

Chemistry of baking

Mixing together eggs, flour, sugar, water and other ingredients to make dough, then baking that dough in an oven, can seem like a simple yet magical process.

Protein Bonding

Flour contains two important proteins -- glutenin and gliadin. When water is added to flour to make dough, it allows these proteins to bond together and form a new protein called gluten. Kneading the dough intensifies these gluten bonds. After the dough is placed into a heated oven, it begins to rise and grow the gluten network. This network eventually hardens during the baking process, giving the inside of a loaf of bread or similar baked good its signature structure.

Maillard Reactions

Maillard reactions occur when proteins and sugars are broken down and rearranged by high temperatures. These sugars and proteins can be derived from flour by itself, or they can be enhanced with the addition of sugars and eggs. The reactions produce ring-shaped organic compounds that darken the surface of baking dough. Maillard reactions also produce toasty and savory aromas and flavor compounds. These compounds also react among each other, producing even more complex aromas and flavors.

Flavors of Caramelization

Caramelization, which occurs at 356 degrees Fahrenheit, is the last chemical reaction to occur during the baking process. The reaction occurs when high heat causes sugar molecules to break down and release water, which turns into steam. Diacetyl, which gives caramel its butterscotch flavor, is produced during the first stages of caramelization. Next, esters and lactones, which have a rum-like flavor, are produced. Finally, the production of furan molecules imparts a nutty flavor, and a molecule called maltol imparts a toasty flavor.