A COMPARISON OF QUANTITY PLAIN CAKE MADE FROM A PREPARED CAKE MIX AND A STANDARDIZED FORMULA USING INDIVIDUAL INGREDIENTS

by

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INTRODUCTION

The success of an efficient food service establishment depends upon the uniformity and quality of products that satisfy the customer. Baked items frequently mean the difference between an outstanding and an average operation. It is of prime importance to produce a wide variety of quality products with maximum efficiency at a minimum cost. Thus, the possibility of using pre-prepared cake mixes should be of interest to institutions facing these problems.

One of the difficult problems in quantity food production is finding suitable recipes that can be adapted to different quantities in preparation. Many recipes obtained from quantity sources are limited to one size. With the trend toward more and larger food service establishments, increased labor cost and a lack of skilled workers, the problem is mounting. Food service operators must realize that the amount of skill and time it takes to prepare an item is a definite part of its costs. Newer methods in food production emphasize standardization of recipes and simplification of work procedure.

Several studies of home size mixes have been made. Many of these formulas and recipes are available to homemakers. Asp et al. (1957) found that preparation period at meal time was shortened by using home prepared mixes. However, formulas on experimental work of institutional mixes seemed limited. Knickrehm et al. (1952) reported that the cost of prepared quantity cake mix was approximately two-thirds the cost of commercial

mixes. According to Terrell (1957), mixes proved to be economical in the utilization of the workers' time. It can be made during the lull in preparation schedule, thus alleviating "rush" during the peak production period. Kirkpatrick and Sunderlin (1949) found that the cake mix could be prepared in large quantities and stored in tightly covered containers for several weeks at room temperature.

The cake mix is flexible and can be adapted to other baked products. It is easily used and can be handled effectively by unskilled workers. Other advantages in using prepared mixes are reduction in the chances of failure, the use of fewer utensils, and an assured standard of nutritive value.

This study was initiated to develop a formula for preparing a cake mix in quantity. It was believed that a prepared mix would be easier to prepare than a standardized formula using individual ingredients. The objectives of this study were to:

1. Develop a quantity cake mix that saves time and labor and that yields a quality product.
2. Standardized preparation procedures for the cake mix that are easy to follow.
3. Determine the comparative quality and acceptability of cakes made from a mix and a comparable product made from individual ingredients.

REVIEW OF LITERATURE

Flour mixtures often are classified as batters and doughs. Pyler (1952) defined a flour mixture as a product in which all dry ingredients such as flour, sugar, liquids, leavening agents, eggs, and shortening are blended according to a definite formula.

The proper proportion of these ingredients should produce a moist, tender, and delicate tasting product.

Basic prepared mix formulas include a wide variety of breads, cookies, cakes, pancakes, icings, pie products, and others. Paddleford (1949) stated that a pancake mix was introduced on the market in 1889. It was the first commercially prepared mix to be distributed nationally. The first cake mix marketed, according to Barackman (1931), was under the Swans Down label by the Igleheart Brothers in 1919.

Different kinds of cakes require varying combinations of ingredients. They may range from a rich pound cake to a lean (low sugar, low fat) cake formula. According to Treat and Richards (1966), there are six necessary essentials to quality cake making. These include:

1. A properly balanced formula
2. Correct temperature of ingredients
3. Accurate weights or measures
4. Controlled mixing of ingredients
5. Proper relationship of batter to pan
6. Correct oven temperature and baking time

Balancing the Cake Formula

The American Institute of Baking started research on standardization of cake formulas for bakery use as early as 1926 (Coughlin, 1942). Each ingredient exerts an individual effect upon the characteristic of the final product so that a basic major change in one ingredient requires an appropriate adjustment

in the proportion of the others. Lowe (1955) observed that a cake containing large proportions of sugar to flour required more baking powder than cakes containing a smaller proportion of sugar. Sugar and other ingredients also furnish flavoring material. Coughlin (1942) found that flour, milk solids, and egg whites contributed to toughness in a cake formula; whereas, sugar, shortening, and egg yolk caused tenderness. The fluids and eggs provide moistness; flour, sugar, and dry milk produce dryness.

Success in cake making depends not only on the formula, but also on kinds of ingredients used. The amount of sugar that can be incorporated in a cake formula varies from a high to a low ratio. High levels of sugar in cakes are balanced by increasing other ingredients. The amount of liquid is influenced by the kind of flour and the amount of sugar used in the formula.

A suitable test formula may be developed by varying one ingredient at a time while other components are held constant (Kissell and Marshall, 1962). By using this approach, along with basic formula rules, one may construct a desirable formula. Many modern batter type cake formulas are based on the high sugar, high liquid ration cake by Pyler (1952). These rules are generalized as follows:

1. The weight of the sugar should exceed that of the flour.
2. The weight of the eggs should exceed that of the fat.
3. The weight of the liquid (milk, water, eggs) should equal or exceed the weight of the sugar.

On a flour weight basis, Matz (1960) gave the following rules for formulating a yellow cake:

1. The sugar should range from 110 to 160 per cent.
2. Eggs as liquid should equal or exceed the shortening.
3. Total liquids, including the water, egg, and milk, should exceed the amount of sugar by approximately 25 to 35 per cent.
4. Shortening should range from 30 to 70 per cent.
5. Sodium bicarbonate should be 1.2 to 2 per cent and salt from 3 to 4 per cent of the weight of the flour.

Role of Ingredients

Flour. The proper grade of flour used in a cake formula is important. For cake making, a short patent, soft wheat, bleached flour usually is preferred. Sweetman and MacKeller (1954) stated that a fine grounded, chlorine bleached cake flour with a low protein content produced better baking results. The low protein content makes the flour less strong and tenacious than the gluten complex found in all-purpose flour. Peckham (1964) further explained that chlorine treatment lightens the color and softens and mellows the protein. This mellowing produces a tenderizing effect that causes better baking performance.

It is evident that the temperature and moisture content of the flour play an important part in its storage life. Ludwig (1962) maintained that formation of free fatty acid must be ascribed to lipase activity. This activity becomes more important after the flour is mixed with other raw materials such as shortening, eggs, and leavening agents. Flour, especially low grade flour, bran, and germ contain lipases which under proper conditions hydrolyze the glycerides forming free fatty acid.

Matz et al. (1952) noted that mixes with flour moisture content of 8.8 per cent stored well for one year at 22°C (72°F). He found the maximum stability of a mix was obtained with flour of 7.4 per cent moisture content.

Sugar. In addition to a sweetening agent, sugar has a tenderizing effect on the crumb and promotes coloring of the crust. Pyler (1952) found that sugar retains moisture in the crumb, which causes a softer texture and better eating quality. The granulation of sugar affects the quality of the cake. Griswold (1962) stated that sugar with fine crystals was superior to regular granulated sugar. Cake volume improves as the granulation of sugar becomes finer. This fact was verified in earlier studies by Dunn and White (1939).

The principal effect of sugar is to reduce gluten strength. Lowe (1955) observed that increases in sugar also increased the tenderness of the starch gels. This explains the improved texture of cakes containing high sugar ratio. On a flour weight basis, the amount of sugar that can be added to a cake formula varies from 100 to 160 per cent (Pyler, 1952). This variation depends on other factors such as the amount of fluid, eggs, and fat used. He also stated that the high levels of sugar in the formula are balanced by increasing the proportion of liquid, eggs, and fat. Hanning and de Goumois (1953) reported that a 30 per cent addition of sucrose to a basic cake formula resulted in increased volume and compressibility. Lowe (1955) explained that the additional liquid must be sufficient to bring the sugar into solution without

depriving the flour starch of adequate moisture for gelatinization. Matz (1959) found that sugar acted as an antioxidant when used in mixes, thus improving the shelf life of the product.

Shortening. The kind of shortening used in cake mixes is highly critical in affecting the characteristic of the mix and its shelf life. Peckham (1964) stated that fats add tenderness, crispness, and volume to the cake. Two properties highly desirable in shortening are resistance to oxidative change (rancidity) and creaming or emulsifying property (aeration) for good baking performance. Rancidity is caused by oxidation of unsaturated fatty acid. Lowe (1955) found that hydrolytic rancidity was caused by hydrolysis of the glycerides. Schroder (1952) indicated that resistance to rancidity depends upon a combination of factors, such as the congealing and melting point of the shortening.

Plastic fat consists of masses of tiny crystals of high melting triglycerides in which a liquid phase is composed of lower melting triglycerides. This produces a cake of larger volume and finer grain because of better emulsifying and aerating qualities. The function of emulsifying agents is to improve the aeration quality of the fat. Peckham (1964) reported that monoglycerides were most widely used as emulsifiers. Fats with high emulsification qualities are capable of dispersing air evenly throughout the batter. Favors et al. (1953) found that monoglycerides and polyoxyethylene type emulsifiers increased the volume of white cake at most shortening levels and permitted the

use of higher shortening levels for maximum cake volume. A combination of the two produced a larger volume than could be obtained by using either emulsifier independently.

According to Alikonis (1966), plastic fat normally has 15 to 20 per cent fat solids at 80°F., but an emulsified type shortening, containing 3 to 4 per cent of monodiglycerides, has 30 to 42 per cent fat solids at 80°F. With a wider range of fat solids, emulsified shortening is easy to distribute in the mixes. In shortening containing monodiglycerides, more sugar and liquid per pound of flour can be added. Thus, the emulsifying properties not only increase volume, but also produce a more tender and moist cake.

Lightness is noticeably influenced by the addition of emulsifiers, which also affects grain, tenderness, and crust appearance. Jootes and Mackey (1952) agreed that emulsifiers increase the cake volume and produce a better cell structure. However, they noted that increasing the emulsifier from 3 to 6 per cent did not significantly improve the cake batter. Emulsified shortening increases the amount of water that can be added, contributing to tenderness and the resistance to staleness.

Ostwald (1963) reported that the composition of shortening depends upon the kind of oil used and on the condition of hydrogenation. Hydrogenated fats are manufactured from refined, bleached animal and vegetable oils that can be changed to the plastic state by hydrogenation. Such fats are whipped or aerated to give added plasticity. Super glycerinated shortening to which

5 per cent monoglycerides and diglycerides have been added are recommended for cake making (Peckham, 1964).

Leavening Agents. Cake batters are leavened by air, steam, and carbon dioxide gas. Air may be incorporated by sifting dry ingredients, creaming the shortening, beating the eggs, or by beating the mixture itself. According to Lowe (1955), one volume of water forms about 1,600 volumes of steam. Baking powder is the main chemical leavening agent and it produces carbon dioxide gas. The type of baking powder varies according to the kind of acid used. Lowe (1955) listed four general types: (1) tartrate, (2) phosphate, (3) sulfate, and (4) a combination of sulfate and phosphate. The alkaline ingredient in all baking powder is sodium bicarbonate.

Leavening agents in cake mixes must have a tolerance for a number of baking and climatic conditions. Jackson (1952) found that slow acting, sodium aluminum sulfate combined with a quick acting acid, as monocalcium phosphate or monohydrate, produced good results. Logue (1951) reported that monocalcium phosphate is used in prepared mixes. The stability of this product is improved by coating the particle surface to reduce the rate of dissolvability in solution. In cake making there should be a good distribution of gas during the baking. Lowe (1955) pointed out that increased quantity of baking powder produced a coarse, loose texture, a harsh crumb, and possible off flavor. Too little baking powder produces a cake that is compact. Jackson (1952) stated that one can determine if adequate expansion of the batter

has taken place before gelatination by determining the approximate gelatination and crusting time. Lowe (1955) found that generally, a high sugar ratio cake requires slightly more baking powder than a low ratio one. Peckham (1964) stated that sodium aluminum phosphate, when used in combination with anhydrous monocalcium phosphate in a cake mix, produced a soft, moist cake of good eating quality. This combination of acid produces a better formula than does the sodium acid pyrophate.

The importance of the correct pH in chemically leavened baked products was stressed by Stamberg and Bailey (1939). The texture becomes finer as the pH increases. The most suitable pH, according to Pyler (1952), is between 7.22 and 7.35. This range is slightly higher for chocolate cake and slightly lower for angel cakes. White and yellow cakes with a pH value lower than 7.0 or higher than 7.9 generally have an inferior quality.

Liquids. Since liquids perform many functions in a formula, it is necessary that they are used in correct amounts. According to Lowe (1955), liquid is used as a solvent for sugar, soluble salts, and proteins. They also are used as hydrating agents for flour and egg protein. West et al. (1966) stated that milk was the most commonly used liquid in cake batters. However, fruit juices or other liquids may be used instead of milk. Griswold (1962) reported that non-fat dry milk was used frequently in a cake formula. She indicated that the non-fat dry milk solids may be used in either the dry or reconstituted form. When milk

solids are added to the recipe as a dry ingredient, the liquid used in the batter is water.

Dry Milk Solids. Many studies indicated that dry milk solids, which are high in food value, may be substituted for fresh milk with no loss of cake quality. Choi's study (1952) revealed that most baked products made from dry milk solids had a better texture, color, flavor, and keeping quality than those without milk solids. The amount of milk solids used in a cake formula varies from 8 to 30 parts per 100 parts of flour. Morse et al. (1950) reported that non-fat dry milk solids increased viscosity or gel strength of paste in proportion to the amount of dry milk used.

Ashworth and Krueger (1951) observed that pre-heating the fluid milk to a temperature of 80°C for 30 minutes improved the volume of a loaf of bread. The pre-heat treatment causes an agglomeration of the casienate miscelles in milk which have a tendency to form a gel structure. This is important in relation to the water holding capacity of dry milk in batters.

Havighrost (1954) reported that "instant" non-fat dry milk is produced from the conventional spray dried non-fat milk powder. Instant powdered milk is made by placing the powder in an air processing unit, dispersing it and adjusting the moisture content. This operation causes it to form a fluffy, porous, sponge-like structure. It is then subjected to sizing and screening equipment where the desired particle size is obtained. Brockian et al. (1957) concluded that the wetability of instant dried milk

resulted mainly from the distribution of salts, lactose, and protein and from the increased particle size. Havighrost (1954) stated that this new processing offered the following properties:

1. Rapid and complete dissolvability
2. Free flowing and non-packing
3. Foamless when reconstituted

Dry milk solids offer the advantages of economy and convenience in handling and storage. It is stable and does not require refrigeration. The keeping quality, dispersibility, and flavor of instant non-fat dry milk favor its use in institutional cookery.

Eggs. According to Pyler (1952), eggs perform a binding, leavening, and emulsifying action in cake batter. They also add flavor and nutritive value to the product. An increase in egg content should be balanced by increasing the fat and sugar. Lowe (1955) found that an increase in eggs without additional sugar and fat caused a tough, rubbery, compact crumb and a decrease in cake volume.

Many studies have indicated that fresh eggs consistently produce cakes of better quality and volume than cold storage or frozen eggs. Lowe (1955) suggested that this smaller volume is the result of the elevation of coagulation temperature of the egg protein caused by deterioration. A highly significant correlation between the cake and the quality of the eggs used also was observed by Pyke and Johnson (1944).

Peckham (1964) stated that frozen eggs may be used successfully in cake formulas. She reported that there was little apparent change in the egg albumen as a result of freezing. However, freezing causes the yolk to release its water content, thus binding the solid portion together in a firm mass. This usually is prevented by adding edible substances such as sugar, salt, or glycerine. These substances increase the osmotic pressure and lower the freezing point. Sweetman and MacKeller (1954) reported that pasteurization of eggs before freezing destroyed the pathogenic organism and prolonged the keeping quality. Jaax (1967) found that pasteurization of whole eggs had no significant effect on the volume, crumb, color, texture, grain, tenderness, moistness, or flavor of sponge cakes. Pasteurization of whole eggs at 140 to 146°F for four minutes reduced coliform bacteria more than 99 per cent (Miller and Winter, 1951). The irradiation of frozen eggs, observed by Brogle et al. (1957), caused only minor deterioration in the functional properties of frozen eggs. The flavor in most of the baked products tested was not affected.

Before using frozen eggs, it is important that the content of the entire container be thawed and thoroughly mixed. Pyler (1952) stated that once defrosted, the eggs become extremely perishable and should be refrigerated until ready to use. Eggs should not be refrozen, since every refreezing increases denaturation of the proteins and damage to their colloidal properties.

Weighing Ingredients

Accurate weighing of ingredients is necessary for uniformity of quality in a product. West et al. (1966) emphasized that failure to standardize recipes and to weigh accurately may result in the production of a poor quality product. Pyler (1952) stated that correct measuring of ingredients is the first basic step in good food production. For less human errors in measurement, Griswold (1962) recommended that ingredients be weighed rather than measured.

Temperature of Ingredients

Recent studies suggest that all cake ingredients perform best at room temperature. Treat and Richards (1966) recommended a temperature range of 70° to 75°F for all ingredients. This is especially recommended for the high sugar ratio cake using super glycerinated shortening. The eggs and milk should not be used directly from the refrigerator. McWilliams (1966) stated that cold fat makes it difficult to encase air in the mixture. On the other hand, a warm fluid batter is less apt to entrap air in the mixture. Dunn and White (1937) reported that both the creamed mixture and cake volume were greater when fat was conditioned at 21°C. Lowe (1955) found that cakes prepared from ingredients at 18° to 18°C were inferior in quality compared to cakes prepared from ingredients at 24°C.

Mixing Method

The method of combining ingredients plays an important role in baked products. Matz (1952) explained that the primary purpose of mixing was to bring about a homogeneous dispersion of several ingredients with maximum incorporation of air and a minimum development of the gluten. Griswold (1962) stated that there are few foods for which the method of combining ingredients is so important to success of a product as it is for cakes.

Ingredients of a shortening cake may be combined by three basic procedures designated by Pyler (1952) as the creaming method (sugar butter), the blending method (flour batter), and the simplified (single stage) method. A variety of ways of combining ingredients tends to replace the conventional creaming method. The single stage method was recommended by Griswold (1962), partly attributable to a desire to save time. The single stage consists of placing all the major ingredients into a bowl at one time and mixing. Contrary to statements frequently made, Hunter et al. (1950) found that the one bowl and pastry blend methods compared favorably with, and in many instances even superior to, the conventional method. Modification of these methods may be used.

According to Lowe (1955), the optimum amount of mixing varies with (1) amount of creaming, (2) intensity of mixing, (3) the temperature of the ingredients, (4) the type and amount of baking powder used, and (5) the point at which the baking powder is added. Kissell and Marshall (1962) stressed that a strong

interaction resulted in a markedly reduced cake quality when leavening, sugar, and water were unbalanced. Pyke and Johnson (1940) reported that batters in which the water content varies between 90 and 100 per cent of the weight of the flour, the specific gravity is easily controlled by the single stage method of mixing. Increased proportions of sugar and fat produced cakes with a fine, uniform cell structure, and a more tender crumb than was produced by a lean mixture whatever method of mixing was employed.

The plasticity of fat influences the amount of liquid necessary in the cake formula. Morr (1939) found that hydrogenated fat permitted larger quantities of liquid to be used and recommended this shortening for the high sugar ratio cakes. According to Pyke and Johnson (1940), the single method gave excellent results in cake batters containing larger amounts of liquid and sugar. However, some of the tested products gave a better volume when the single stage method was modified, by holding back a portion of the liquid (water or milk) until a stable and smooth batter had been formed. The remaining liquid was then added slowly to prevent curdling. Pyke and Johnson (1940) stated that the first mixing period should continue for approximately eight minutes to reach a maximum specific volume (the point where the batter ceases to become lighter). At this point the remaining liquid is added and mixing continues for a short period. The additional liquid may cause a slight drop in specific volume, but the batter remains stable. Carlin (1944) pointed out that fat

containing an emulsifying agent caused a finer dispersion of fat in the batter and thus promoted better water holding capacity than fat without emulsifying agents. The resulting cakes usually were more moist and had a finer grain.

Batter Viscosity

The method of mixing affects the density of batters in an irregular manner, depending on the kind of fat and the temperature of the batter. Hunter et al. (1950) found that batter made with hydrogenated shortening and mixed by conventional method showed better dispersion than batters mixed by the pastry blend method. The latter method of mixing, however, adapts to a wider range of ingredient temperatures for the production of high quality cake.

McWilliams (1964) stated that the proportion of ingredients influences the viscosity of the batter. A high proportion of liquid is incapable of holding a large amount of air for a long time. In thicker batter, it is difficult for the air to escape. Lowe (1955) found that the fat is largely dispersed in an oil-in-water emulsion in thin batters and in the thicker batters as a water-in-oil emulsion. Viscosity of the batter decreases with added quantities of emulsifying agents. As specific gravity of the batter increases, the cake volume increases, and fat lake areas become finely dispersed according to Carlin (1944). Batters containing emulsifying agents were less viscous than those made without emulsifying agents. Collins and Sunderlin (1940) found a substantial correlation between the water-in-oil

emulsions. They found fewer, larger, and less uniform gas bubbles scattered irregularly in the batters of low viscosity. However, in the high viscosity batter many small gas bubbles were grouped in clusters. Lowe (1955) pointed out that fat distribution in the batter contributes to the velvety texture of the finished product.

Relationship of Batter to Pan

To yield a fine texture and better volume the batter should be baked in the proper size pan. Peet and Thye (1955) reported that a household size pan too large caused excessive browning of cakes, while a pan too shallow caused a coarse texture. Kotschevar (1966) stated that to allow for proper expansion the pan should be filled from one-half to two-thirds full. An overfilled pan may cause the cake to fall and lose its quality.

Baking Time and Temperature

The correct temperature is an important factor in cake baking. It is during this time that leavening action takes place, the starch gelatinizes, and the protein coagulates causing a firm cell structure to form, stated Kotschevar (1966). Jootes and Mackey (1952) found that emulsified fats increased volume and improved cell structure. The larger volume indicated that more gas was retained in the batter at the time of coagulation. Smaller cakes will bake at a higher temperature than larger ones.

Preparation Time

Increased labor cost and a lack of skilled workers are causing a re-evaluation of work procedures in many institutional kitchens. Bond (1964) stated that in order to remain in the competitive food service business there must be an increase of yield per labor hour expended per unit produced. Good procedures in any work simplification program will reduce labor cost per unit. In many instances time and labor can be saved by using pre-prepared items.

Hefner (1957) reported that commercial cake mixes required 15 to 20 minutes less time per 100 servings to make then conventional cakes. Kirkpatrick and Sunderlin (1949) found that preparing large quantities of a mix in advance alleviated the "rush" during the peak work period. Time used in weighing ingredients and mixing the conventional cake batter for four pounds of flour was 42 minutes. When using the prepared mix, the time for making the cake was 19 minutes. Seven minutes were added to represent the time used in making the portion of the mix. The total preparation time with a mix was 26 minutes, compared to 42 minutes when cake batter was made by the conventional method. In a similar study, Knickrehm et al. (1952) found that the average time required to make the mix and batter for 10 layers of cake was 22 minutes. The time required to weigh the ingredients and prepare the batter of 10 layers of cake made by the conventional method was 30 minutes. Both studies are evidence that time can be saved by using a pre-prepared mix.

EXPERIMENTAL PROCEDURE

Statistical Design and Analysis

Statistical Design. A total of 24 cakes were baked and evaluated in 12 baking period. A baking period consisted of preparation of batter, baking, and evaluation of cakes made from individual ingredients and from a pre-prepared mix. In an effort to control the amount of time and energy used, the statistician arranged the preparation of the formulas in alternating sequence. The cake mix formula was prepared and baked at the beginning of the baking period, followed by the formula made from individual ingredients. The order of preparation of the cakes was reversed at the next baking period. Both types of cakes were baked at $350^{o}F$ for 45 minutes.

Statistical Analysis. Objective evaluations were made of the batter and baked product. Data were collected on preparation time, batter temperature and consistency, and cake volume for statistical analysis. The subjective data included such factors as appearance, tenderness, texture, moistness, and flavor. The Student "t" test was used to determine if there was a difference in cakes prepared by the two methods. Analyses of findings were based on a cake formula made from individual ingredients versus a cake formula made from a prepared mix.

Procurement and Storage of Ingredients

Procurement. In an attempt to have ingredients used from baking period to baking period as nearly identical as possible, a sufficient quantity of each ingredient for the entire study was purchased at one time. Fine granulated sugar and cake flour were procured in 100 pound bags. A superglycerinated, hydrogenated all vegetable shortening was obtained in a 50 pound can. A 10 pound can of double-acting baking powder containing sodium bicarbonate, corn starch, sodium aluminum, calcium sulphate, and calcium acid phosphate was purchased. Other ingredients used included iodized salt and pure vanilla extract with 35 per cent alcohol. A case of instant non-fat dry milk was purchased directly from the company. Pasteurized frozen whole eggs with 0.5 per cent monosodium phosphate were obtained in 6-8 plastic containers for the study.

Storage. Hydrogenated vegetable shortening, baking powder, salt, and vanilla were stored in their original containers. After opening, the instant non-fat dry milk was kept in a metal can covered with a tight fitting plastic lid. The cake flour and sugar were kept in covered metal bins in the laboratory. Frozen whole eggs instead of fresh eggs were used because of economic value and keeping quality. The eggs were stored in a walk-in freezer at -20°F. They were thawed in a refrigerator two days prior to the baking period.

Procedure for Weighing Ingredients

A Toledo scale was used to weigh the ingredients. With the exception of the eggs, all ingredients were weighed at room temperature. Flour, dry milk, sugar, baking powder, and salt were weighed in plastic bags. The shortening was scaled onto wax paper. The eggs, water, and vanilla were weighed in plastic containers.

Preparation of Cake Mix

A preliminary series of cake mix formulas was prepared to determine the proper ratio and proportion of ingredients that should be used to obtain a satisfactory product. The following rules for a high sugar ratio formula devised by Pyler (1952) were used in formulating the cake mix:

1. The weight of the sugar should exceed that of the flour.
2. The weight of the liquid (milk, water, and eggs) should equal or exceed the weight of the sugar.
3. The weight of eggs should exceed that of the fat.

The ingredients used were cake flour, sugar, shortening, salt, double-acting baking powder, and instant non-fat dry milk (Table 1). The required amount of prepared cake mix for the entire study was made prior to the scheduled baking periods.

The basic cake mix formula and the mixing procedures were based on a quantity cake mix formula developed by Knickrehm et al. (1952). A 30 quart Hobart Mixer with a flat paddle was used to prepare the mix. Formula for the basic quantity cake mix is

Table 1. Cake mix formula.[a]

Ingredient	Amount weight	Percentage weight[b]
Cake flour	10 lb. 8 oz.	100
Sugar	11 lb. 4 oz.	105
Shortening (hydrogenated and emulsified)	4 lb. 14 oz	47
Double-acting baking powder	8 oz.	4
Non-fat dry milk (instant)	1 lb. 12 oz.	22
Salt	1½ oz.	0.08
Total weight	30 lb. (approximately)	

[a] Formula yields approximately 7 cakes baked in 12 x 20 x 2 inch pans.

[b] Quantities are given as percentage weight of flour.

given in Table 1. After weighing the ingredients, approximately one-half of the sugar was weighed in 2 pound portions. The flour, baking powder, non-fat dry milk, salt, and remaining sugar were blended in the mixer for one minute. This mixture was removed from the mixer bowl and placed in a large container. The shortening was placed in the mixer bowl and creamed for three minutes. The motor was stopped, mixer bowl lowered, and the bowl and paddle were scraped down with a rubber tip spatula. Two pounds of sugar were added to the shortening and creamed for one minute on second speed. This was repeated until one-half of the sugar was added. The bowl and beater were scraped after each addition.

Four quarts of the blended dry ingredients were added to the creamed mixture and blended on first speed for one minute. The above step was repeated, scraping the bowl and beater after each mixing. The bowl was lowered and the remaining dry ingredients were added. The machine was started on first speed with bowl down, gradually raising the bowl to mixing position, and the formula was mixed for one minute. The mixture resembled cornmeal in consistency. The mix was stored at room temperature in a 50 pound metal can with a tight fitting lid.

The formula and procedure for using the prepared cake mix was developed and evaluated. Proper proportion of eggs and liquid to add to the mixture and the best procedure for mixing were determined during the preliminary baking period. Early observation indicated that a modification of the single stage method proved most satisfactory. This method consisted of placing all of the mix into the bowl at one time, adding the eggs, vanilla, and one-third of the water to the mix and blending thoroughly. The remaining water was gradually added during the second stage of mixing. Cakes made by this method rated the highest when evaluated. The following criteria recommended by Child and Purdy (1926) were used to evaluate the cakes:

External appearance - golden brown, flat or slightly rounded top.

Internal appearance - moderately fine-grained texture, slightly moist crumbs, and a pleasing delicate flavor.

Formula for the plain cake made from the mix is given in Table 2. The cake was prepared in a 12 quart Hobart Mixer

Table 2. A plain cake using cake mix.

Ingredients	Weight	Method
Cake mix	4 lb. 4 oz.	1. Place mix in a 12 qt. mixer bowl. Add all eggs, vanilla, and one-half of water;
Eggs, frozen whole	12 oz.	blend on first speed for two minutes. Scrape bowl and paddle.
Vanilla extract	1/3 oz.	2. Mix on second speed for three minutes. Scrape down, mix two more minutes.
Water	1 lb. 6 oz.	3. Gradually add remaining water, beating on first speed for two minutes. Scrape down.
		4. Mix on second speed for one minute.
		5. Scale 5 lb. of batter into lightly greased and lined 12 x 20 x 2 inch pan.
		6. Bake for 45 minutes at 350°F.

using a flat paddle. All ingredients except the frozen eggs were measured and mixed at room temperature. The frozen eggs were thawed in the refrigerator and measured at the beginning of each baking period.

The cake mix was placed in the mixer bowl. All the eggs, vanilla, and approximately one-half of the water were added to the mix, and blended on first speed for two minutes. Bowl and beater were scraped. The mixture was beaten on second speed for

three minutes and the bowl scraped again. Mixing was continued for two additional minutes on second speed. The remaining water was added gradually during the final two minutes of mixing on first speed. Five pounds of batter were scaled into a lightly greased and lined baking pan. Variations of the plain cake may be made by adding chocolate or spices (Appendix, p. 55).

The controlled formula with individual ingredients was suggested for use in this study because it produced a good quality cake. The formula was modified to use ingredients similar to those used in the quality cake mix. The controlled formula used throughout the investigation is shown in Table 3.

The dry ingredients were placed in the mixer bowl. Shortening was cut into six pieces, then added to the dry ingredients. A rubber tip spatula was used to remove the measured shortening from the wax paper. Eight ounces of water were gradually added to these ingredients and blended on low speed for five minutes. The mixer was stopped and the bowl lowered for a scrape-down procedure.

Meanwhile, the eggs and vanilla with remaining water were blended with a wire whip. These ingredients were gradually added to the flour mixture after the scraping process. The batter was mixed on low speed for five minutes, the bowl and beaters scraped, and continued mixing for five more minutes. The pan was lightly greased and lined with dry wax paper. Five pounds of batter were scaled into a weighed baking pan.

Table 3. Plain cake formula.[a]

Ingredients	Amount	Procedure
Cake flour	1 lb. 9 oz.	1. Place ingredients in mixer bowl in order listed.
Sugar	1 lb. 14 oz.	
Milk (instant)	2½ oz.	
Non-fat dry milk	1/3 oz.	
Baking powder	1¼ oz.	
Shortening	10 oz.	2. Add shortening and water. Mix on low speed (no. 1) for five minutes. Scrape bowl and beater.
Water	262.5 ml. or 8 oz.	
Frozen eggs, whole	8 oz.	3. Mix eggs, vanilla, and remaining water with a wire whip, add to mixture.
Vanilla extract	15 ml. or 1/3 oz.	
Water	350 ml. or 12 oz.	
		4. Mix on low speed for five minutes. Scrape bowl and beater. Mix on low speed for five more minutes. Scale 5 pounds of batter in a 12 x 20 x 2 inch pan.
		5. Bake 45 minutes at 350°F.

[a] Standardized by Felix (1967). Unpublished data, Institutional Management Department, Kansas State University.

Procedure for Mixing Batter

The cake batter was mixed in a 12 quart table model Hobart Mixer, using a flat paddle. Both cakes were prepared in the Institutional Management Research Laboratory, according to their

respective formulas (Tables 2 and 3). The bowl and beater were scraped several times during mixing. For the scrape-down procedure the motor was stopped and the mixer bowl lowered. A complete circular motion close to the side of the bowl with a rubber tip spatula was counted as one stroke. Six strokes were used for each scrape-down. The mixing time was carefully checked with a Kodak timer. During the mixing period the oven temperature was checked and the baking pans were lightly greased, lined, and weighed. Five pounds of batter were scaled into a 12 x 20 x 2 inch aluminum baking pan. The batter was evenly distributed by cutting through the batter several times with a spatula.

Procedure for Baking Cakes

The cakes were baked in a Reed Reel baker's type oven with a single gas unit for 45 minutes at 350°F. The baking compartment consisted of four shelves suspended on vertically revolving wheels by means of a fixed arm that prevented the shelves from swaying when in motion. The rotation direction could be reversed or stopped by a switch lever. The oven was equipped with an automatic timer which was used to determine the exact baking time. After baking for 45 minutes at 350°F, the cakes were cooled on a wire rack for 10 minutes before removing from the pan. All cakes were allowed to set for one hour before evaluating.

Evaluation: Materials and Methods

Temperature. Temperature of the batter was recorded immediately after mixing. A chemical centigrade thermometer was inserted in the batter where it remained for one minute and a temperature reading was taken.

Preparation Time. The time required for weighing and mixing ingredients for each cake was recorded. This included the time used in assembling and weighing the ingredients, and mixing and panning the batter.

Batter Consistency. This test measures the consistency of the batter in terms of its ability to spread on a flat surface.

Materials. (1) A diagram of concentric circles drawn 1/8 inch apart was used. The smallest circle had a diameter of 2 inches with no number on the first line, with number one on the second line, and the other lines numbered consecutively; (2) A hollow cylinder with a 2 inch diameter; and (3) A flat glass plate.

Procedure. The metal ring was placed on the glass plate over a line spread circle chart. The ring was centered on the innermost concentric circle of the chart. The ring was filled with cake batter and leveled off with a metal spatula. The timer was started and the metal ring quickly lifted from the plate. After one minute the first visible number was read at four widely separated points on the outer edge of the batter. The average of

those four numbers was recorded as the line spread reading. This reading represented the number of 1/8 inch units the batter had spread in one minute.

Index to Volume (Area of slice). A compensating polar planimeter was used to determine the volume or area of a slice of the cake. In this procedure the area of a slice of baked cake was measured in square inches. This furnished a comparison of products that are similar in shape.

Materials. (1) A compensating polar planimeter, (2) a flat surface, and (3) a large piece of brown paper.

Procedure. A one inch slice of cake was cut from the center part of the cake (Form II). The slice was traced on a large piece of brown paper with a soft lead pencil. This area was measured with the planimeter as described by Griswold (1962). The initial reading was subtracted from the final reading for the actual measurement. This measurement was recorded in square inches.

Index to Volume (Standing height). A cross section of a slice of cake was traced on a piece of brown paper. Five perpendicular measurements were made using a centimeter ruler: (1 and 2) near each end, (3) in the center, (4 and 5) half-way between the center and end of the slice. An average of these five measurements indicated the standing height in centimeters (cm) (Appendix, p. 51).

Organoleptic Evaluation. The cakes were scored subjectively by a panel of six judges. The following characteristics were used in evaluating the cakes:

External - appearance, shape, and crust color

Internal - texture, tenderness, moistness, flavor, and over-all quality

Possible scores on the rating scale ranged from superior (5 points) to poor (1 point). A one inch sample of each cake was cut from one-half section of the sheet cake (Appendix, p. 49). The coded samples were placed on a white china plate and presented to each panel member for evaluating. The samples were coded in reverse order on alternating baking period. One-half of each cake was placed on a tray for external evaluation. The organoleptic evaluation was made the same day the cakes were baked.

RESULTS AND DISCUSSION

The time study indicated that a considerable amount of time was saved in the measuring and mixing procedures of the cake mix formula. The result of the time comparison analysis in Table 4 denoted that preparation time was longest for making the control formula from individual ingredients and shortest for the prepared cake mix formula. However, the preparation time of the pre-prepared cake mix was not included because it was believed that this task could be performed during "lull" periods of production. The average time required for the standardized formula was 33 minutes as compared to 20 minutes, a saving of 13 minutes.

Table 4. Analysis of time comparison per 50 servings of plain cake.

Variable	Mean Formula	Mean Mix[a]	Mean difference	Variance	t 0.05 (11df) = 2.201
Measuring time[b]	9.43	4.79	4.625	0.089	53.8*
Mixing time	14.33	22.91	8.58	0.492	42.57*
Total time	32.66	19.29	13.37	0.914	48.44*

[a] Preparation time for mix was not included.

[b] Time in minutes.

* Significant at the 5% level.

The preparation time for approximately 30 pounds of cake was 35 minutes.

Objective Evaluation. Since all of the ingredients except the eggs were kept at room temperature, there was little difference in batter temperature. It was observed that the temperature of the cake mixture was generally higher in the cake batter made from individual ingredients than in batter made from the prepared mix formula (Appendix, pp. 50 and 51). However, there was no significant difference between the batter temperatures of the two types of cake. McWilliams (1966) found that the batter viscosity varied with the temperature of the mixture and the portion of ingredients used. Increased viscosity was caused by using cold fat which made it difficult to encase air into the batter. On the other hand, a very fluid mixture entrapped less air than a

somewhat cooler mixture. Having the ingredients at room temperature gave favorable results for mixing the batters.

The consistency of the batter prepared from the cake mix differed significantly (at the 5% level) from that of the control formula. The mean scores were 5.46 and 4.82, respectively (Table 5). Collins and Sunderlin reported that with the same kind of ingredients and other conditions controlled as closely as possible, the consistency of cake batters varied from a thin fluid batter to a thick fluffy one. The difference in batter consistency may have been attributed to the mixing procedure since the same kind of ingredients was used in both formulas.

Table 5. Analysis of objective measurement of batter and baked cake.

Variable	Mean Formula	Mean Mix	Mean difference	Variance	t 0.05 (11df) = 2.201
Batter Temperature (°C)	21.75	22.16	-0.417	0.902	1.52 ns
Consistency	4.82	5.46	-0.64	0.938	2.28*
Cake Standing height (cm)	5.15	5.125	0.025	0.184	-201 ns
Area of slice (sq.in.)	21.82	21.63	0.19	0.6	.844 ns

ns Non-significant.

* Significant at the 5% level.

The indices to volume, as measured by the standing height and the area of a slice, indicated no significant difference in

the baked cakes. Both methods used were in agreement. However, the cake mix formula had a slightly lower reading when measured with the planimeter. The planimeter measures the entire area of a slice of cake, whereas the standing height measures only five particular points on the cake slice. Griswold (1963) suggested the use of the planimeter for greater accuracy.

Subjective Evaluation. The prepared cake mix formula consistently produced a fine-grained, velvety textured product. The control formula was uniformly fine grained in texture and closely resembled the prepared mix in cell structure (Plate I). The six judges gave favorable scores to all factors evaluated for both cakes. The mean for the cake mix generally ranged slightly higher than that of the controlled formula in most of the qualities evaluated. Table 6 summarizes the data obtained from the subjective measurements. The internal characteristics were similar in all qualities rated. Two judges stated that they could not detect any differences in the samples.

The mean score for the cake mix generally ranged slightly higher than that of the controlled formula in most of the qualities evaluated. Table 6 summarizes the data obtained from the subjective measurement. One half of each cake was placed on a tray for external evaluation. The internal over-all quality was evaluated from a one inch square sample of each cake (Appendix, p. 49). Two judges stated that they could not detect any differences in the samples.

EXPLANATION OF PLATE I

Texture and volume of cakes made from two formulas.

A. Cake mix formula.

B. Standardized formula using individual ingredients.

PLATE I

A

B

Table 6. Analysis of subjective measurements.

Variable	Mean score		Mean difference	Variance	t 0.05 (11df) = 2.201
	Formula	Mix			
Shape	3.59	4.00	0.416	0.379	2.35*
Crust	3.35	3.86	-0.51	0.284	2.31*
Texture	3.49	3.84	-0.35	0.121	3.46*
Tenderness	3.48	3.89	-0.41	0.144	3.76*
Moistness	3.61	3.73	-0.12	0.074	1.52 ns
Flavor	3.80	3.86	-0.059	0.187	0.475 ns
Over-all quality	3.67	3.82	-0.15	0.197	1.17 ns

Scoring range, 1-5.

* Significant at the 5% level.

ns Non-significant.

Shape of the Cakes. The mix formula generally had a slightly rounded top. However, the shape of control formula varied from a flat to a well-rounded shape (Plate I). The irregular variation in the symmetry of the cakes was noted by the panel members. The slanting shape of the cakes may have been caused by a slightly uneven oven shelf. The average mean scores of 4.00 for the mix and 3.59 for the control formula were statistically significant for shape.

Crust. The browning of the crust was similar in pattern for both cakes. The outer edges of the cake were darker brown in color than the center portion. Each cake was golden brown in color, with slightly darker brown pebbles over the cake.

Pyler (1962) stated that this type of browning is common in high sugar ratio cakes. Statistically, there was a significant difference in the crust of the two formulas. The mean scores were 3.35 for the control formula and 3.86 for the mix formula.

Texture. The texture of the mix formula resembled the controlled formula closely. Two of the judges stated that they could not detect any difference in the texture of the two formulas. However, the mean score for mix (3.84) was higher than the control formula (3.49), indicating a significant difference in formulas.

Tenderness. The average tenderness score for the formula was 3.48 compared to 3.89 for the mix, as evaluated by the judges' scores. The difference between these scores was significant.

Moistness. The order of mixing the formulas and baking the cakes had no apparent effect on the moistness of the cake. The preparation of each formula was alternated at each baking period. Statistically, no significant difference existed between the mix and the formula. The cake mix formula received a slightly higher mean score. However, both cakes were relatively moist.

Flavor and Over-all Quality. The statistical analysis showed no significant difference in flavor and over-all quality of cakes made from controlled formula and mix. Some of the judges commented that they found little or no difference in flavor. The over-all quality of both cakes was rated acceptable.

The mean scores for the formula and the mix were 3.67 and 3.82, respectively. Three of the judges' scores indicated that the over-all quality of both cakes was similar. The similarity may have been attributable to the ingredients used, since they were obtained from the same lot. The cake mix formula was stored for six months. The storage appeared to have no effect on the cake quality. The judges' scores indicated that there were no differences in over-all quality. Furthermore, no value difference in indices to volume was apparent as a result of storage.

SUMMARY

This study was undertaken to compare the preparation time, quality of the product, and over-all quality of quantity plain cakes made from individual ingredients and a pre-prepared cake mix. A standardized formula, using individual ingredients, was designated as the control formula. The cake mix formula was developed and prepared in the Institutional Management Research Laboratory in 30 pound quantities.

A total of 24 cakes were made and evaluated during 12 baking periods. A baking period consisted of preparation, baking, and evaluating cakes made from a pre-prepared cake mix and individual ingredients. All ingredients except the eggs were kept at room temperature. The frozen eggs were thawed in a refrigerator at 36^{o}F two days prior to baking. After controlled mixing procedures of the cake formulas, the batter was scaled into a 12 x 20 x 2 inch baking pan. The cakes were baked for 45 minutes

at 350°F and cooled for 10 minutes before removing from pans. They were allowed to remain at room temperature at least one hour before evaluation.

Subjective and objective measures were used to evaluate the batter and baked cakes. An organoleptic panel of six judges evaluated the cakes for shape, crust, color, texture, tenderness, moistness, flavor, and over-all quality. The mean scores for cakes indicated that both formulas were acceptable in all qualities tested. Approximately 13 minutes of preparation time were saved when using the cake mix. The temperature and the consistency of the batter had little or no effect on the volume of the baked cakes.

The statistical analysis indicated a significant difference in preparation time and consistency of the batter. In the organoleptic evaluation, the shape, crust, color, texture, and tenderness characteristics revealed a significant difference in the two formulas. However, differences in the moisture, flavor, and over-all quality were not significant.

Based on the conditions under which this study was made, the evaluation of the two products indicated that a good quality cake resulted from both formulas. A standardized cake mix saved time in preparation without sacrificing the quality of the product.

CONCLUSIONS

Under the conditions of this study the following statements may be made:

1. A standardized cake mix formula produced a product that was comparable to cakes made from individual ingredients.
2. Simplification of preparation procedures of a cake mix saved time without sacrificing product quality.
3. The cake mix eliminates for the baker the routine steps necessary in the formulation of a product from individual ingredients.
4. Equal amounts of batter from prepared mix and individual ingredients gave the same proportionate yield.
5. The mix can be stored for six months without any noticeable deterioration in quality.

RECOMMENDATIONS

Since the proportion and kind of ingredients play an important role in cake mix formulation, it is suggested that further investigation be made concerning the specifications and quality of ingredients. The quality of flour, shortening, and leavening agents should be of special interest to investigators.

It was found that the cake making process is a complicated task. In further work, it may be of interest to study the different methods of mixing ingredients in a cake mix formula.

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APPENDIX

FORM I

SCORECARD FOR SHORTENED CAKES

NAME_____ DATE_____

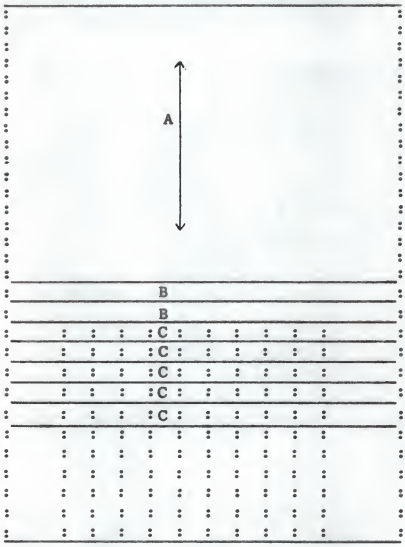
Factor	Samples 1	Samples 2	Comment
EXTERNAL APPEARANCE:			
Shape - Flat or slightly rounded top			
Crust - Smooth, tender, golden brown color			
INTERNAL CHARACTERISTICS			
Texture (grain) - Uniform cell structure, fine and velvety			
Tenderness - Tender but not crumbly or feathery			
Moistness - Slightly moist; not dry			
Flavor - Pleasing, delicate, sweet, and well blended			
GENERAL ACCEPTANCE: Over-all quality			

Scale: 5. Superior
4. Good
3. Average
2. Fair
1. Poor

FORM II

SAMPLING PLAN

SHEET CAKE



Diagram

A. External characteristics

B. Index to volume

C. Organoleptic evaluation

Table 7. Measurements of temperature and consistency of batter and cake volume of control formula.

Replication	Batter		Cake	
	Temperature (°C)	Line spread	Standing height (in. cm.)	Area of slice (sq. in.)
1	22	5.0	4.9	20.15
2	23	4.0	5.0	21.11
3	20	4.7	5.3	21.80
4	21	4.7	5.5	22.89
5	22	4.7	5.3	22.45
6	21	4.5	4.9	21.42
7	23	5.2	4.6	20.38
8	22	3.7	4.8	20.17
9	22	5.7	5.4	22.33
10	23	5.5	5.5	22.68
11	21	4.7	5.4	22.69
12	22	5.7	5.2	23.00
Average	21.75	5.82	5.15	21.74

Table 8. Measurements of temperature and consistency of batter and cake volume of cake mix formula.

Replication	Batter		Cake	
	Temperature (°C)	Line spread	Standing height (in. cm.)	Area of slice (sq. in.)
1	22	5.7	5.1	21.60
2	22	5.0	5.1	21.20
3	22	6.7	5.3	22.23
4	22	5.7	5.4	23.44
5	21	6.5	5.3	21.26
6	22	5.7	5.1	21.60
7	23	3.7	4.6	20.67
8	21	3.5	4.6	19.55
9	23	5.7	5.3	21.91
10	23	5.7	5.3	22.00
11	22	6.0	5.3	22.51
12	22	5.7	5.2	21.65
Average	22.16	5.46	5.14	21.63

Table 9. Mean palatability scores[a] for control cake formula.

Replication	External appearance		Texture	Internal characteristics			
	Shape	Crust		Tenderness	Moistness	Flavor	Over-all quality
1	2.8	2.5	3.3	3.3	3.6	4.0	3.3
2	3.5	3.1	3.0	3.0	3.3	3.1	3.1
3	2.8	2.6	3.0	3.1	3.3	3.6	3.6
4	3.1	3.5	3.1	3.8	3.3	3.5	3.6
5	3.8	3.3	3.5	3.3	3.6	3.8	3.6
6	4.1	3.5	3.3	4.1	3.8	3.8	4.0
7	2.5	3.1	3.0	3.1	3.5	4.0	3.6
8	3.1	3.3	3.1	3.1	3.8	3.5	3.1
9	4.5	3.6	3.8	4.1	4.0	4.1	4.1
10	4.5	4.1	3.8	4.1	3.6	4.3	4.1
11	4.3	3.8	3.8	4.3	4.1	4.3	4.3
12	4.1	4.1	3.6	4.0	4.0	3.6	4.0
Average	3.59	3.35	3.49	3.49	3.61	3.80	3.67

[a] Scoring range, 5 to 1.

Table 10. Mean palatability scores[a] for cake mix formula.

Replication	External appearance		Internal characteristics				
	Shape	Crust	Texture	Tenderness	Moistness	Flavor	Over-all quality
1	2.8	3.8	4.0	3.8	3.6	3.5	3.1
2	4.3	4.1	4.0	3.6	3.5	4.1	4.1
3	4.0	3.6	3.8	3.6	3.5	3.6	3.6
4	4.1	3.8	3.8	3.8	3.8	3.3	3.8
5	3.3	3.6	3.8	3.5	3.6	3.8	3.5
6	4.6	4.1	4.0	4.0	3.8	4.1	4.0
7	4.0	4.0	3.6	3.3	3.0	3.5	3.8
8	3.8	4.0	4.0	3.5	3.8	3.8	4.0
9	4.5	4.0	3.8	4.1	4.1	4.1	4.1
10	4.1	3.6	4.1	3.8	3.8	4.0	4.1
11	4.3	4.0	4.1	4.3	4.0	4.5	3.6
12	4.3	3.8	4.1	4.3	4.3	4.1	4.3
Average	4.00	3.86	3.89	3.84	3.73	3.86	3.82

[a] Scoring range, 5 to 1.

Table 11. Master cake mix formula.

Ingredient	Amount
Cake flour	10 lb. 8 oz.
Shortening*	4 lb. 14 oz.
Sugar	11 lb. 4 oz.
Baking powder (double acting)	8 oz.
Non-fat dry milk (instant)	1 lb. 12 oz.
Salt	2 oz.

* Use hydrogenated shortening that contains an emulsifier.

PROCEDURE:

1. Weigh approximately one-half of the sugar into 2 lb. portions.
2. Thoroughly mix flour, powdered milk, baking powder, salt, and remaining sugar for 1 minute on low speed. Place dry ingredients in a large container.
3. Cream shortening on second speed for 3 minutes. Scrape bowl and beater.
4. Add 2 lb. sugar to shortening and cream on second speed for 1 minute. Repeat until one half of the sugar is added. Scrape bowl and beater.
5. Add 4 quarts of blended dry ingredients to mixture, blend on first speed 1 minute. Repeat this step once more. Lower bowl, add remaining dry ingredients, blend on first speed for 1 minute while slowly raising mixer bowl. The mix should resemble cornmeal in consistency.
6. Store mix in a covered container with a tight fitting lid.

Table 12. Plain cake, using mix formula.

Ingredient	Amount	Procedure
Cake mix Eggs, frozen whole Water Vanilla extract	4 lb. 4 oz.	1. Place mix in bowl. Add all the eggs, vanilla, and approximately 1/3 of the water to the mix. Blend on first speed for 2 minutes. Scrape bowl. 2. Mix on first speed for 3 minutes and second speed for 2 more minutes. Scrape down bowl and paddle. 3. Add remaining water gradually, beat on first speed. Scale 5 lb. of batter into a lightly greased and lined 12 x 20 x 2 inch pan. 4. Bake 45 min. at 350°F.

VARIATIONS:

Spice cake - Blend 1/3 oz. cinnamon, 1/3 oz. nutmeg, 1/2 oz. cloves, and 1/8 oz. allspice with cake mix. Then proceed as for plain yellow cake.

Chocolate cake - Blend 4 oz. of cocoa and 1/4 oz. baking soda with mix for 1 minute. Then proceed as for plain yellow cake.

Note: Add 4 extra oz. of water to the remaining liquid.

A COMPARISON OF QUANTITY PLAIN CAKE MADE FROM A PREPARED CAKE MIX AND A STANDARDIZED FORMULA USING INDIVIDUAL INGREDIENTS

by

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B. S., Tuskegee Institute, 1950

AN ABSTRACT OF A MASTER'S THESIS

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An important factor in the success of a food service is the uniformity and quality of products that are acceptable to the customer. Baked items frequently mean the difference between an outstanding and an average operation. It is of prime importance to produce a wide variety of quality products with maximum efficiency at a minimum cost. Thus, the possibility of using cake mixes should be of interest to institutions facing these problems. A mix prepared on the premise could be included in a worker's schedule at a convenient time. The purpose of this study was to develop a quantity cake mix that reduces labor at time of mixing and to compare its quality and acceptability with a cake prepared from individual ingredients.

The control cake was made from a standardized formula and prepared from individual ingredients; the other from a mix. Factors considered were time required for preparation, quality of baked product, and palatability. Ingredients for both formulas were purchased at one time. These included cake flour, granulated sugar, double acting baking powder, hydrogenated shortening with an emulsifier, instant non-fat dry milk, and pure vanilla extract. Frozen whole eggs were purchased and stored at -10°F in a walk-in freezer.

Twenty-four cakes were made and evaluated during 12 baking periods. A baking period consisted of preparation of batter, baking, and evaluation of cakes made from individual ingredients and the mix. All ingredients, except the eggs, were stored at room temperature. The frozen eggs were thawed in a refrigerator

at 36°F two days before using. Ingredients were weighed and batter was mixed using controlled procedures. Five pounds of batter were scaled into a 12 x 20 x 2 inch baking pan and baked for 45 minutes at 350°F.

Statistical analysis indicated a significant difference between the two cakes for preparation time and viscosity of the batter. Shape, crust color, texture, and tenderness characteristics revealed a significant difference between the two formulas. However, differences in the moisture, flavor, acceptability, indices to volume and batter temperature were not significant.

A good quality cake was produced from both formulas. The standardized cake mix required less preparation in time than mixing from individual ingredients without sacrificing quality of the product.