

How Baking Soda Works

By Stella Parks

From the [Stella Parks on Cookie Science](#) series.

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Baking soda is the most basic leavening agent, and a cornerstone of American desserts. Chemical leavening agents were known even in ancient times, but it wasn't until the mid-19th century, when pure sodium bicarbonate from brands like Arm & Hammer became commercially available, that their popularity in baking really took off. Instead of relying on the lengthy process of biological leavening, used for yeasted breads and cakes, American home cooks turned their attention to the chemically leavened quick breads, muffins, and drop cookies that came to the table in a fraction of the time.

Most of us grasp sodium bicarbonate's role in these treats thanks to elementary school experiments involving papier-mâché volcanoes—something about baking soda plus vinegar making things go boom. (More technically, the alkaline baking soda reacts with the acidic vinegar to create water and carbon dioxide...but we know that's not really what those volcanoes were all about.) That's true enough, but it's a little more complicated when it comes to cookies. Air, Apparent

Cake batters can take advantage of buttermilk, yogurt, coffee, and other acidic liquids to react with sodium bicarbonate—but because the reaction starts immediately, you have to get your cake batter in the oven right away, before you lose all those little air bubbles. Cookie dough, on the other hand, typically gets its acidity from dry ingredients, like brown sugar or natural cocoa powder. That's part of the reason it keeps so well in the fridge—the acid and alkali don't truly mix until the butter melts, which means the reaction doesn't really start until you've put the cookies in the oven.

Once they start baking, carbon dioxide begins to filter through the dough, gently expanding any air cells trapped inside and holding the dough aloft. That last bit's an important detail, because without pre-existing pockets of air, the carbon dioxide would simply tunnel up and out, like the chain of bubbles in a flute of champagne. When the cookie sets, the carbon dioxide's footprint is preserved in the crumb.

Most cookie doughs rely on creaming the butter and sugar to beat those initial micro pockets of air into the dough, though some weirdos people opt for whipped eggs instead. Even particularly coarse or porous ingredients, like whole-wheat flour or rolled oats, can smuggle a good deal of air into the mix, so there's no need to throw shade at recipes that don't include any obvious aeration step to help baking soda raise the dough. Alkali Makes All the Difference

But leavening isn't sodium bicarbonate's only job. It also raises the dough's pH, and that's a pretty big deal. Creating an alkaline environment slows protein coagulation, which gives the dough more time to spread before the eggs set. This promotes a uniform thickness from edge to center, helping the cookies bake more evenly. What's more, alkalinity weakens gluten, keeping cookies tender, and even speeds the Maillard reaction so that deeper flavors and colors develop in a shorter amount of time.

I'm hooked on these off-label applications. For example, my gingersnap recipe calls for only baking soda, no baking powder, and it's a perfect illustration of how powerfully baking soda can impact a cookie, even when used in modest amounts. In my totally unbiased opinion, it improves the gingersnaps across the board.

Without any baking soda at all, the acidic gingersnap dough will absorb its sugar coating. The cookies turn out porous, cakey, and horrifically bland, like a sip of water when you're expecting Sprite.

A single pinch of baking soda is all it takes to get a little spread. The gingersnaps are still pretty cakey, but now they're crisp around the outer edges. The flavor falls a little flat, but it's a dramatic improvement over the last batch.

Jump up to a quarter teaspoon of baking soda, and the gingersnaps are crunchy through and through. A pleasant toastiness adds dimension to the ginger, though there's still something under-seasoned about it. If I didn't know any better, I'd think it needed salt.

A half teaspoon is love at first sight—look at those gorgeous cracks! The cookies are explosively crisp, their ginger flavor mellowed by a malty, rich complexity that seems more butterscotch than molasses.

At three-quarters of a teaspoon of baking soda, the cookie's texture becomes fragile like that of a soda cracker, with a deeply roasted flavor that distracts from the ginger. It might be someone else's favorite gingersnap, but not mine.

Hitting a full teaspoon, the gingersnaps are crisp but not snappy. Crumbly, maybe? And the nuance is gone; no warm ginger, no earthy molasses, just an overwhelming sense of burnt toast and sadness.

Given how quickly baking soda can take a cookie from “wow” to “tastes like burning,” it pays to be cautious about going rogue. I don't ever recommend changing the chemistry of a recipe you've never tried before, but if there's some family favorite you're always tinkering with, a careful adjustment of sodium bicarbonate can be a revelation.

When you're stymied by cookies that brown or burn too quickly, try dialing down the baking soda by a quarter teaspoon. Conversely, if your cookies seem too thick and cakey or disappointingly pale, increase the baking soda by as little as an eighth of a teaspoon for every three ounces of flour (85 grams, or two-thirds of a cup) to nudge things in the right direction.

Baking soda can work as a flavor enhancer, to be sure, but when cookies taste bland, it's smart to investigate the salt; most recipes are criminally under-salted. (I think most cookies need a quarter teaspoon of kosher salt for every eight ounces of sugar, less if there are bitter or sodium-rich ingredients like cocoa or molasses.) If the sodium levels look good, an additional eighth of a teaspoon of baking soda may coax out a little more complexity. *A Good Baking Soda Is Not Hard to Find*

Since baking soda is what it is, it doesn't matter what brand you choose. And regardless of the date stamped on the container, there's little risk that baking soda will ever truly expire. The internet loves to question its “freshness” when cakes and cookies fall flat, but that's the least likely of all possible explanations, including alien abduction.

Sodium bicarbonate can't just spontaneously decompose. In order to react without an acid, baking soda has to be warmed above 122°F, or subjected to long-term heat and humidity at levels no American household could sustain. A study conducted by Baxter Healthcare found that an open container of sodium bicarbonate, kept at 104°F and 75% relative humidity, showed only slight decomposition after three months of continuous exposure. I'm not sure how rough things get in your pantry, but so long as it's vaguely better than that, you should be fine.

At or below 77°F and 75% relative humidity, baking soda will keep indefinitely even when you unceremoniously tear the box right open. If science in action would reassure you, test your baking

soda's viability before using it by putting a tablespoon in the bottom of a drinking glass, then splashing in a tablespoon of vinegar. It'll foam up faster than you can say "volcanic gingersnaps"!

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