Chemically Leavened Products

Definition

Chemical leavening is the combination of sodium bicarbonate (baking soda) and acidic agents with water to generate carbon dioxide gas in controlled volumes and rates. Ammonium bicarbonate or potassium bicarbonate may be used instead of sodium bicarbonate for some applications.

Functions

Chemical leavening is an acid + base reaction which results in water, carbon dioxide gas. Chemical leavening is used to aerate the dough or batter rendering it light and porous. The bubbles created by the leavening expand during baking creating the baked product's crumb structure. Chemical leavening will affect a cake's pH, which also influences the cake's crumb color. For example, lowering a cake's pH will result in a whiter crumb color for a white layer cake.

Applications

For cake use, chemical leavening will be pre-blended with the flour and any other dry, minor ingredients. This blend is added in the final stages of mixing to the cake batter. Chemical leavening will begin to react upon hydration; therefore, timing and the choice of leavening is key to proper cake aeration and gas retention. **Leavening will be 0.5 – 1.5% of the cake formulation.** In cookies, leavening follows a similar mixing methods as cake products, although the usage level will be lower, <1%.

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Many bakery products depend on the evolution of gas from added chemical reactants as their leavening source. Items produced by this system include layer cakes, cookies, muffins, biscuits, corn bread, and some doughnuts. The gluten proteins of the flour serve as the basic structural element in chemically leavened foods, just as they do in bread. The relatively smaller amounts of flour, the weaker (less-extensible) protein in the soft-wheat flours customarily employed, and the lower protein content of the flour, however, result in a softer, crumblier texture. In most chemically leavened foods, the protein content of the flour, inadequate in quantity and quality to support the amount of expansion required in bread, produces a product of higher density.

1. **Hot Breads**

Hot breads, such as biscuits, muffins, pancakes, and scones, constitute a large and important class of chemically leavened bakery foods. They consist of flour, baking powder, salt, and
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liquid, with varying amounts of eggs, milk, sugar, and shortening. Other variations include the addition of fruits such as raisins, condiments such as peppers, and adjuncts such as cheese. In corn breads a considerable proportion of the flour is replaced by cornmeal. Mixing and forming methods, and the baking conditions applied, also affect product appearance, texture, and flavour. For example, a batter suitable for making corn bread might also be used to make muffins or pancakes, and each kind of finished product would vary not only in appearance but also in flavour and texture. Recipes for hot breads usually contain not more than about 15 percent shortening and 5 percent sugar. Eggs, when used, are customarily whole eggs. Milk is often used both for flavour and for its texturizing and crust-coloration properties.

Cakes

There are traditional rules for assuring “formula balance,” or the correct proportioning of ingredients, in layer cakes. For every 10 parts of flour, yellow layer cakes should contain 10 to 16 parts sugar by weight, and white layer cakes should contain 11 to 16 parts sugar. Shortening should range from 3 to 7 parts for each 10 parts of flour. The weight of liquid whole eggs should equal or exceed that of the shortening in the mixture. Total water, including the moisture in eggs and milk, should exceed the amount of sugar by 2 1/2 to 3 1/2 parts. Baking-powder weight should equal from 3 to 6 percent of flour weight; salt should equal 3 to 4 percent of flour weight. If the amount of sugar in a formula is increased, the egg content should be increased an equal amount, and more shortening should be added when the percentage of eggs is increased. Additional water is rarely added when the formula contains dry milk, but if the formula water is not sufficient to equal the reconstitution water for the milk, about 1 percent of water for each additional percent of milk solids is added.

Common cake varieties include white cake, similar in formula to yellow cake, except that the white cake uses egg whites instead of whole eggs; devil’s food cake, differing from chocolate cake chiefly in that the devil’s food batter is adjusted to an alkaline level with sodium bicarbonate; chiffon cakes, deriving their unique texture from the effect of liquid shortening on the foam structure; and gingerbread, similar to yellow cake but containing large amounts of molasses and spices.

Cookies

Recipes for cookies (called biscuits or sweet biscuits in some countries) are probably more variable than those for any other type of bakery product. Some layer-cake batters can be used for soft drop cookies, but most cookie formulas contain considerably less water than cake recipes, and cookies are baked to a lower moisture content than any normal cake. With the
exception of soft types, the moisture content of cookies will be below 5 percent after baking, resulting in crisp texture and good storage stability.

Cookies are generally high in shortening and sugar. Milk and eggs are not common ingredients in commercial cookies but may be used in home recipes. Sugar granule size has a pronounced effect on cookie texture, influencing spread and expansion during baking, an effect partly caused by competition for the limited water content between the slowly dissolving sugar and the gluten of the flour.

1) Quick Breads

Baked products that can be prepared in a short amount of time. Examples: biscuits, muffins/banana bread, pancakes, and waffles.

2) Batter-Type Quick Breads

Range in consistency from thin liquids to stiff liquids...Pancakes vs. Biscuits. Pour batters (Thin)=Large amount of liquid, small amount of flour. Example: Pancakes.

Drop batters (Stiff) =High proportion of flour; get dropped from a spoon onto pan. Examples: Drop biscuits, banana bread, some muffins.

3) Dough-Type Quick Breads

Have a higher proportion of flour than stiff batters. Stiff enough to shape by hand.

Soft dough

Example: Shortcakes, rolled biscuits.

Stiff dough

Example: Rolled cookies (sugar), pastry/pie crust.
Ingredients & Functions

i. Flour
   - Gives structure to baked products.
   - Mostly use all-purpose flour.

ii. Leavening Agents
   - Ingredients that produce gases in batters and doughs.
   - Make baked products rise and become light and porous.
   - Chemical reaction during baking cause these ingredients to release carbon dioxide gas.

iii. Baking Soda (Sodium Bicarbonate)
   - An alkaline ingredient…can produce a bitter taste if not neutralized by an acid ingredient in the recipe.
   - Acid Ingredients: Buttermilk, honey, molasses, brown sugar, vinegar, applesauce or other fruit, and citrus juices, (baking powder).

iv. Baking Powder
   - Contains a dry acid or acid salt, baking soda, and starch or flour.
   - Using too much =produce too much gas and product will collapse.
   - Using too little =not enough gas produces so product will be small and compact.

v. Leavening Agents
   - Two gases that make baked products rise.
   - **Steam:** Produced when liquid ingredients reach high temperatures during baking.
   - **Air:** Incorporated into baked products by beating eggs, creaming fat and sugar together, folding doughs, and beating batters.
   - All baked products contain some air.

vi. Liquids
   - Water, milk, fruit juices, eggs, & fat.
   - Hydrate (cause to absorb liquid) the protein and starch in flour.
   - Proteins must absorb liquid to later form gluten.
   - Starches must absorb liquid to gelatinize during baking.
   - Helps to moisten or dissolve ingredients such as baking powder, salt, and sugar.
   - Converted to steam during baking.
vii.  **Fat**
- Butter/Margarine, shortening, oil.
- Tenderizes the baked product.
- Fat coats the flour particles and causes the dough structure to separate into layers.
- Aids in leavening.
- When you beat fat, air bubbles form.
- Fat traps these air bubbles and holds them.

viii. **Eggs**
- When beaten, they help incorporate air into baked products.
- Add color.
- Add flavor.
- Contribute to the structure.
- During baking, the egg proteins coagulate (go from liquid state to solid state) giving the batter or dough elasticity and structure.

ix.  **Sugar**
- Gives sweetness to baked products.
- Has a tenderizing effect.
- Helps crusts brown.
- Using brown sugar produces baked products that are moister than products made with granulated sugar (table sugar).

x.  **Salt**
- Adds flavor.

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**Food Science Principle of Preparing**
- Development of gluten.
  - A protein that gives strength and elasticity to batters and doughs and structure to baked products.
  - Holds the leavening gases to help baked product rise.
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- Made up of proteins gliadin and glutenin, found in wheat flour.
- When you combine wheat flour with liquid and stir or knead the mixture, the glutenin and gliadin form gluten.
  - Chemical reactions that produce leavening gases.
- Baking soda an alkali, combined with an acid ingredient releases carbon dioxide.
- Most baking powders are double-acting.
- Release some carbon dioxide when moistened (by liquid ingredient).
- Release most carbon dioxide when heated (oven).
  - Biscuit Method
    - Sift dry ingredients together in mixing bowl.
    - Use pastry blender (or two knives) to cut in fat into dry mixture until particles are size of coarse cornmeal.
    - Add liquid all at once; stir until dough forms a ball.
    - Use when making biscuits and pastry.

Kneading dough
- Press dough down with palms, fold dough in half, then give dough a quarter turn.
- 8 to 10 times; then roll or pat into a circle.
- Cut dough with a biscuit cutter; place on ungreased baking sheet.
- You will knead the dough for rolled biscuits.

Characteristics of Biscuits
- High-quality rolled biscuit will have an even shape with a smooth, level top and straight sides.
- Crust will be an even brown.
- When broke open, the crumb or soft interior, is white to creamy white.
- It is moist and fluffy and peels off in layers.
- If under-mixed= Low volume; rough, rounded top.
- If over-mixed= Low volume; smooth, rounded top.

Muffin Mixing Method
- Measure dry ingredients into mixing bowl.
- Make a well (hole) in center of dry ingredients.
- In separate bowl, combine beaten eggs with all other liquid ingredients.
- Pour liquid ingredients in center of well of dry ingredients.
- Stir just until the dry ingredients are moistened; grease pan to prevent sticking.
• Use for muffins, waffles, pancakes, and some coffee cakes and breads.

**Characteristics of Muffins**

• High-quality muffin has a thin, evenly browned crust.
• Top is symmetrical, but looks rough.
• When broken apart, texture is uniform and crumb is tender and light.
• If under-mixed = Low volume; flat top with coarse crumb.
• If over-mixed = Peaked top; pale, slick crust. When broken apart, narrow, open areas called tunnels are visible.
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