Variation in ingredient ratios

Baked goods are unique in that a small number of ingredients (viz., flour, butter, egg, sugar, milk, and salt) are found in most recipes. This allows subcategories of baked goods, like cakes and breads, to be compared by the mass ratios of ingredients to shed light on how recipe modifications can affect the final product. For example, adding an extra egg to a brownie recipe shifts the ratios closer to those of cake, and as expected, this modification tends to make brownies more cake-like.

Common sources of elasticity in baked goods

Gluten

Upon addition of water, glutenin proteins begin forming bonds with one another, ultimately forming an elastic network. Time, greater hydration, and kneading all promote additional glutenin bond formation. The glutenin network cannot form through sheets of fat (e.g., as introduced into pie crusts by fraisage). Bread flour contains more glutenin than all-purpose, which in turn contains more than cake flour.

Egg proteins

At temperatures in the range of 60-70°C, egg proteins denature, exposing previously-buried hydrophobic regions. These hydrophobic regions can become involved in intermolecular crosslinks, producing a gel that increases the baked good's elasticity.

Starch granules

Starch granules are composed of concentric rings of densely-packed, anhydrous starch. When hydrated in warm water, starch granules expand dramatically; this allows them to reach very high volume fractions that increase the viscosity or elasticity of baked goods.

Leavening methods

Physical introduction of air bubbles

Air bubbles can be introduced by whipping (often with egg whites or cream) or creaming butter and sugar together to create air pockets. These foams can be stabilized by adding surfactants or with high-viscosity batter which impedes the rising or coalescence of bubbles.

Chemical leaveners

Baking soda (sodium bicarbonate, $NaHCO_3$) is a base that releases carbon dioxide gas when it reacts with an acid. The acid may be provided naturally by ingredients like brown sugar, buttermilk, vinegar, or cocoa. Baking powder contains both baking soda and cream of tartar (tartaric acid, $C_4H_6O_6$) at a 1:1 molar ratio to ensure reaction when no other acids are present. Unreacted bases like baking soda promote Maillard reactions: this is why pretzels and some bagels are dipped in lye (NaOH) before baking. The reaction of baking soda and vinegar is our equation of the week:

$$NaHCO_3 + HC_2H_3O_2 \rightarrow NaC_2H_3O_2 + H_2O + CO_2$$

The CO_2 gas produced can often remain fully dissolved in the water-based batter initially (which explains why no bubbles are immediately apparent). However, the solubility of gas in water decreases with temperature, causing gas bubbles to form throughout the batter during cooking.

Production of steam

Many ingredients commonly founded in baked goods contain some water, including butter, eggs, and dairy products. At the boiling point, the density of H_2O suddenly switches from ≈55 mol/L (water) to 0.05 mol/L (steam): even moderate evaporation can thus generate a large volume of gas.

Microbial action

Baker's yeast, lactic acid bacteria (used in sourdough), and many other microbes generate carbon dioxide as they consume sugar.