

# CAKE

This name is given to a variety of baked sweet items, often served as a dessert or at tea or coffee time, usually made from a mixture of flour, sugar, fat and eggs. Cakes are most often round or square but can also be made in all sorts of other shapes and sizes, for example for a children's birthday. They are frequently used to celebrate a family occasion or religious festival, for example Christmas cake, Wedding cake, Christening cakes, etc. Most cakes are decorated to some extent, varying from a simple dusting of icing sugar to elaborate designs piped in royal icing or moulded in fondant sugarpaste. Some cakes such as Dundee and Simnel cakes are associated with traditional kinds of decoration.

There are three main types of cake, classified according to the proportion of ingredients they contain, and the method by which they are made. The three main types are plain, rich and sponge. Other smaller categories include 'Quick Mix' (One Stage) cakes and those made by a method which involves warming the sugar, fat and a liquid sweetener (syrup or treacle) together before they are added to the dry ingredients.

## CAKE-FORMULA

### CAKE - MAKING INGREDIENTS

Cake making ingredients are classified as:

Essential ingredients i.e. flour, sugar, shortening and eggs

Optional ingredients i.e. baking powder, milk, fruits etc.

Above ingredients are also classified according to the function which they perform in cake making. This classification is as follows:

Structure builders - flour, eggs, milk

Tenderizers - fat, sugar, baking powder

Moisteners - milk, egg.

### FLOUR

Flour builds structure of cake and holds other ingredients together in an evenly distributed condition in the cake.

1. Flour for cake making should have protein content of 7 to 9 percent and the protein should be of soft nature. Short patent flour made from soft wheat is ideally suited for cake making.

2. Cake flour should have fine granulation which has beneficial effect on the fineness of the grain structure of cake.

3. Cake flours are bleached to a greater degree in order to brighten its colour. This extra bleaching has also a modifying action on gluten forming proteins under low pH conditions, starch gelatinizes faster and thus affects a faster set of the cake structure in the oven which is desirable in the case of cakes having high amounts of sugar and moisture such as high ratio cakes.

4. Cakes made from too strong flour will peak in the center, be tough and dry eating. In case of too weak flour, the cakes may flatten out or even sink. However, the following guidelines may be useful while selecting flour for making specific types of cakes:

{a} Medium type flour is used for making small queen cakes and Madeira cakes.

{b} Slab cakes and pound cakes are made best with soft flour.

{c} For cherry cake or heavily fruited cakes, medium flour should be used in order to prevent fruits from sinking and also to avoid crumbliness in cakes.

{d} For rich cakes like wedding, christmas or special birthday cakes, a combination of medium and soft flour gives good results.

Although some flour mills do possess necessary technology to produce cake flours but its availability is very limited. Addition of 5 to 10 percent corn flour in general purpose flour may be tried to tone down the strength and make it somewhat suitable for sponges and pound type cakes. However it has been experienced that cakes made with addition of corn flour or corn starch have holes on the top crust.

### SUGAR

1. Sucrose is most commonly used sweetening agent in cake making.

2. Due to its tenderizing action on flour proteins it makes the cakes tender.

3. Being hygroscopic in nature, sugar helps to retain moisture in cakes, improving its shelf life.

4. The golden brown crust colour of cakes is due to caramelisation of sugar.

Dextrose-mono-hydrate is used where it is desired to cut down the excessive sweetness of cakes. Dextrose caramelises at lower temperature and thus imparts a darker colour to cake crust. A dark crust and crumb is desirable in certain cakes such as Devils Food cake or fruit/plum cake. Browning reaction or Millard reaction is the action between protein and simple sugar {Glucose} in the presence of heat as takes place in the cake during baking operation making the product darker in colour. Dextrose-mono-hydrate contains 8% moisture which should be taken into account while adjusting the cake formula so that the total moisture content of the mix remains unaffected. When fat and sugar is creamed together, small air cells are incorporated in the mix. A coarsely powdered sugar is most suitable for cake making.

Relative sweetness of Sugars

Cane Sugar	-	100.0	Invert Sugar	-	125.0
Dextrose	-	75.0	Fructose	-	175.0
Lactose	-	15.0	Maltose	-	32.5
Galactose	-	32.5			

## FATS

Fats have a tenderizing action on flour proteins and thus make the cake tender. It is the fat part of the batter which holds innumerable air-cells incorporated during creaming operation. These air cells also have a tenderizing influence on cakes. As a moisture retainer, fat helps to keep the cakes moist and thus improves the shelf life of cakes.

Fat used in cake-making should be:-

1. Plastic in nature which could incorporate and hold minute air cells during creaming operation. Granular fats do not fulfill this function and should be avoided.
2. Fat should be able to maintain its plasticity within working temperature range i.e. 60 to 85 deg.F. Too hard fats will not cream up well while too soft fats will not be able to retain the aeration.
3. Use of emulsified type of shortening makes it possible to add more water in the batter. Such cakes retain their moist eating quality for longer time. In the absence of emulsified type of shortening, a judicious use of emulsifiers such as glycerol mono stearate, sorbitol mono stearate, poly sorbate, lecithin, either singly or in combination should be considered.

## EGG

Most important function of eggs is to provide structure to the cake.

1. Although eggs by themselves do not act as aerating agent, air incorporated during mixing (whipping) operation performs this function.
2. Eggs provide moisture to the cake.
3. Lecithin present in the egg yolk acts as an emulsifier.
4. Lutin, also found in yolk, imparts colour to the cake.
5. Egg improves the taste, flavour and nutritional value of the cakes.

## MILK

1. Milk solids perform the function of structure formation of cakes.
2. Milk proteins *have* a binding action on flour proteins which creates toughness in cakes. However, adequate quantities of fat, sugar and water present in the formula keeps the cakes tender and moist.
3. Milk enriches the cakes nutritionally.
4. Lactose sugar present in milk improves the crust colour and moisture retention capacity of cakes.
5. Milk also improves flavour and taste of cakes.

## WATER

1. Water, whether added as such or in the form of liquid milk, hydrates flour proteins, forming gluten, which builds up the structure of cakes.
2. Formation of gluten, release of CO<sub>2</sub> gas from baking powder and formation of vapour pressure are made possible by the presence of water. These factors are important in regulating the volume of cakes.
3. Sugar, in order to be effective, should be dissolved in water.
4. Water regulates the consistency of batter which affects the volume and texture of cakes.
5. Shelf life of cakes is determined by the amount of moisture retained in the cake which eventually depends upon the amount of water used in the formula.

## **SALT**

1. Salt enhances the natural flavour of other ingredients used in cake making and thus improves the overall flavour of the cakes.
2. It also improves the crust colour of cakes by lowering the caramelization temperature of sugar.
3. Certain cakes contain more sugar either in the formula or in the form of icing. Since sugar helps to keep the cakes moist for long time, it may not be desirable to reduce the quantity of sugar. Salt helps to cut down the excessive sweetness of such cakes.
4. Salt being hygroscopic in nature, helps in retention of moisture in cakes.
5. Functions of salt and sugar are considered to be complementary to each other.
6. Salt can be used at the rate of 0.7 to 1.2% depending on the flavour and taste desired in the cakes, and the amount of sugar in the formula. In some sweet products salt content could be as high as 1.5%.

## **LEAVENING AGENTS**

Leavening action in cakes is achieved by three means:

1. **Mechanical aeration:** When fat is whipped with sugar or flour, the mixture is filled with minute air cells which expand under the action of heat giving volume to the product.
2. **Chemical aeration:** Baking powders of various types, when moistened with water and heated, evolve CO<sub>2</sub> gas which expands during baking and imparts volume to cakes.
3. **Vapour pressure:** Water, which is evenly distributed in the batter, forms vapours under the action of heat. This water vapour exerts pressure as a result of which the cakes are leavened.

Baking powders are of three different kinds:

1. **Fast acting:** This type of baking powder releases most of its CO<sub>2</sub> gas during bench operation and very little gas is released during baking.
2. **Slow acting:** Such baking powders do not release much of gas during bench operation and all the gas is released when it comes in contact with heat.
3. **Double acting:** This type of baking powder is most widely used by bakers. This baking powder releases a part of gas during bench operation, increasing the fluidity of cake batter. This action makes the weighing operation easy, enabling the baker to apportion the batter in moulds correctly. The remaining CO<sub>2</sub> gas is released in the oven which imparts volume to the cake. If fast acting or double acting baking powders are used, these should be incorporated in the mix as near to the last mixing operation as possible and the product should be loaded in the oven immediately in order to avoid any loss of gas.

## **FLAVOUR**

Flavour is a very important aspect of a quality product. A pleasant flavour is usually indicative of good taste also. While selecting a flavouring agent, the baker should ascertain that its effect is not impaired either by heat during baking or during normal storage period. Cheap flavours often breakdown under the influence of heat giving sub standard flavour to the product. It is always wise to use a small quantity of a good flavouring material rather than to overload the cake with a cheap essence. Flavouring agent should always be measured carefully as even a slight excess of essence will not only be a wasteful practice but it will spoil the gastronomical appeal of the product.

### **Selecting cake tins:**

The type of tin in which a cake is baked radically affects the baking time and also gives character to the finished cake. It is important to use the shape and size of tin stated in the recipe. In general, dense, long-cooking cake mixtures need thicker tins to prevent scorching.

### **Preparing and greasing cake tins:**

Cake tins are coated with fat, flour or both to give a smooth golden surface to the cake. To make the cake easy to unmould and to protect the batter from oven heat, the tin is usually lined with greaseproof paper. For some cakes, notably those made with egg whites, the tin is not greased as the batter is supposed to cling. Non-stick tins are particularly helpful for moist batters and do not need greasing unless a coating is needed, or a protective paper lining is used.

Greasing a tin helps loosen a cake so it is easy to unmould after baking. The fat used for greasing should be the same as that used in the batter. Melt or soften the fat and, using a pastry brush, apply a thin, even coating, taking care to brush the corners and rim.

### **Preparing your oven for baking:**

Most ovens take 10-15 minutes to reach the correct temperature and should therefore be heated in advance. Precision is important so check the temperature of the oven with a the beforehand. Position the shelf so that the cake will fit in the centre of the oven or slightly lower. Deep cakes should be placed lower in the oven than shallow ones. If baking more than one cake at a time, stagger the tins so that one is not directly above another. the oven temperature is uneven, rearrange the tins when me start to brown. So that the heat circulates freely, the edge - baking tray should never be less than 1 in/2.5 cm from the side of the oven. Trays of cakes often need turning front to back during cooking so that they brown evenly. However, do not open the oven door until a cake is set and lightly browned.

### **CAKE MAKING METHODS**

Following methods are used for making cakes.

1. Sugar - batter method.
2. Flour - batter method.
3. Blending method.
4. Boiled method.
5. Sugar - water method. 6. All-in process.

#### **Sugar - Batter method:**

In this method, all the fat and sugar is creamed together. Shortenings used for cake making should be plastic in nature. Granular fats should be avoided which have very poor whipping quality. It is very necessary that all the fats are at room temperature i.e. 70 to 75 deg.F. Very hard shortenings will not cream up well, while too soft shortenings will not be able to retain aeration. If cold and hard fat is creamed with soft fats, the hard fat will break into small pieces which will be scattered in the whole mix. These hard lumps will be difficult to break and will adversely affect the process of aeration. Shortenings used for cake making should not melt by the heat produced due to friction during creaming process. In practice, all the fats should be first blended together { either by machine or by hand } thoroughly. Then sugar is added gradually continuing the creaming process. All the sugar should not be added to fat at a time as this will adversely affect the aeration process and it may take extra time to achieve the desired results. When adequate aeration is achieved, the mixture becomes very light, fluffy and brighter in appearance.

When adequate aeration is achieved in the fat-sugar mixture, eggs are added gradually. Eggs should be at room temperature (70 to 75 deg.F) at the time of adding to the cream. Although cake shortenings are emulsified type, emulsifiers in the form of gels Can be used for better results. These can be added after about half of the total egg is added or even earlier if the batter shows any signs of curdling.

When eggs are added to the creamed mixture little at a time and mixed just sufficiently, the air cells of whipped eggs either diffuse into the air cells already present or increase the number of air cells in the cream and the liquid part of egg is evenly distributed in the mixture giving it a smooth, velvety appearance.

However, if the eggs are stale, or too much egg is added at a time or after each addition of egg, it is not mixed properly, the perfect blending does not take place and the fat is broken into small fragments separated by liquid component of egg. If too cold eggs are used, the fat will solidify soon as it comes in contact with eggs and perfect amalgamation of fat and egg will not take place. In this case also, the fat will break down into small lumps which will be coated with egg. The break down of fat into small fragments separated by egg is known as "Curdling" of batter.

When batter is curdled due to low temperature of eggs, the mixture should be slightly warmed over a pot of hot water, taking care that the bowl containing mixture does not touch hot water. Direct heating of mixture is not advisable as the fat will melt or egg may coagulate. In both the cases there will be loss of aeration.

If the batter is curdled due to poor quality or improper mixing of egg, an adequate quantity of flour should be added and mixed quickly. This flour will absorbed the excessive moisture and the mixture will again become smooth. When all the egg is amalgamated, the mixture should have a smooth and velvety appearance. A part (one half to two third) of liquids such as liquid sugars, water, milk, fruit juices, fruit pulp etc. along with essences, colour, and salt can be added at this stage.

Next stage is to incorporate flour in the mixture. Whether flour is mixed by hand or by machine, the operation should be carried out in a fashion that the flour is evenly mixed with minimum possible of mixing action in order to avoid toughening of gluten. Flour should not be added all at once, but it should be divided into two or three portions and each portion should be added at a time with minimum possible movements of hand or machine. Each portion of flour should be added alternately with water at low speed. If any fruits are to be mixed, these should be added alternately with flour. , if the mixture appears to be tough, little water should be added to avoid toughening of gluten. The batter is now ready for panning and baking.

### **Flour - Batter method:**

In this method, fat and a quantity of flour not exceeding the weight of fat is creamed together. Fat should be in smooth and plastic state and the flour should be added gradually. The whole mass is whipped till it becomes light and fluffy. Eggs and an equal quantity of sugar is whipped to a stiff froth. This is added to the creamed mixture of fat and flour. Although, there is less risk of curdling of the batter, still the egg mixture should be added in small portions at a time and after each addition it should be mixed thoroughly and then only the next portion should be added. At this stage, the remaining sugar is dissolved in milk or water and added to the mixture. Any colour or flavour is also added along with this liquid. Lastly, the remaining flour sifted with baking powder, is added and mixed. A thorough treatment of batter ensures smoothness of the batter which is desirable for obtaining good texture in cakes.

### **Blending Method:**

This method is suitable for making high ratio cakes in which quantity of sugar is more than the quantity of flour. Usually emulsified type of shortening and special cake flours are used for making high ratio cakes. In this method, emulsified shortening, flour, baking powder, and salt are whipped together to a very light and fluffy consistency. Sugar, milk or any other liquid, colour and flavour are mixed together and added to the previous mixture. Eggs are added next and the whole mass is mixed to a smooth batter.

### **Boiled Method:**

This method is used for making good quality Madeira cakes and genoese sponge. Butter or margarine is placed in a bowl and heated till it melts and water in them actually starts to boil (hence boiling method). Remove the bowl from heat and add about twothird (or less) flour and mix thoroughly. Egg and sugar is whisked to a stiff sponge. Colour and flavour may be added while whisking the sponge. This sponge is added to the fat-flour mixture in about four to five equal parts. After each addition of sponge, it should be mixed thoroughly. Remaining flour can be added at this stage. When the mixture is smooth, it is scaled off into paper-lined baking sheets to about one inch thickness for making genoese. For making Madeira cakes, mixture is baked in moulds lined with grease-proof paper.

### **Sugar-Water Method:**

In this method, all the sugar and approximately half the quantity (of sugar) of water is agitated in a bowl till all the sugar is dissolved. Then the remaining ingredients except egg are added and the mixture is well agitated to acquire aeration. Lastly, egg is added and the mixture is cleared. Due to more aeration and better emulsification obtained in this method, the cakes so produced have better texture and longer shelf life.

### **All -In Process:**

In this process all the ingredients are put into the mixing bowl together. Aeration of the mixture is achieved by controlling the speed of the mixer as well as the mixing time. After adding all the ingredients in the mixing bowl, the mixing operation is carried out as follows:

1. Half a minute at slow speed. This is done at slow speed so that all the dry ingredients are moistened without flying off from the bowl.
2. Two minutes at fast speed. At this stage, all the ingredients break up and are incorporated evenly throughout the mass. The batter is also well aerated.
3. Two minutes at medium speed. Aeration achieved during the second stage is not evenly distributed in the batter. By mixing at medium speed the larger air-cells break up into smaller cells and the aeration of the mixture becomes even.
4. One minute at slow speed. This is done in order to eliminate any possible large air pockets and still finer breaking down of air-cells.

### **Baking of Cakes:**

Different kinds of cakes are baked at different temperatures. The oven temperature is adjusted according to richness of formula, size of cakes and number of units required to be baked at a time. Regarding richness of formula, the basic principle should be remembered that is, "Richer the formula lower the temperature of baking". Rich cakes contain more amount of fat and eggs, and they acquire all its aeration during creaming of fat and sugar or by way of whipped eggs. These cakes contain very little baking powder, if any at all. The batter does not contain much moisture and is comparatively less fluid. Such cakes should have a very slow and gradual rise in the oven in order to have thorough baking and this is precisely the reason for baking them at low temperature. If rich cakes are baked at high temperature, there will be faster crust formation on cakes. The crust will prevent heat from penetrating inside the cake resulting in an under-baked product. There will be much concentration of heat on the crust giving it too dark colour. When, ultimately heat does reach inside the cake, the internal part will expand bursting the crust and spoiling the appearance of the cake. Lean formula contains less amount fat and eggs. All the aeration in such cakes is

achieved by baking powder. Lean cake batter is more fluid in comparison with rich cake batter. Such cakes are baked at high temperature so that evolution of gas from baking powder, acquiring of volume by cake and setting of structure of cake takes place simultaneously. If such cakes are baked at low temperature, there will be evolution of gas from baking powder which will expand the cake, but due to low temperature the structure of cake will not set and the cakes will collapse. Cakes baked as large units should have a slow and gradual expansion in the oven which is possible only when the baking temperature is low. Smaller units require less baking time. Faster setting of structure is made possible by baking at higher temperature. When oven is not filled to the capacity, it is necessary that the temperature of the oven is reduced. Good results are achieved by placing a pot of water in the oven. The water will absorb some of the excessive heat and at the same time the water vapours will delay the process of crust formation on cakes thus allowing the cake to rise evenly and acquire proper volume. Lining the moulds with paper, covering the cakes in the oven with moist brown paper, placing the moulds on baking sheets while baking, are some of the means to cut down absorption of heat by cakes and these measures should be adopted while baking such cakes which require too long baking time or while baking a small batch of cakes in large oven.

### **Baking and Cooling Loss:**

Normally there is about 12% baking and cooling loss in cakes. Excessive baking and cooling loss will result in dry-eating cakes. If there is lack of temperature in the oven, the cakes will take longer time in baking and consequently there will be excessive evaporation of moisture resulting in dry-eating cake. But most important factor in determining baking and cooling loss in cakes is the amount of batter filled in a given size mould and the depth of the mould. A mould should be filled with sufficient amount of batter so that when due expansion has taken place during baking, the mould, more or less, contains (filled with) the cake. If a small amount of batter is baked in a large pan, there will be excessive baking and cooling loss which will result in not only a dry eating cake but also will mean economic loss to the baker.

### **Baking Temperatures:**

Most cakes are baked between 375-400°F (190-200°C). If cakes are baked at too low temperature. The gas evolved from baking powder will escape before the structure has a chance to set resulting in small volume, flat appearing cakes. On the other hand, if the cakes are baked at too high temperature, the cake will peak and burst in the center, will be tough and may also not be baked adequately. As a rule, large cakes and rich cakes should be baked at low temperature while lean cakes and smaller cakes should be baked at higher temperature.

## **CHARACTERISTICS OF CAKES**

**Volume** - It is rather difficult to set standards for volume of cakes which will vary according to different types of cakes and also according to consumer preference. However, the cakes should not have a pinched appearance and should not appear over extended too. A well risen cake will have a pleasing appearance with slight convex top surface. Although, the relative weight of a particular volume of cake will differ in different types of cakes, but a cake should not appear too small or too large for its weight.

**Colour of Crust** - The crust should have a pleasing golden brown colour. Too dark or too light or dull colour is not desirable. Crust must have a uniform colour, free from dark streaks or sugar spots or grease spots.

**Symmetry of Form** - Cakes should have a symmetrical appearance. Peaking, crack on top surface, low sides, sunken or high center, burst, caved in bottom or uneven top are undesirable characteristics of cakes.

**Character of Crust** - Crust of a good cake should be thin and tender. Thick, rubbery, sticky or over moist, too tender, tough or blistery crust is indicative of poor quality of cakes.

**Texture** - Texture denotes the pliability and smoothness of the crumb as felt by sense of touch. It depends on the physical condition of the crumb and type of grain. A good texture is soft and velvety without weakness and should not be crumbly. Rough, harsh, too compact, lumpy or too loose texture is not desirable.

**Grain** - The grain is the structure formed by the extended gluten strands including the area they surround. Grain will vary according to the type of cake. However; uniformity of the size of cell and thin cell walls are desirable qualities. Coarseness, thick cell walls, uneven size of cells, large holes and tunnels are indicative of poor grain. Grain should not be too open or too close.

**Colour of Crumb** - Crumb should have a lively, lustrous and uniform colour. It should be free from any streaks or dark patches. Grey, non-uniform, dark, light or dull colour of crumb will be undesirable.

**Aroma** - Aroma of good cake should be pleasant, rich, sweet and natural. It is not desirable to have any foreign aroma i.e. aroma not produced by normal ingredients of cake. Flat, musty, strong or sharp aroma is indicative of poor quality of cake.

**Taste** - Taste of a cake should be pleasant, sweet and satisfying. Cakes should not leave any unpleasant after taste in the mouth, should not have a bland taste and should also not have any foreign taste i.e. taste which can not be acquired by the use of normal ingredients of cakes. Use of excessive salt or soda will also adversely affect the taste.

## BALANCING OF CAKE FORMULA

Basic requirement of a cake is that it should have a pleasing appearance, with thin and tender crust, should be light, even textured and pleasant to eat. In case of fruit cakes, fruits should be evenly dispersed in the crumb. Each ingredient of cake making has certain definite function e.g. flour and egg give structure, sugar, fat and baking powder act as tenderizing agents, egg and milk impart liquid to cakes. If haphazard quantities of these ingredients are used in a cake, the resultant product will vary from day to day. Such proportions of raw material which can produce a desirable cake are termed as "Cake Formula". It will be desirable to understand the difference between "High ratio" and "Low ratio" cakes and "Rich cakes" and "Lean cakes", before attempting to balance cake formula. A "High ratio" cake has more sugar than flour while a "Low ratio" cake has either equal proportion of sugar and flour or sugar is less than flour. Different high ratio cakes have different quantities of sugar which varies from 110 to 140 percent for yellow layer cakes (in which whole egg is used) and 110 to 160 percent for white layer cakes (in which only white of egg is used) and 110 to 180 percent for Devils Food cakes (in which cocoa is one of the ingredient). Sugar helps in retaining moisture and thus improves the shelf life of cakes. Higher percentage of sugar in cakes will further add to the shelf life of cakes. Addition of more sugar will necessitate additional quantity of liquid in order for sugar to be effective in cakes. A normal cake formula will not tolerate additional amount of liquid without deteriorating the quality of cakes. In the case of low ratio cakes, total quantity of eggs and milk should be equal to sugar while in case of high ratio cakes total quantity of egg and milk should be more than the quantity of sugar i.e.  $\text{Total liquid} = \text{Liquid egg} + \text{liquid milk} = \text{Sugar} + 25$ . In the case of low ratio cakes, shortening should not exceed egg, while in the case of high ratio cakes, eggs should be equal to or higher than shortening (by about 10%).

Shortening in high ratio cakes ranges from 30 to 80%. Thus Ie know the quantity of fat (between 30-80%) and the quantity of sugar (say 110-140%) for a particular formula. Quantity of egg can e calculated which should be more ( say by 10%) than the quantity f fat. By substituting the figures for sugar and egg in the formula;

$$\text{Liquid egg} + \text{Liquid milk} = \text{Sugar} + 25$$

We can find the quantity of milk which should be used in the 'atter. In this formula, 25 is an arbitrary figure which gives desirable esults in the product. In case of white layer cake, in which only gg white is used (which has more moisture content), the milk ontent will be automatically reduced while applying the above xmula. In devils food cake, cocoa is used, which, due to its drying !ffect on cakes, necessitates addition of more liquid. Hence the formula to be used in this case is:-

$$\text{Total liquid} = \text{Liquid egg} + \text{liquid milk} ::= \text{Sugar} + 30 + (1.5 \times \text{Cocoa})$$

Thus the liquid content of batter will be directly related to the quantity of cocoa in the mix.

### Rich Cakes and Lean Cakes

Cakes having more fat in the formula are known as rich cakes and cakes having less fat are known as lean cakes. Since, more fat will incorporate more air during creaming operation, the quantity of baking powder should be reduced in rich cake. More baking powder will be required in lean cake formula as less air will be incorporated in lean cake batter due to lesser quantity of fat. Since a lean cake batter is more fluid, such cakes should be baked at higher temperature in order to have a faster "set" in the oven, other wise CO<sub>2</sub> gas released from baking powder will escape leaving the cake flat appearing. In rich cakes, most of aeration is achieved during creaming operation and very little baking powder is used. Such cakes should be baked at low temperature in order to allow a slow, gradual and full expansion of cakes. High temperature in case of rich cakes will form a crust on top before the cake has a chance to expand fully, and the crust will inhibit heat penetration in the cake. At a latter stage, when heat does penetrate, the upper crust of cake will develop an unsightly crack due to expansion of air cells.

### **Following are some of the points which should be followed while balancing a cake formula.**

1. Salt content will vary between 0.8 to 2.0 percent depending on the quantity of sugar in the formula and the amount of flavour desired in the product. Very minute quantity of salt can influence the flavour of the cake a great deal.
2. As the percentage of sugar is increased, the percent of egg should also be increased by approximately the same percent. This will be necessary in order to make up for additional structure builders and moisteners (to match the tenderising action of sugar) required in the formula. In order to compensate for the dryness and toughness created by additional egg, it may be necessary to increase the quantity of fat.
3. When liquid sugars such as invert syrup, honey, corn syrup etc. are used in the formula, their moisture content should be known and necessary amendments should be made so that the total moisture content of formula does not change.
4. When cocoa is used in the formula, it is necessary to increase the moisture content, because cocoa acts as a dryer. For the same reason it may be necessary to increase the fat content also.
5. When using cocoa, sodium bi-carbonate is used. This soda reacts with the natural acidity present in cocoa thereby imparting leavening action and also darker crumb colour. However it should be remembered that alkalinity of soda will be conducive to microbial spoilage of cake and calcium propionate as a preservative will be less effective in alkaline medium.
6. Slight acidity in egg whites improves its air trapping capacity. Cream of tartar, citric acid, monoacid calcium phosphate, acetic acid or lime juice may be used at desired levels (0.1 to 0.5%) while whipping egg whites.
7. When egg yolk is desired to be used, additional moisture will be necessary, as moisture content of egg yolk is less than that of whole egg.
8. Too much milk solids will give undesirable results in cakes unless compensated with necessary amount of Water.  
When using sugar with low caramelization point, it may be necessary to use some amount of acid salt (such as MACP) in order to prevent too dark crust colour.

## **CAKE FAULTS AND REMEDIES**

### **Reasons for faults in cakes may generally be grouped as follows:**

1. Wrong quality of raw material
2. Improper balancing of formula
3. Operational mistakes

#### **1. Wrong quality of raw material**

##### **Flour**

If strong flour is used in cake making, gluten development will take place during mixing operation resulting in cakes of small volume, peaked top, unsightly crack in the center and an uneven texture. Such cakes will be dry eating and will stale rapidly. With slightly strong flours it is advisable to use flour-batter system of cake making. Liquid content may be slightly increased and mixing operation should be carried out to minimum possible extent in order to avoid undesirable development of gluten. Use of 5 to 10 percent (based on flour) corn flour will dilute the gluten and to some extent may remedy the defect. Too weak flour will not be able to carry sugar and fat and the cakes will be poor in volume. Weak flours will be unable to carry the normal amount of liquid. This will cause the crumb at the base of the cake to remain compact showing as wet streak. In the case of cakes with fruits, structure will not be strong enough to hold the weight of fruits which will sink to the bottom. While cutting such cakes it may crumble rather than cutting into neat slices.

##### **Sugar**

Very large crystals of sugar will not dissolve during mixing operation and the resultant cake will have all the defects as if lack of sugar has been used in the formula i.e. harsh crumb, poor eating quality and rapid staling. For sugar to be effective, there must be sufficient water in the formula to dissolve the sugar. If there is lack of water in the formula, then also the cakes will have the above defects. When sugar is not completely dissolved, it appears as white specks on the top crust which spoils the appearance of cakes. Too large or too small crystals of sugar are not desirable as they do not cream up well (resulting in poor aeration) and thus adversely affect the volume and texture of cakes.

##### **Shortening**

For use in cake making, shortening must be smooth and plastic.

Such shortenings cream up well and hold the air cells which are incorporated during creaming operation. Granular shortenings will not cream up well and are not capable of holding the air cells. Resulting cakes will be poor in volume and have a coarse texture. If the shortening melts during mixing operations, aeration will be lost, affecting

the volume and texture adversely. Special emulsified type of shortenings for cake making give best results in batter type cakes.

### **Egg**

Weak and watery eggs should never be used in cake making as such eggs have very poor whipping quality, and cause curdling of batter. If the batter is curdled, the aeration will be lost and the cakes will have poor volume and texture. In most bakeries eggs are used by count which is a wrong practice. Eggs must always be weighed (without shell) for use in any formula.

### **Baking powder**

Baking powder should not be stored in warm and humid place where it loses its aerating power and will be incapable of aerating the cakes. It should be stored in cool, dry place in air tight containers.

### **Fruits**

Fruits must be washed before adding in the cake batter. Unwashed fruits or fruits with syrup sticking to them will discolour the cake batter and may also imbalance the formula by increasing its sugar content. Fruits must be properly prepared so that these are of even size. Too large pieces of orange peel or citron peel or glazed cherry will sink in the cake.

## **2. Improperly balanced formula**

Sugar acts as a tenderizing agent and has to be balanced with structure forming ingredients such as flour and egg. When excess sugar is used, it opens up the structure too much which is not supported by flour and egg and as a result the cakes collapse, have white sugar spots and dark and thick crust. As sugar delays the setting of structure, in the presence of excess sugar, fruits will sink in the cake. Excessive sugar may also cause (excessive volume with very open texture. Such cakes may be too tender to cut. Too little sugar will produce a very close grain and texture. Cakes may pull away from paper lining. Too little sugar will cause setting of top crust earlier than the inner portion. When inner portion expands, it will cause an ugly crack in the top crust and the cake will have pale brown crust colour.

Fat acts as a tenderizing agent. It has lubricating action on flour proteins. Quantity of fat should be balanced against quantity of egg which should be either equal to or higher by 10% than fat. If fat is higher, egg will not be able to support structure and cakes will have a flat top, dark and thick crust, gummy and greasy eating quality and will be too tender to cut (Crumbly). In the case of cup cakes the paper cases will separate out from cakes. Excessive fat can not be retained by protein and starch network and will squeeze out when cakes are handled.

Cakes having lack of fat will have coarse grain, holes and tunnels, be dry eating and will stale rapidly. Crust of such cakes will be sticky due to insufficient bake off of moisture in the oven as less lift will result in poor volume of cakes and poor heat penetration.

Eggs subscribe to the structure, moisture and aeration of cakes.

If the egg content of the formula is less than fat, the cake will not be able to carry extra fat and will collapse having flat top. This condition will also make the fruit cakes crumbly. Lack of egg will make the cakes too tender to cut specially high ratio cakes. Lack of eggs will result in less air incorporation and reduced volume of cakes. Grain will be close and compact. Due to lack of volume, heat penetration will be poor. There will be insufficient bake off of moisture and the crust will be light coloured, thin and sticky.

Excessive eggs will impart abnormal volume to the cake. The 1st will be dark, thick and will peel off as a flake. Grain will be open and coarse. Texture will be rough and dry. Excessive volume will cause more moisture evaporation from the cakes, rendering the cakes dry eating.

### **Baking powder**

Lack of baking powder will produce cakes having less volume and flat on top. Due to lack of volume, there will be poor heat penetration which will result in light coloured, tough, thin and sticky crust. As there is not enough heat penetration, grain will be like solid unbaked mass.

Excessive baking powder will produce excessive gas during baking. Volume will increase initially but as the crumb becomes over extended, it will not be able to hold gas and will collapse. Due to higher pH and good heat penetration, there will be more caramelization of sugar giving a dark coloured, very tender and dry crust. Grain will be very open and coarse. Texture will be very crumbly due to excessive evaporation of moisture and weakening of structure. Excessive baking powder will cause the fruits to sink in the fruit cake.

### **pH:**

pH of cake batter should be about 6.5. Higher pH weakens the proteins resulting in collapse of cakes. There will be excessive caramelization of sugar as well as browning reaction in the presence of higher pH resulting in dark and flaky crust. Grain will be open and coarse due to weakened protein. Cake will have a soapy taste and aroma due to saponification. Higher pH will also encourage bacterial spoilage of cakes. Low pH will give lack of volume to cakes. Due to lack of heat penetration and low pH, crust will be light coloured and sticky to touch. Texture will be almost smooth. Cake will have a bland aroma.

## **Batter temperature**

A cake batter should have a temperature of approximately 72 deg.F in order to have best results. At low temperature, shortening will be rendered too hard for creaming, resulting in lack of aeration in the batter and consequent lack of rise in the oven. Crust will be thin, light coloured and moist. Grain will be coarse and tough due to insufficient aeration. Higher-temperature of batter will cause much loss of gas from baking powder during bench operation resulting in small volumed and flat appearing cakes. In this case also the crust 'lOt be able to hold aeration resulting in a close and compact grain.

## **Improper amount of moisture in the formula:**

Insufficient amount of moisture in the formula will considerably reduce the stretchability of flour proteins and cakes will collapse in the oven. Crust will be dark, thick, dry and tender. Grain will be coarse and texture will be dry and rough. Excessive moisture will weaken the structure reducing its gas retention power. Cakes will have small volume and flat top. Crust will be light coloured, thin, tough and moist. Grain will be very close and compact. Texture will be very moist, smooth and prone to fungus infestation.

## **4. Operational mistakes**

1. Flour, baking powder and any other dry ingredients should be sifted sufficiently in order to ensure even blending. Uneven blending will result in substandard shape and texture.
2. While creaming fat and sugar, all the sugar should not be added to fat at a time. Gradual addition of sugar in small portions will ensure better and faster aeration.
3. Creaming operation should be carried out till the mixture is light and fluffy. Lack of aeration during creaming operation will adversely affect almost all the characteristics of cake. Similarly, excessive aeration (during creaming operation) will break down the cream resulting in loss of aeration.
4. Eggs should be added to the cream gradually in small portions. When one portion is completely amalgamated in the cream, then only the next portion should be added. If too much egg is added at a time or subsequent portions of egg added too quickly, the batter will curdle and aeration will be lost. The resultant cake will have small volume, coarse and crumbly texture and be added at a time.
5. While mixing flour in the cream, mixing operation should be carried out efficiently so that undesirable gluten development does not take place. Over mixing will develop gluten rendering the cakes having small volume with peak in the center and an unsightly crack. Texture will be compact with holes and tunnels. Under-mixing of batter will impart uneven texture to cakes. It is advisable to add flour in two or three small portions rather than all the flour at a time.
6. While flour is being added, the (formula) liquid should also be added simultaneously. If there is lack of liquid content during mixing of flour, gluten development will take place resulting in poor quality cakes.
7. A fruit cake batter should not be aerated too much and should be sufficiently stiff to support the weight of fruits. Too much aeration or too soft a batter will cause the fruits to sink in the batter during baking.
8. When the batter is ready, it should be stirred gently in order to break any large air pockets which might have been formed during mixing. While weighing the batter into moulds, care should be taken to avoid entrapping air pockets. Large air pockets entrapped in the batter will cause holes and tunnels in the cakes.
9. Soon as the batter is weighed into the moulds, it should be loaded into the oven immediately. If the moulds are left out for any appreciable length of time, there will be undue loss of gas which in turn will adversely affect the qualities of cake. There will be loss of moisture from the top surface which will render the top crust dry, too dark and possibly having sugar spots.
10. When the cakes are in the oven, these should not be moved unless the structure of cake is set. During the initial stage of baking the batter is in a very delicate condition. Any movement in this condition will result in collapse of cakes.
11. Scrapings from the bowl should be evenly mixed with the batter or it can be used with the next mix. Scrapped batter put on top of batter in the mould will produce unsightly streaks.
12. Normally cake batter will produce enough water vapour in the oven so as to enable the cakes to have a slow and gradual rise. Crust will be dry and will peel off. Crust will also develop an unsightly crack. In such situation it is advisable to put some water in the oven at least 15 minutes prior to baking .. High humidity in the oven will not allow normal bake off of moisture from the cake which will render the cake prone to fungus infection. Crust will be light coloured because steam will act as an insulator.
13. Presently, most of the bakers produce cakes by All-in-one process. In this case also it is highly recommendable that the ingredients are added in a particular sequence only. This becomes necessary because the ingredients which are available may not be in right condition (For example sugar may have too large a grain which may not dissolve during normal mixing time or fat may be too hard and may not break up and mix thoroughly) or the cake mixer may not be very efficient to produce the right kind of batter within normal mixing operation.

