
4	3.9	3.6	4.2	4.5	4.6
5	3.9	3.7	4.2	4.6	4.6
6	3.7	3.8	4.0	4.7	4.6
7	4.1	3.7	4.2	4.6	4.7
8	4.1	3.9	3.9	4.1	4.6
9	3.8	3.8	4.3	4.3	4.4
10	4.0	3.9	4.3	4.7	4.7
11	3.8	3.8	4.3	4.6	4.8
12	3.9	3.9	4.6	4.6	4.4
Av.	3.9	3.7	4.1	4.4	4.5

Table 20. Palatability scores of crusts for type C pies which were commercially precooked and frozen (Scoring range, 5.0 - 1.0).

Replications	Appearance	Color	Moisture content	Tenderness	Texture	Flavor
1	2.1	2.5	2.9	2.6	2.0	2.5
2	2.1	2.2	2.7	2.1	2.0	2.6
3	2.3	2.4	2.8	2.3	1.8	2.3
4	1.9	2.5	3.1	2.4	2.1	2.5
5	2.6	2.7	3.1	2.6	2.2	2.7
6	2.2	2.4	3.3	2.6	2.2	2.7
7	2.3	3.0	2.6	2.3	2.1	2.8
8	2.2	3.1	3.0	2.6	2.0	2.3
9	2.0	3.0	3.1	2.6	2.0	2.6
10	2.2	3.2	2.8	2.7	1.9	2.6
11	2.0	2.3	2.7	2.4	1.9	2.3
12	2.3	2.8	2.9	2.2	2.0	2.2
Av.	2.2	2.7	2.9	2.4	2.0	2.5

Table 21. Palatability scores of fillings for four lots of commercially precooked and frozen pies (Scoring range, 5.0 - 1.0).

Lot number		Appearance	Color	Consistency	Texture	Flavor
I		3.8	3.8	4.3	4.3	4.4
		3.8	3.8	4.3	4.6	4.8
		3.9	3.9	4.6	4.6	4.4
	Av.	3.8	3.8	4.4	4.5	4.5
II		4.1	3.7	4.2	4.6	4.7
		4.1	3.9	3.9	4.1	4.6
		4.0	3.9	4.3	4.7	4.7
	Av.	4.1	3.8	4.1	4.5	4.7
III		3.8	3.1	3.6	3.9	4.1
		3.9	3.6	4.2	4.5	4.6
		3.9	3.7	4.2	4.6	4.6
	Av.	3.9	3.5	4.0	4.3	4.4
IV		3.8	3.8	4.1	4.4	4.6
		3.7	3.4	4.0	4.4	4.3
		3.7	3.8	4.0	4.7	4.6
	Av.	3.7	3.7	4.0	4.5	4.5

Table 22. Palatability scores of crusts for four lots of commercially precooked and frozen pies (Scoring range, 5.0 - 1.0).

Lot number		Appearance	Color	Moisture content	Tenderness	Texture	Flavor
I		2.0	3.0	3.1	2.6	2.0	2.6
		2.0	2.3	2.7	2.4	1.9	2.3
		2.3	2.8	2.9	2.2	2.0	2.2
	Av.	2.1	2.7	2.9	2.4	2.0	2.4
II		2.3	3.0	2.6	2.3	2.1	2.8
		2.2	3.1	3.0	2.6	2.0	2.3
		2.2	3.2	2.8	2.7	1.9	2.6
	Av.	2.2	3.1	2.8	2.5	2.0	2.6
III		2.1	2.5	2.9	2.6	2.0	2.5
		1.9	2.5	3.1	2.4	2.1	2.5
		2.6	2.7	3.1	2.6	2.2	2.7
	Av.	2.2	2.6	3.0	2.5	2.1	2.6
IV		2.1	2.2	2.7	2.1	2.0	2.6
		2.3	2.4	2.8	2.3	1.8	2.3
		2.2	2.4	3.3	2.6	2.2	2.7
	Av.	2.2	2.3	2.9	2.3	2.0	2.5

Table 23. Preparation and cleanup time needed for chocolate cream pies prepared from individual ingredients.

Replications	Time recorded in minutes and seconds									
	Crust					Filling				
	Weighing	Mixing	Standing	Rolling and panning	Baking	Weighing	Mixing	Cooking	Clean-up time	Total preparation and cleanup time
1	4:30	5:20	5:00	11:00	12:00	9:00	6:42	9:50	17:30	78:52
2	4:00	4:45	5:00	12:00	11:13	8:00	4:45	9:47	20:30	80:00
3	5:00	5:55	5:00	12:00	10:35	7:50	5:45	9:20	18:50	80:15
4	6:00	5:00	5:00	11:00	11:15	8:35	3:15	9:55	18:10	78:10
5	4:00	6:00	5:00	14:10	10:55	9:18	7:32	8:00	18:55	83:50
6	4:50	5:10	5:00	15:10	10:50	7:30	7:30	8:40	22:00	86:40
7	4:00	6:00	5:00	14:36	11:12	7:00	8:30	8:12	21:00	85:30
8	3:00	7:00	5:00	16:00	11:00	8:00	6:00	9:00	19:00	84:00
9	3:15	6:30	5:00	13:00	10:00	10:25	6:05	8:30	18:07	80:52
10	4:20	5:40	5:00	13:00	9:00	8:30	6:30	9:00	15:00	76:00
11	3:30	6:30	5:00	12:00	10:00	8:00	7:00	10:00	17:00	79:00
12	4:00	6:00	5:00	13:00	9:45	9:00	6:00	9:00	15:30	77:15
Av.	4:12	5:49	5:00	13:05	10:39	8:16	6:17	9:06	18:28	80:52

Table 24. Preparation and cleanup time needed for chocolate cream pies prepared from commercial mixes.

Replications	Time recorded in minutes and seconds									
	Crust					Filling				
	Weighing	Mixing	Standing	Rolling and panning	Baking	Weighing	Mixing	Cooking	Clean-up time	Total preparation and cleanup time
1	-	3:00	2:00	12:30	11:25	-	3:15	5:45	11:00	48:55
2	-	2:00	2:00	13:27	11:28	-	2:48	5:20	10:00	47:03
3	-	3:47	2:00	13:00	11:13	-	3:50	5:00	11:00	49:50
4	-	3:00	2:00	12:30	11:30	-	3:00	4:30	12:35	49:05
5	-	4:00	2:00	14:15	11:00	-	5:10	5:17	15:26	57:08
6	-	4:00	2:00	16:00	10:50	-	4:30	4:40	12:00	54:00
7	-	2:00	2:00	15:00	9:50	-	4:30	4:40	15:00	53:00
8	-	2:00	2:00	16:00	9:10	-	4:00	5:00	9:00	47:10
9	-	4:00	2:00	18:00	10:00	-	4:00	5:30	8:00	51:30
10	-	4:00	2:00	13:00	9:00	-	3:45	5:15	8:00	45:00
11	-	4:00	2:00	14:00	10:00	-	3:00	5:15	11:00	49:15
12	-	4:00	2:00	13:00	9:00	-	3:00	5:00	7:00	43:00
Av.	-	3:19	2:00	14:14	10:22	-	3:44	5:06	10:50	49:35

A COMPARISON OF THE QUALITY, ACCEPTABILITY, AND COST IN TIME AND MONEY, OF FROZEN CHOCOLATE CREAM PIES

by

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AN ABSTRACT OF A MASTER'S THESIS

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The use of convenience foods has increased rapidly during the last decade. Convenience foods found on the market today include such products as mixes, partially prepared and precooked or ready-to-serve frozen foods. One of the relatively new products among the packaged precooked or ready-to-serve foods is frozen chocolate cream pies.

It appeared that the packaged and/or frozen precooked foods would be time and energy savers, though generally higher in cost than similar food prepared from a home recipe. Thus it seemed advisable to compare the quality, general acceptability and cost of pies prepared from individual ingredients and frozen (type A), prepared from commercial mixes and frozen (type B), and pies commercially precooked and frozen (type C).

Each type of pie was evaluated 12 times, using a randomized complete block design for the order of preparation and for the presentation of the pies to the palatability panel. Type A and B pies were prepared and stored in the freezer for one week, whereas type C pies were procured commercially and stored in the laboratory freezer until evaluated. Palatability scores and percentage acceptability of the three types, as well as the data for preparation time for crusts and fillings of type A and B pies were analyzed statistically. The analysis of variance indicated that differences in all quality factors for both fillings and crusts were significant at a 0.1 percent level.

The results of the palatability tests revealed that, in general, type A was best of the three types of pies, except for

the flavor of the filling. The flavor of type C pie filling was scored significantly ($P < .05$) better than either of the other two types. However, the crusts of type C were scored significantly ($P < .05$) lower than either type A or B. Type B pie fillings were scored significantly ($P < .05$) lower than types A or C in all characteristics except color. There was no significant ($P < .05$) color difference between types B and C. Mean scores for all characteristics of type B crusts were significantly ($P < .05$) greater than type C and significantly ($P < .05$) less than type A except for color. There was no significant difference in color of crusts for types A and B. Percentage acceptability for type A pies averaged 82 and was significantly ($P < .05$) higher than types B and C that averaged 51 and 75, respectively. Type C filling was the most preferred, whereas type A crust was most preferred.

Differences in type C pies, attributable to lots, showed that appearance of the fillings and color of the crusts were the only palatability factors that varied significantly. With regard to all other characteristics of the pies and to percentage acceptability differences in lots were nonsignificant.

The G-test revealed that type A crusts required a significantly ($P < .001$) longer time for mixing than type B. The mixing time for the fillings and time required for cooking the fillings of type A were longer than for type B; the differences were significant at the 1.0 and 0.1 percent levels, respectively. However, there was no significant differences between the time

used in rolling and panning or baking of the crust for types A and B.

Fuel costs were computed and included with the initial cost of ingredients for total cost of types A and B pies. No preparation or cleanup time was calculated for type C pies. Only the initial cost was considered for them, since they were ready-to-serve after defrosting at room temperature. Each pie provided six servings. The average cost per serving of type A was 6.4 cents, of type B, 7.6 cents and of type C, 11.5 cents.

In general, type A pies were most acceptable and cost less than any of the three types evaluated. Type B was least acceptable and intermediate in cost, whereas type C was intermediate in acceptability and cost the most.