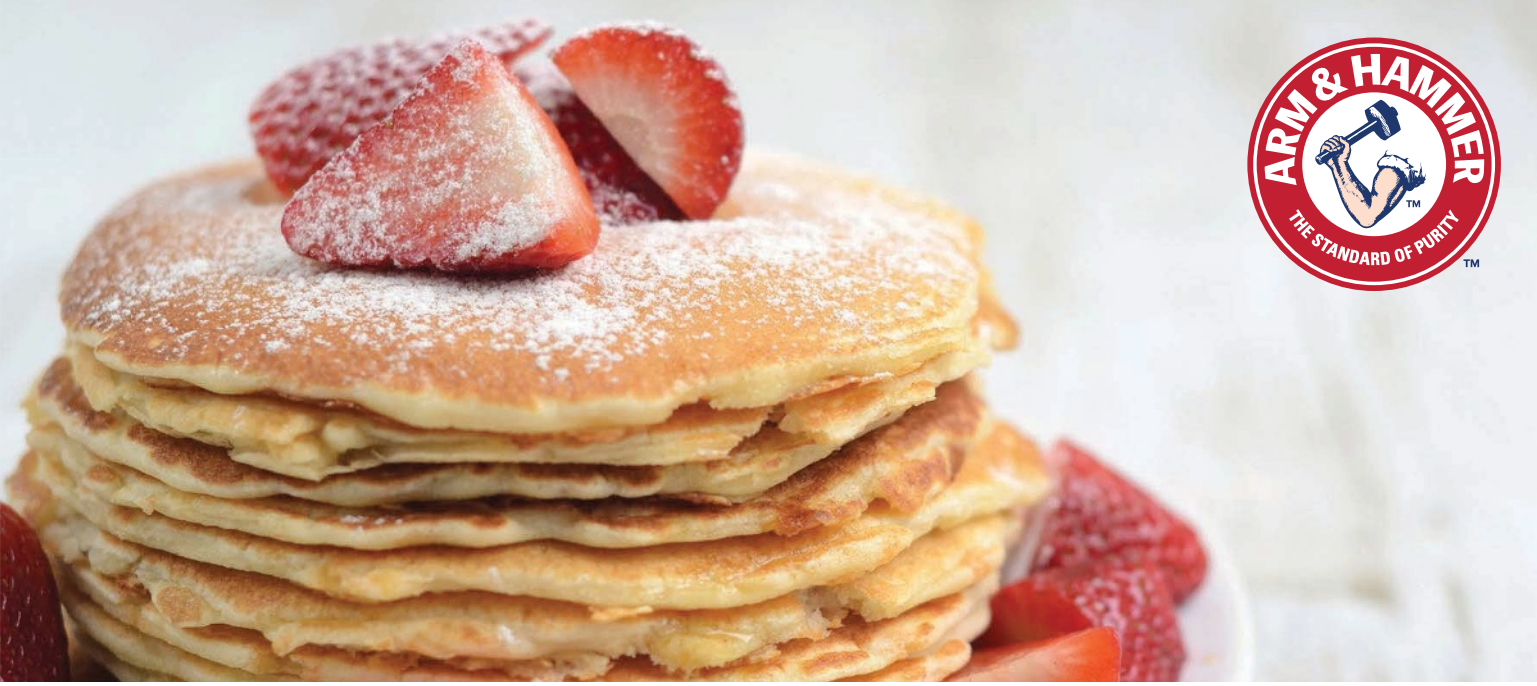


baking with LESS SODIUM

Shoppers crave information. They want to know where their food comes from and how it was made. They read labels and often make purchase decisions based on nutrition profiles.

Sodium content, in particular, can be a deal breaker, with levels that are too high deterring purchase. This is because today's consumers understand the important role food choices play in their health, yet still struggle to make changes to improve their food selection.

For many, choosing foods with less sodium is one approach. In fact, more than half of U.S. consumers report that they compare sodium contents in foods such as soup, bread and frozen meals, according to the 2017 Food & Health Survey from the International Food Information Council Foundation.

Supporting this figure is the impressive 67% of shoppers who said they generally read food labels to see what is in the foods they buy, with more than half (53%) saying that the salt/sodium content of foods concerns them, according to the 2016 Shopping for Health Report, compiled by The Food Marketing Institute and Rodale. One-third of the consumers surveyed report they are buying more foods that are lower in sodium, as compared to the previous year.

Consumers typically understand that sodium is vital to human life. In fact, the body needs relatively large amounts of sodium to properly operate. Sodium is involved with nerve and muscle function, fluid balance and blood pressure. Without sodium, the body shuts down; however, this is seldom a concern, as most Americans consume too much sodium.

The 2015-2020 Dietary Guidelines for Americans advise keeping sodium intake under 2,300 mg per day (1,500 mg for those with hypertension), but the average daily consumption still tops 3,400 mg. This excessive amount contributes to high blood pressure, heart disease and other health problems. Science supports the relationship between sodium reduction and improved health.

Replacing sodium-containing leavening agents, namely sodium bicarbonate (baking soda), in baked goods is an important part of a baker's total sodium-reduction strategy. Arm & Hammer™ , a brand of Church & Dwight's Performance Products Group, is a leading sodium bicarbonate supplier. The company also offers two sodium-reduction options: potassium bicarbonate and ammonium bicarbonate. Read more to learn how these ingredient technology tools may help you bake with less sodium.

FORMULATING WITH
Sodium Bicarbonate Alternatives

Sodium bicarbonate's most widespread use is as a chemical leavening agent for baked goods. It releases carbon dioxide gas when reacted with an acid (another potential sodium source) under heat and in the presence of water. Bicarbonates can also release carbon dioxide gas without an acid through thermal decomposition. The gas bubbles cause batter and dough to rise, resulting in lighter biscuits, cakes, pancakes, cookies and other baked goods. Sodium bicarbonate is a key ingredient in baking powders, self-rising flours and packaged baking mixes. It is also used to develop light textures in candies such as brittles and crisps.

In efforts to keep sodium content down, bakers are learning how to work with potassium bicarbonate and ammonium bicarbonate. Both are sources of leavening gases and void of any sodium component.

"A baked food with a 100-g serving size and 1% sodium bicarbonate gets 273 mg sodium from the sodium bicarbonate," said Rob Berube, Manager, Technical Service, Church & Dwight Co., Inc. "Flow K™ potassium bicarbonate provides equivalent leavening performance without contributing sodium to the product formula."

The potassium in Flow K™ is significant, too. Potassium was named as a "nutrient of concern" by the 2015-2020 Dietary Guidelines for Americans, meaning that Americans don't get enough in their current daily diets. Potassium bicarbonate contains 39% potassium, so each gram contributes 390 mg potassium, more than 10% of the Daily Value, set at 3,500 mg by FDA in a 2013 guidance document.

"The potassium it contains is associated with positive, healthful claims for blood pressure reduction and cutting the risk of stroke," Mr. Berube said. FDA approved such health claims for potassium in 2000. "Never bitter, it can also enhance perception of sweetness in finished goods. It can be used in any formula where sodium bicarbonate is used," he added.

Using Flow K™ requires an adjustment in dosage. The molecular weight of potassium bicarbonate is 100.12 vs. 84.01 for sodium bicarbonate, or 19% higher. "Both materials release the same amount of carbon dioxide on a molar basis," Mr. Berube said. "So, to get the same amount of leavening gas, 19% more potassium bicarbonate is required."

Partial replacement is also possible, allowing greater flexibility for bakery formulators. Mr. Berube explained, "If the formulator's sodium reduction goals have largely been achieved

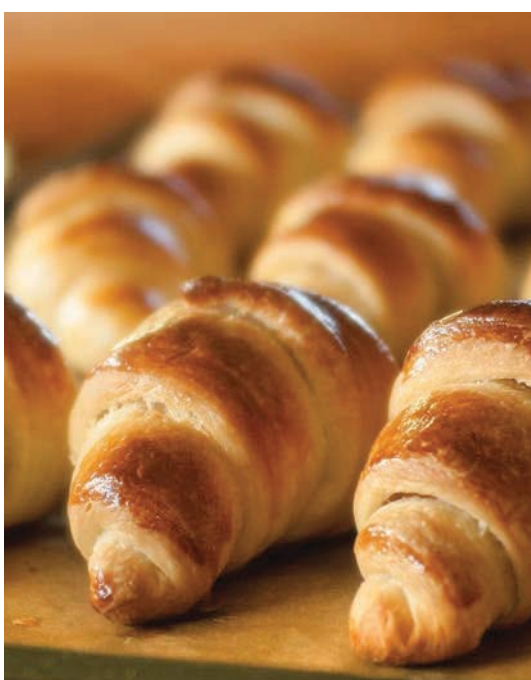
AMMONIUM BICARBONATE APPLICATIONS AND FUNCTIONS

product	function
Sprayed butter crackers	Controls color
Milk or graham crackers	Controls spread and thickness, hastens bake-out, darkens color
Semi-sweet products, such as tea biscuits	Controls spread, height and top grain
Rotary molded cookie products, such as plain, sugar, base cakes, marshmallow, cream-filled sandwiches, etc.	Controls spread, height and top grain
Wire-cut cookie products, such as chocolate chip, molasses, etc.	Controls spread, darkens color
Bars (chewy type)	Controls spread, darkens color
Eclairs and puff shells	Very open, large cell structure
Pretzels (hard, crispy types)	Improves texture

by salt reduction and conversion of leavening acids to non-sodium analogues, it may not be necessary to convert all of the sodium bicarbonate to potassium bicarbonate."

Ammonium bicarbonate is another sodium-free option. Without a leavening acid, it reacts rapidly in the presence of heat and water to release carbon dioxide and ammonia gases, both of which contribute to leavening. Used in this way, ammonium bicarbonate leaves behind no residue in baked goods, which means it functions as a processing aid and does not require declaration as an ingredient. Typical applications are cookies, crackers and biscuits.

"Bakers should note that ammonium bicarbonate use without a leavening acid is restricted to low-moisture products to limit ammonia retention," said Mr. Berube. "This is because high-moisture products such as cakes and muffins will retain some ammonia gas, yielding a baked good with an undesirable ammonia taste and odor."



how bicarbonates leaven

BAKED GOODS

THE BICARBONATE EXPERTS™

How does sodium bicarbonate leaven baked goods?

Sodium bicarbonate releases carbon dioxide gas when reacted with acid and heat in the presence of water. The bubbles cause batter and dough to rise, resulting in lighter baked goods. The sodium is retained in the baked good as a sodium salt.

$HX + NaHCO_3 \rightarrow NaX + H_20 + CO_2$

(acid salt) (sodium bicarbonate) (heat and water) (sodium salt) (water) (carbon dioxide)

How does potassium bicarbonate compare?

Potassium bicarbonate reacts very similarly to sodium bicarbonate, releasing carbon dioxide gas into the system with the baked good retaining the potassium. Potassium bicarbonate also has a similar pH to sodium bicarbonate, but requires more of the product to react completely with the acid salts.

$HX + KHCO_3 \rightarrow KX + H_20 + CO_2$

(acid salt) (potassium bicarbonate) (heat and water) (potassium salt) (water) (carbon dioxide)

Is the same true of ammonium bicarbonate?

No. When ammonium bicarbonate breaks down, it releases carbon dioxide and ammonia gases. At ambient temperature, ammonium bicarbonate will decompose slightly in a batter. With the addition of heat, it rapidly breaks down, even without the addition of an acid or a water source.

$NH_4CO_3 \rightarrow NH_3 + H_20 + CO_2$

(ammonium bicarbonate) (heat) (ammonia) (water) (carbon dioxide)

Can ammonium bicarbonate be used in all the same places as the other two bicarbonates?

No. Ammonium bicarbonate works best in cookies, crackers and low-moisture products, as these products have a porous cellular structure that allows gases to escape slowly. The special leavening action of ammonium bicarbonate contributes to several desirable characteristics in such small, porous baked goods. For example, in cookies there's increased spread of the batter. In some applications, ammonium bicarbonate assists with brown color development. It is often used in conjunction with a slower-acting leavening agent for a two-stage release of gases, as this helps with the development of uniform height and shape. In high-moisture products such as cakes and muffins, the ammonia gas does not escape completely and the taste and odor of ammonia remains.

Sodium, Potassium & Ammonium Bicarbonate Supply

ARM & HAMMER™ Performance Products is the leader in providing high-quality bicarbonate products optimized to meet customer expectations. For more than 170 years, the ARM & HAMMER™ logo has communicated our dedication to customer satisfaction – and it remains the symbol by which our quality makes itself known.

The Performance Products Group is guided by the principles of Responsible Care®, a policy on environmental sustainability and health, safety and security issues. The policy details the group's commitment to protecting the environment, ensuring the safety and safe use of products, and continually improving products and processes to minimize their impact on our communities.

For more information about **Arm & Hammer™** Performance Products, visit www.ahperformance.com.