Get the Scoop: Almond Roasting and Acrylamide Management

High-temperature cooking creates the toasted, tasty notes in our favorite foods. At the same time, certain methods of roasting specific foods can at times produce a compound called acrylamide. The Almond Board of California (ABC) has been researching acrylamide and its relationship to almonds for nearly two decades. The findings have yielded actionable parameters that processors can follow to keep this commonplace chemical in check while also keeping the safety and quality of their finished products.

We sat down with two almond experts actively involved in the work—Guangwei Huang, principal scientist, and Tim Birmingham, director of quality assurance and industry services—to understand how to manage acrylamide.

Q Let's start with the basics—what is acrylamide?

BIRMINGHAM | Acrylamide is a chemical that forms during the heating of carbohydrate-rich foods. Most acrylamide forms when the free amino acids asparagine and glutamine react with the reducing sugars glucose and fructose at temperatures above 250°F. And that's the key: You can find acrylamide in any carbohydrate-rich food—potatoes, baked goods, cereals—subjected to high-temperature cooking like roasting, baking or frying.

HUANG | The reaction that produces acrylamide is a part of the Maillard reaction, which also produces the appealing flavors, roasted notes and browned colors that develop during roasting or baking. But those same precursors and processes can also produce acrylamide.

Q Why is acrylamide a concern?

HUANG | Acrylamide is considered a probable human carcinogen at relatively high levels. But it's important to remember that this compound is a natural product of thermal processing above temperatures of 250°F—a common cooking temperature. It's existed, and we've consumed it for many years, but a turning point in regard to awareness occurred in 2002 when researchers in Sweden released a study identifying acrylamide in starchy foods like potato chips, French fries and bread cooked above 250°F.

Q Where do almonds fit into the story?

HUANG | Almonds contain relatively good levels of protein and amino acids including free asparagine and glutamine and reducing sugars glucose and fructose. Almonds are also frequently roasted to temperatures that produce desirable Maillard reaction compounds and, at the same time, acrylamide. Natural (non-roasted) and blanched almonds, and the products made with them, haven't undergone the kind of high-temperature roasting that would produce acrylamide.

Q How much acrylamide do we find in almonds processed this way?

HUANG | Acrylamide levels vary with the roasting temperature. The roasting temperature is a very important dictating parameter because the relationship between temperature increase and acrylamide generation is exponential, not linear. However, acrylamide levels in roasted almonds are relatively low, and daily exposure is safe.

Q How do acrylamide levels in roasted almonds compare to those in other foods?

HUANG | We detect acrylamide using high-performance liquid chromatography, and we measure it in parts per billion, or ppb. These are levels on the order of micrograms per kilogram, so it's very minute.

According to an FDA survey of common food sources, almonds' acrylamide levels can run anywhere from 50 to 700 ppb. By contrast, potato chips and French fries commonly come in at over 1,000 or 2,000 ppb.[1] Interestingly, coffee has a low level of acrylamide, but high rates of consumption mean that dietary exposure from coffee can be much higher than with almonds.

Q What does ABC's research say about methods to lessen acrylamide production?

HUANG | After acrylamide issues came to the surface in 2002, ABC funded several projects to better understand acrylamide generation in roasted almonds. We looked at the precursor levels and how roasting temperature and time affect acrylamide formation. We learned that if we roast almonds at temperatures below 280°F, we can mitigate resulting acrylamide levels.

BIRMINGHAM | You can learn more about almond roasting and best practices on our website, www.almonds.com/food-professionals.

Q If almond processors follow these recommendations, how will that affect other quality aspects of their finished products?

HUANG | You can generate great roasting flavors in almonds even below 280°F. And by roasting at more moderate temperatures, you also preserve the finished product's oxidative stability and shelf life potential, because both are compromised by extreme thermal processing. That said, if a processor wants to use roasting as a pathogen-control procedure, roasting at lower temperatures could be a concern.

BIRMINGHAM | From a pasteurization standpoint, we like higher roast temperatures and longer roast times, whether you're dry or oil roasting, to get the Salmonella kill that's required. Unfortunately, at these kill-step temperatures, you've got competing interests between microbial control and acrylamide formation.

Q So what do we do?

BIRMINGHAM | If you're dry-roast processing, you can pre-pasteurize your product using a process such as steam, moist heat or PPO—propylene oxide pasteurization. Then you can roast at a lower temperature. For oil roasting, the temperatures typically used do provide a good control on pathogens, and an acrylamide concern can be mitigated via selection of a proper roasting temperature.

Q What else is the Almond Board studying regarding acrylamide?

HUANG | At this point, FDA hasn't released recommended acrylamide levels, nor is it suggesting any levels going forward. Until we have a limit to work against, we plan to continue educating the industry through seminars, communications and discussions like this.

References:
(FDA) U.S. Food and Drug Administration. 2006. Survey data on acrylamide in food: Individual food products, 2002–2006. Available at: http://www.fda.gov/Food/FoodborneIllnessContaminants/ChemicalContaminants/ucm053549.htm