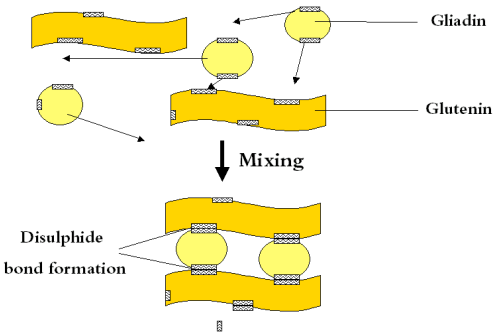
# GLUTEN

Gluten is a composite formed from several different proteins. It is found most commonly in wheat and other related grains, such as barley and rye. Adding texture and a characteristic chewiness to baked goods, this ingredient is used in a wide variety of other foods as a thickener and binder, flavor enhancer, and protein supplement. Some people can develop an intolerance to these proteins, however; a gluten-free diet often helps to alleviate symptoms caused by this intolerance and prevents further damage to the body.




What people call gluten is the formation of linkages between glutenin and gliadin. Most of the protein in wheat — 80% — is made up of the gliadin and glutenin. The "development" of dough consists of the formation of these bonds. These proteins have SH groups on them than can be linked into S-S groups. Kneading develops gluten by stretching out the proteins & increases the rate at which the reaction occurs. Kneading also forms an ordered cohesive mass. The reaction remains essentially, a chemical reaction. When these molecules are joined together, they stretch and harden, allowing dough to form a light, airy loaf with a chewy texture. As a result, these proteins are commonly found in flour and other baking products.

Used as a thickener, gluten can be found in soups and broths, as well as gravies and sauces such as ketchup, salad dressings, or marinades. Since it enhances flavor, it is used in bouillon, spice blends, and other foods such as coffees, dairy products, vinegars, and liquors. It can also be found in the substance used to seal envelopes since it acts as a stabilizer.

## Function in Bread

Kneading dough creates the strands that help the gliadin and glutenin molecules to join or cross-link. The more the dough is kneaded, the more links are developed and the chewier the final product becomes. In addition, the proteins thicken when heated, trapping the carbon dioxide produced by yeast. This enables baked goods to rise more and retain their shape instead of crumbling.

The amount of gluten added to the flour can have an impact on the texture of the final product. Bread flour needs more of these proteins to produce a loaf that isn't too dense or crumbly, while pastry flour — which should be flaky instead of chewy — has less.

# Leavening

Leavening is that which gives breads, cakes, muffins, pancakes, cookies, and so forth the ability to rise and increase in volume. Even crakers and pie crusts benefit from leavening to make them flaky. Leavening can occur mainly during cooking, such as for pie crusts. In other cases most of the leavening happens prior to baking, as with many yeast breads, or more often, leavening may occur partially before and partially when the product is heated. The type of leavening used may depend on the product, for example whether it's a batter or a dough. But no matter what, the idea behind leavening is that something (water or a gas) has to EXPAND for rising to occur.

Several types of leavening agents can be combined to give the maximum amount of lift to the product. For example, a recipe might require sugar and butter to be creamed, representing one type of leavening (air), and call for baking powder as well, which is another type of leavening (carbon dioxide).

**STEAM** When water is heated, steam is produced. The water molecules turn to gas and take up a greater volume than when the water is liquid. Since water is in most foods, especially liquid batters, steam will be produced when the foods are heated. Steam is the leavening agent in popovers, eclairs, and cream puffs, which firm up quickly enough to take advantage of the volume provided by the steam. Steam leavening is present but less obvious in pie crusts where it provides the lift to separate layers and make the crust flaky. However, there is so little water and the nature of the dough is such that you don't get the same volume with pie crust as you do with popovers.

**AIR** Air is important for many foods since when the product is heated air expands to take up greater volume. Beating of a batter or egg whites, creaming of butter and sugar, incorporates air which will help the product rise when the heating begins and the air bubbles expand. The amount of beating has to be sufficient to incorporate enough air yet overbeating will often cause the air to be lost. Air may be the major, if not only, leavening agent in pound cakes and angel food cakes.

**CARBON DIOXIDE ($CO_2$):** Carbon dioxide is an important leavening agent for most baked goods. Like air, carbon dioxide is a gas that expands when heated. However, carbon dioxide is different than air in that it is generated from within the product rather than being incorporated in by beating. The creation of the gas bubbles itself is enough to provide quite a bit of leavening action. This is apparent with yeast breads, for which it is the yeast that is added to the batter or dough and the carbon dioxide is a waste product of yeast metabolism. As the yeast go to work, the carbon dioxide produced causes the bread to rise. More rising occurs in the oven when the bread, and hence the carbon dioxide gas bubbles, is heated.

Carbon dioxide can also be produced in a product by chemical means. Sodium bicarbonate (in baking soda or baking powder) can combine with an acid to release carbon dioxide when the wet and dry ingredients of a recipe are mixed.

## Baking Soda

Baking soda is pure sodium bicarbonate. When baking soda is combined with moisture and an acidic ingredient (e.g., yogurt, chocolate, buttermilk, honey), the resulting chemical reaction produces bubbles of carbon dioxide that expand under oven temperatures, causing baked goods to rise. The reaction begins immediately upon mixing the ingredients, so you need to bake recipes which call for baking soda immediately, or else they will fall flat! Other acidic compounds that induce this reaction include phosphates, cream of tartar, lemon juice, yogurt, buttermilk, cocoa, vinegar, etc.

Sodium bicarbonate was sometimes used in cooking vegetables, to make them softer, although this has gone out of fashion, as most people now prefer firmer vegetables that contain more nutrients. However, it is still used in Asian cuisine to tenderise meats. Baking soda may react with acids in food, including Vitamin C. It is also used in breadings such as for fried foods to enhance crispness.

Heat causes sodium bicarbonate to act as a raising agent by releasing carbon dioxide when used in baking. The carbon dioxide production starts at temperatures above 80 °C. Since the reaction does not occur at room temperature, mixtures (cake batter, etc.) can be allowed to stand without rising until they are heated in the oven.

The reaction is:

$2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

## Baking Powder

Baking powder contains sodium bicarbonate, but it includes the acidifying agent already (cream of tartar), and also a drying agent (usually starch). Baking powder is available as single-acting baking powder and as double-acting baking powder. Single-acting powders are activated by moisture, so you must bake recipes which include this product immediately after mixing. Double-acting powders react in two phases and can stand for a while before baking. With double-acting powder, some gas is released at room temperature when the powder is added to dough, but the majority of the gas is released after the temperature of the dough increases in the oven.

Yeasts are single-celled fungi. As fungi, they are related to the other fungi that people are more familiar with. These include edible mushrooms available at the supermarket, common baker's yeast used to leaven bread, molds that ripen blue cheese and the molds that produce antibiotics for medical and veterinary use. Many consider edible yeast and fungi to be as natural as fruits and vegetables. In the production of baked goods, yeast is a key ingredient and serves three primary functions:

***Production of carbon dioxide***:

Carbon dioxide is generated by the yeast as a result of the breakdown of fermentable sugars in the dough. The evolution of carbon dioxide causes expansion of the dough as it is trapped within the protein matrix of the dough.

***Development of fermentation flavor***:

Yeast imparts the characteristic flavor of bread and other yeast leavened products. During dough fermentation, yeast produce many secondary metabolites such as ketones, higher alcohols, organic acids, aldehydes and esters. Some of these, alcohols for example, escape during baking. Others react with each other and with other compounds found in the dough to form new and more complex flavor compounds. These reactions occur primarily in the crust and the resultant flavor diffuses into the crumb of the baked bread.

Functions of various ingredients:

FLOUR: Flour gives the muffins or cakes it's volume and structure. The flour browns during the baking process so the finished produce will usually have a golden brown colour. Its also high in starch which is the most important carbohydrate in the human diet.

SALT: Salt has several functions in baked goods:

- It contributes to overall flavor.
- In bread, it controls the fermentation rate of yeast.
- It has a strengthening effect on the gluten protein in the dough.

Without salt, bread rises faster and air pockets enlarge where the gluten has broken, allowing holes to form. Bread made without salt will taste bland. If you choose to eliminate salt, decrease the proofing time so that the large air pockets don't have time to develop. Salt should not be eliminated from recipes using automatic bread-making machines.

SUGAR: Sugar has many functions in food other than providing sweetness. In small amounts, added sugar helps yeast begin producing gas for raising yeast dough. Sugar in large amounts slows yeast fermentation; in a very sweet dough the rising time is longer. Moisture is retained better in sweetened breads than in unsweetened breads. It

is the sugar in cookie dough that causes spreading to occur during baking. Reducing the amount of sugar by more than 1/3 can cause loss of tenderness, moisture, browning, and sweetness.

FAT In baking, it tends to come in the form of solid shortening, margarine, or butter; or in the liquid form of oil contributes tenderness, moistness, and a smooth mouthfeel to baked goods. Fats enhance the flavors of other ingredients as well as contributing its own flavor, as in the case of butter. In baked goods such as muffins, reducing the amount of fat in a recipe results in a tougher product because gluten develops more freely. Another tenderizing agent such as sugar can be added or increased to tenderize in place of the fat. A small amount of fat in a yeast dough helps the gluten to stretch, yielding a loaf with greater volume.

EGGS: Eggs serve many functions in baked goods. They add flavor and color, contribute to structure, incorporate air when beaten, provide liquid, fat, and protein, and emulsify fat with liquid ingredients. Reducing or omitting egg yolks can result in less tenderness. Reducing or omitting egg whites can result in less volume. Cakes made without the emulsifying action from the egg yolk may not have a uniform flavor and texture.