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Module on Cakes: Manufacture And Role Of Ingredients

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TEXT

Introduction to Cake

The cake is prepared mainly from the combination of the flour's starches, by the proteins in whole eggs, egg whites, and/or in milk. The melt in mouth texture comes from tiny air holes left in the cake's structure, created through mixing, leavener serving as nuclei which enlarges due to carbon dioxide gas from the chemical, heat and /or steam during baking. The sugar and fat in the recipe, as well as any acids, tenderize the cake. They also interfere with gluten formation and egg protein coagulation, there by interrupting the network of gelatinized starch **(table 1)**. However, unbalanced recipe for example, that is too much sugar and fat, makes the cake's structure too weakened to support its own weight thus collapse. Too much flour and too many eggs may make the cake tough and/or dry. Overall, the flour mixtures that produce cakes and cookies are very similar to those used to make breads, although they are sweeter and have added flavorings not used in breads. Cakes have a higher proportion of sugar, milk and fat than flour compared to bread. **(Table 2)**.

Cakes can be presented in many forms, from simple sheet cakes to elaborately decorated works of art for weddings and other important occasions.

Manufacturing of Cake

Manufacturing of cake comprises of mixing of ingredients, which depends on the type of the cake.

Mixing:

The selection of high-quality ingredients is, necessary to produce a high-quality cake. However, good ingredients alone do not guarantee a fine cake. A thorough understanding of mixing procedures is essential. The three main goals of mixing cake batters are:

- To combine all ingredients into a smooth, uniform batter.
- To form and incorporate air cells in the batter.
- *To develop the proper texture in the finished product.*

Combining ingredients into a homogeneous mixture

Two of the major ingredients in cakes are fat and water which, by nature does not mix.

A uniform mixture of two unmixable substances is called an emulsion. Properly mixed cake batters contain a water-in-fat emulsion –that is the water is held in tiny droplets surrounded by fat and other ingredients.

Improper mixing leads to curdling. Curding occurs when the fat can no longer hold the water in emulsion. The mixture then changes to a fat-in-water mixture, with small particles of fat surrounded by water and other ingredients.

The following factors can cause curdling:

- 1. Using the wrong type of fat.
- 2. Having the ingredients too cold.
- 3. Mixing the first stage of the procedure too quickly.
- 4. Adding the liquids too quickly.
- 5. Adding too much liquid.

Formation of air cells in the batter

Air cells in cake batters are important for texture and for leavening. A fine, smooth texture is the result of small, uniform air cells. Large or irregular air cells result in a coarse texture.

When no chemical leavener is used, the trapped air, in addition to steam, provides all the leavening. When baking powder or soda is used, the air cells provide places to hold the gases released by the chemical leavener. Granulated sugar is the sugar of choice for creaming- method cakes. As confectioner's sugar is too fine to produce good air cells.

In the case of egg-foam cakes (sponge, angel food, chiffon), the air cells are formed by whipping eggs and sugar. For the best foaming, the egg and sugar mixture should be slightly warm (about 38°C). Whipping is done at high speed first, but the final stages of whipping should be at medium speed in order to retain air cells.

Developing proper texture in the product

Both the uniform mixing of ingredients and the formation of air cells are important to a cake texture. Another factor of mixing that affects texture is gluten development. Very little gluten development is desired in cakes. Hence, cake flour, low in gluten is used. For sponge cake part of the flour is replaced with cornstarch, to reduce the gluten. However, pound cake and fruit cake formulas needs more gluten.

The mixing methods used for most types of cakes in the modern bakeshop are.

• High-fat or shortened cakes

Creaming method, two-stage method, one-stage method, flour-batter method

• Low-fat or foam-type cakes

Sponge method, angel food method, chiffon method

High-Fat Cakes

Creaming Method

The creaming method or conventional method, was the standard method for mixing highfat cakes. The development of emulsified, or high-ratio, shortenings led to the development of simpler mixing methods for shortened cakes containing greater amounts of sugar and liquid. The creaming method is still used many types of butter cakes. The fat specified for creaming-method formulas is butter. Butter cakes are highly prized for their flavor. Butter also influences texture because it melts in the mouth, while shortening does not. The flow chart **fig 1** explains high fat mixing method.

Low-fat or Egg- foam cakes

Most egg-foam cakes contain little or no shortening and depend on the air trapped in beaten eggs for their leavening. Demand for fine pastries and cakes led to the versatility of sponge cakes.

Egg-foam cakes have a springy texture and are tougher than shortened cakes. This makes them the choice for many kinds of desserts that require much handling to assemble. These cakes are baked either in thin sheets or in thick layers that are sliced horizontally into thinner layers. The thin sponge layers are then stacked with a variety of fillings, creams, mousses, fruits, and icings. In addition, sponge layers in this kind of cake are moistened with a flavored sugar syrup to compensate for their lack of moisture.

Flour for egg-foam cakes must be weak in order to avoid making the cake tougher than necessary. Cornstarch is sometimes added to cake flour for these cakes to weaken the flour further. The **fig 2** elaborates the steps on basic plain sponge method.

Combination creaming or Sponge method

Some European-style cakes are prepared by using the creaming method. Where, butter is creamed with sugar until the mixture is light. Instead, of leavening, whipped egg whites are folded into the batter, as for some sponge cakes. For example Hazelnut Sponge Cake (**Fig 3**).

Ingredients and their role

1) Wheat flour

The vast majority of cakes except cheesecakes, foam cakes and gluten free cakes contain wheat flour. It establishes the crumb structure in cakes and bind all the ingredients together during the cake making process. Wheat flour contains two very important proteins, glutenin and gliadin, when mixed with water and stirred, create its structural network (gluten). The gluten from the wheat flour gives dough its strength and elasticity - qualities desired in yeast breads, but not in cakes. To prevent this, chlorinated soft wheat flours, such as bleached cake flour, containing low-gluten forming proteins are used. Other lower gluten flour types include Southern bleached all-purpose and pastry flour (**Table 3**).

Chlorination of cake flour provides two benefits. First it bleaches, which gives a whiter crumb color to cakes, second and more importantly it lowers the gelatinization temperature of the starch within the cake flour. This makes the cake set faster and therefore reduces the loss of leavening during baking. Bleaching also gives the cake flour the ability to carry more sugar and fat (as well as water), without their tenderizing (collapsing) effects, balancing the recipe.

2) Sweeteners

Sugar not only add sweetness, but also plays important role depending upon whether it is in the crystalline (granulated white or brown) or liquid form (honey or corn syrup).

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All sugar acts as a tenderizer by preventing the wheat flour proteins from forming an excessive amount of gluten as, sugar is hygroscopic (honey and some liquid sugars are more hygroscopic than crystalline sugar). Hence, sugar essentially absorbs available water in the recipe, leaving small amounts for gluten formation. This helps in moisture retention and thus increases shelf life by slowing the staling process. Sugar also tenderizes by slowing down the coagulation of the egg white and milk proteins.

Crystalline sugar plays an important role by incorporating air into the batter for leavening when beaten with fat, butter or margarine or solid shortening, called "creaming". Sugar plays an important role with the lubrication of other ingredients in the recipe, when molten, and with crust color. Other types of sugars used in the cakes include dextrose and brown sugar. Syrups such as invert sugar, corn syrup, glucose, molasses, honey or refiner's syrups are also used. Fine granulated sugar, also known as superfine sugar help create the finest texture and maximum volume in a cake.

3) Fats

There are two types of fat used in cake baking: solid and liquid. The primary function of solid fat, also known as plastic fat, vanaspati, stick butter or margarine, is to incorporate air bubbles into its malleable mass for volume. Creaming, or beating the fat with crystalline sugar expands air cells, helps the cake's batter during baking, resulting in cake tenderness. They are also known as shorteners; as they shorten the length of the gluten strands, when the flour is stirred with moisture. Fats also tenderize by readily coating the flour proteins thus preventing moisture from reaching flour proteins for gluten formation and slows down the coagulation of the egg when baked. Fat also increases a baked cake's shelf life by helping to retain the moisture in it.

4) Eggs

Eggs perform a multitude of important functions in a cake recipe, depending on its used part. Foamed eggs from egg white provide leavening. Whole eggs and whites contribute

to structure. Egg yolk is also a rich source of emulsifying agents and, thus, is a tenderizer. It facilitates the incorporation of air and inhibits wheat starch gelatinization. Egg yolks also add color, nutrition, and flavor and help to retain moisture in the finished cake. On the other hand, egg whites can have a drying effect.

5) Leaveners

The leavening used in cakes may serve to produce gas by physical, chemical or biological methods. Air incorporation comes from beating eggs, creaming butter and sugar together, from folding ingredients together or from any agitation. Cakes leavened when the air bubbles in their batters expand when heated from water vapor or steam from liquids. Carbon dioxide is produced from chemical leaveners (baking soda and/or baking powder). If the batter is over mixed or becomes too warm or not baked promptly, the gas will escape and the final cake will have poor texture and low volume.

6) Dairy and liquids

Milk is usually the main liquid used in cake recipes. It hydrates the dry ingredients, dissolves the sugar and salt, provides steam for leavening and allows baking powder and/or baking soda to react and produce carbon dioxide gas. Milk contains proteins (caseins) that set or coagulate from the oven's heat and help form the structure of the cake, along with flour and eggs. Other dairy products, such as buttermilk, sour cream or cream cheese add more moisture and flavor to a cake, consequently with better shelf life. The acid in the buttermilk and sour cream help tenderize the gluten in the recipe, producing a finer crumb.

7) Flavourings

Flavorings come in different forms: ground spices, extracts (especially pure vanilla extract), citrus zest (peel), citrus oil and even liqueurs. Alcohol is sometime added. Salt is an important ingredient because it is a flavor enhancer.

Requirements for cake manufacture

Mixers

Mixers of various types are essential in making cake. While small quantities of dough and batters can be mixed by hand. In commercial baking it is impossible without power mixers. Two main types of mixer are used in small and medium-size bakeshops. Specialized equipment are used in large industrial bakeries.

Vertical Mixer

Vertical mixer or planetary mixer, is the most common type used in baking. The beater attachment spins on its axis while rotating in an orbit to reach all parts of the stationary bowl.

Vertical mixers have three main mixing attachments:

- 1. The paddle is a flat blade used for general mixing.
- 2. The wire whip is used for beating egg foams and cream.
- 3. The dough arm or dough hook is used for mixing and kneading yeast doughs.

Spiral Mixer

Spiral mixers are designed for doughs and heavy batters and are used primarily for making large quantities of yeast doughs for breads. Unlike vertical mixers, spiral mixers do not have interchangeable bowls and agitator arms. The agitator arm is in the shape of a spiral, and both the bowl and the spiral arm rotate to develop the dough quickly and efficiently. Because they are used exclusively for mixing doughs, they do not have the versatility of vertical mixers, as described above. However, they have several important features and advantages that make them the preferred mixers of bread and pizza makers:

Three main varieties of spiral mixer available are:

- **1. Fixer-bowl mixers:** These have a non-removable bowl. The dough must be lifted out by hand.
- 2. Removable-bowl mixers: These have a bowl that may be removed from the machine, usually on a wheeled trolley. These are useful for high-volume operations, as a new bowl of ingredients may be wheeled into place as soon as the earlier batch is removed.
- **3. Tilt mixers:** On there machines, the entire machine tilts up to deposit the finished dough onto a tray or another container.

Horizontal Mixer

Horizontal mixers are large, industrial-size mixers capable of handling as much as several thousand kg's of dough at a time. Each model is designed to work best with a specific range of products, such as bread doughs, pastry doughs, or soft doughs and batters. Beater or agitator designs differ for each of these specialized models.

Many horizontal mixers are equipped with water jackets that surround the mixing container. Water of the desired temperature is circulated through the jacket, enabling the operator to control the dough temperature with great precision.

Dough-Handling Equipment

Dough Fermentation Trough

This is used to hold mixed yeast doughs during fermentation.

<u>Divider</u>

Dividers cut scaled pieces of dough into equal portions by means of a die or cutter attached

to a hydraulic or mechanical lever assembly. After they are divided, the individual pieces must be rounded by hand.

Divider-Rounder

This machine divides the dough as does a simple divider, and it then automatically rounds the individual portions, speeding makeup of the dough products.

Dough Sheeter

A sheeter rolls out portions of dough into sheets of uniform thickness. It consists of a canvas conveyor belt that feeds the dough through a pair of rollers. To make this sheets, the dough usually must be passed through the rollers several times. The operator decreases the space between the rollers after each pass.

<u>Molder</u>

A molder rolls and forms pieces of bread dough for standard loaves, baguettes, and rolls, eliminating the need to perform these tasks by hand.

Proofer

A proofer is a special box in which the ideal conditions for fermentation can be created. The box maintains temperature and humidity level appropriate to the specific dough.(fig 5)

<u>Retarder</u>

Chilling or refrigerating yeast dough slows or retards the rate of fermentation so the dough can be stored for later baking. A retarder is a refrigerator that maintains a high level of humidity to prevent the dough from drying out or crusting.

Ovens

Ovens are, essential for producing breads, cakes, cookies, pastries, and other baked items. Ovens are enclosed spaces in which food is heated, usually by hot air. Several kinds of oven

are used in baking.(fig 4)

Ovens used in bakeries, including deck ovens, rack ovens, and mechanical ovens, and may have steam injected into them during part of the baking cycle.

Deck Oven

Deck ovens are so called, because the items to be baked- either on sheet pans or in the case of some breads, are placed directly on the bottom, or deck, of the oven. Deck ovens are also called stack ovens because several layers may be stacked on top of one another. Breads baked directly on the floor of the oven rather than in pans are often called heart breads, hence known as hearth ovens. Deck ovens for baking bread are equipped with steam injectors.

Rack Oven

A rack oven is large oven into which entire racks full of sheet pans can be wheeled for baking. Normal baker's racks are by choice. Rack ovens hold one to four of these racks at once. The ovens are also equipped with steam injectors. Although this usage is not strictly correct, you may hear the term rack oven used for conventional ovens such as those found in restaurant ranges because the pans are placed on racks rather than directly on the bottom, as in deck ovens.

Mechanical Oven

In a mechanical oven, the food is in motion while it bakes. The most common type is a revolving oven. This mechanical action eliminates the problem of hot spots, or uneven baking, because the mechanism rotates the foods throughout the oven. Because of their size, they are especially useful in high-volume operations. Revolving ovens can be equipped with steam injectors.

Conclusion: Cake making and preparation has long history. Baking cake requires not only the skill but also the creativity. The different ingredients has significant function in cake manufacturing. Type of the flour, part of eggs and the method used, determines the finished product. Mixing of cake ingredients is very crucial in the texture of the cake. For commercial baking many larger and smaller equipment are essential. Cake's are highly versatile and depending on their decorations, icing and presentation can be suited easily from evening tea to light snack to elaborate wedding preparations.

Table 1 : Overall functions of various ingredients

Tougheners	Flour, Milk Solids, Egg Whites will make your cake tougher or stronger				
Tondonizono	Sugar, Fats, Egg Yolks, Chocolate, Leavenings, Emulsifiers, Starches, Gums will				
renderizers	make your cakes more tender or weaker				
Moisteners	Water, Liquid Milk, Liquid Eggs, Syrups, Liquid Sugars				
Driers	Flour, Milk Solids, Instant Starch, Gums, Egg Whites				
Flavors	Salt, Sugar, Cocoa, Chocolate, Butter, Vanilla, other flavors				

ТҮРЕ	FLOUR	EGGS	FAT	SUGAR	QUALITIES
SHORTENED:					
POUND CAKE	100	100	100	100	Moist, soft, rich
BUTTER CAKE	100	40	45	100	Moist, soft
FOAM:					
GENOISE	100	150 - 200	20 - 40	100	Light, springy, somewhat dry
BISCUIT	100	150 - 220	0	100	Light, springy, dry
SPONGE CAKE	100	225	0	155	Light, springy, sweet
ANGEL FOOD CAKE	100	350 (whites)	0	260	Light, springy very sweet
CHIFFON	100	200	50	135	Light, moist

Table 2: Standard cake proportions (%) and impact on quality of cake

Source: On Food & Cooking, by Harold McGee

Fig 1: Creaming Method or High fat cakes

Scale ingredients accurately. Have all ingredients at room temperature (7°F/21°C)

Place the butter or shortening in the mixing bowl. With the paddle attachment, beat the fat slowly until it is smooth and creamy.

Add the sugar: cream the mixture at moderate speed until the mixture is light and fluffy (a). This will take about 8 to 10 minutes.

Some bakers prefer to add the salt and flavorings with the sugar to ensure uniform distribution. If melted chocolate is used, it may be added during creaming.

Add the eggs a little at a time (b). After each addition, beat until the eggs are absorbed before adding more. After the eggs are beaten in, mix until light and fluffy. This step will take about 5 minutes.

Scrape down the sides of the bowl to ensure even mixing.

Add the sifted dry ingredients (including the spices, if they were not added in step 3), alternating with the liquids. Add one-fourth of the dry ingredients. Mix just until blended in. Add one-third of the liquid and Mix just until blended in.

Repeat until all ingredients are used. Scrape down the sides of the bowl occasionally for even mixing.

Variation: *A few creaming-method cakes require an extra step: Egg whites whipped to a foam with sugar are folded into the batter to provide additional leavening.*

Fig 2: Procedure for Plain Sponge or Genoise Method

Scale all ingredients accurately.

Combine the eggs, sugar, and salt in a stainless steel bowl. Immediately set the bowl over a ho water bath and stir or beat with a whip until the mixture warms to a temperature of about 100° F (43°C). (a) The reason for this step is that the foam attains greater volume if warm.

With a wire whip or the whip attachment of a mixer, heat the eggs at high speed until they are very light and thick. (b) This may take as long as 10 to 15 minutes if the quantity is large.

If any liquid (water, milk, liquid flavoring) is included, add it now. Either whip it in a steady stream or stir it in, as indicated in the recipe.

Fold in the sifted flour 3 or 4 stages, being careful not to deflate the foam. Many bakers do this by hand, even for large batches. Fold gently until all the flour is blended in (c). If any other dry ingredients are used, such as cornstarch or baking powder, they should first be

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sifted with the flour.

Immediately pan and bake the batter. Delays will cause loss of volume.

Variation: Butter Sponge or Butter Genoise

- 1. Follow the plain sponge procedure through step 5
- 2. Carefully fold I the melted butter after the flour has been added. Fold in the butter completely, but be careful not to over mix or the cake will be tough (d)
- 3. Immediately pan and bake.

Variation: Hot milk and Butter sponge

- 1. Scale all ingredients accurately. Heat the milk and butter together until the butter is melted.
- 2. Whip the eggs into a foam as in the plain sponge method, steps 2 and 3.
- 3. Fold in the sifted dry ingredients (flour, leavening, cocoa, etc) as in the basic procedure.
- 4. Carefully fold in the hot butter and milk in 3 stages. Fold in completely, but do not overmix.
- 5. Immediately pan and bake.

Variation: Separated egg sponge

- Follow the basic plain sponge method, but use yolks for the basic foam (steps 2 and 3). Reserve the egg whites and part of the sugar for a separate step.
- 2. Whip the whites and sugar to firm, moist peaks. Fold into the batter alternately with the sifted dry ingredients. Fold in completely, but do not overmix.
- 3. Immediately pan and bake.

Fig 3:Combination creaming or Sponge method

1. Cream the butter and sugar.



2. Add the egg yolks a little at a time.



- 3. Mix well after each addition.
- 4. Whip the egg whites and sugar until they

form soft peaks.





5. Fold the meringue into

6. Sift the dry ingredients together.

the butter mixture.





7. Fold in the sifted dry ingredients.







9. Level the top of the batter with a plastic scraper.



Table 3: Three formulas for high-ratio cakes:

There are three formulas for preparing the sweeter high ratio cakes that contain more sugar than

flour, by weight. Following these ingredient proportions will ensure a high-ratio cake that is not too dry or too moist:

- 1. The sugar should weigh the same or slightly more than the flour. It is the weight and NOT the volume that counts.
- 2. Eggs should weigh almost as much as or slightly more than the fat.
- 3. The liquid ingredients (including eggs), should weigh the same as or more than the sugar.

High ratio cakes are mixed using the High Ratio or Two Step Mixing Method.





Deck oven. Courtesy of Macadams Baking Systems (Pty) Ltd.



Rack oven. Courtesy of Lang Manufacturing Company

Fig 4 Types of oven



Proofer. Courtesy of Bevles



Retarder-proofer. Courtesy of TMB Baking, Inc.

Fig 5 Proofer

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