Guangwei Huang
Associate Director of Food Research & Technology

Guangwei Huang, began his career in the food industry since 1983 after graduated from West-China University of Medical Sciences (Now merged to Sichuan University) with a B.S. degree in sanitary inspection and technology. He had spent about 7 years with the China National Center for Food Safety Risk Assessment (formerly, the Institute of Health Inspection and Monitoring, the Ministry of Health) to develop national methods and standards for pesticide residues and contaminants in foods. Guangwei began his career with the US food industry in 1993 after graduated from the University of California, Davis with a M.S. degree in Food Science. He had worked for dried fruits and nuts, Mexico frozen foods, organic baby foods and almond processing companies in Central Valley of California as a laboratory manager, technical service manager, production manager and quality assurance director before he joined the Almond Board of California in 2001.

He has provided most service to the nut industry—specifically the California almond industry. For the last 17 years Guangwei has worked at the Almond Board of California (ABC) in various roles, most recently as Associate Director (Food Research & Technology), and previously as Principal Scientist, Senior Technical Manager and Technical Manager. He manages ABC's almond quality, safety and processing technology, and co-product utilization research projects, and he conducts trade education events and food professional outreach activities. Guangwei has played an instrumental role in development of the almond mandatory pasteurization rule. The thermal lethality and surrogate microbial challenge validation guidelines that he developed for existing almond processes and new pasteurization processes based on the findings from extensive research are now widely followed by other nut and low moisture food industries. Currently he is spending more time in finding more value-added options for almond coproducts including almond hulls, shells, and woody biomass, and better solutions to reduce dust during almond harvesting.

A native speaker of Mandarin Chinese, Guangwei contributes his extensive almond technical/application knowledge towards a variety of ABC market development initiatives. He was heavily involved in trade education and market development for ABC China program from 2001 to 2012 and had seen almond shipments to China grown from 25 million pounds to 240 million pounds annually. During the period, he also created an almond innovation competition in collaboration with the Chinese Institute of Food Science and Technology for food science students at universities throughout China, and the competition had lasted for 9 consecutive years and reached more than 14,000 students from about 60 universities. This pioneering work had triggered a large wave of food innovation competitions launched by many companies during the period.

Guangwei is a member of Institute of Food Technologists (IFT), International Association for Food Protection (IAFP), and American Association of Cereal Chemistry International (AACC), an Executive Board of Director for Subcommittee of China Snack Foods. He had served as a secretary and president for Chinese American Food Society (CAFS), a Board of Director for Chinese Institute of Food Science and Technology (CIFST).

Q&A Almonds

with
GUANGWEI HUANG

The heat is on: A deep dive into almond roasting

There's more to roasted almonds than meets the eye, says Guangwei Huang, Associate Director, Food Research and Technology, Almond Board of California (ABC). That's because the deceptively straightforward process of roasting sets in motion a cascade of physical and chemical events that turn almonds into a feast for all senses.

And none of it, Huang insists, happens by accident. "Roasting emphasizes the natural attributes of almonds — deepening the color and flavor profile, and creating a crispier, crunchier texture." he says.

Huang's spent considerable time investigating the finer points of roasting science, and his efforts have cast light on what occurs within the almond kernel when subjected to a range of temperatures across a span of time. So, we connected with him to discuss the insights he's gleaned and how almond processors can optimize their own roasting operations.

Q First, there are two main types of roasting—dry roasting, and oil roasting. How do they differ?

HUANG | The major difference is the heating medium – hot oil or hot air. Oil has a higher heat-transfer coefficient than air, so even if the oil and air are at the same temperature, the oil will roast almonds to a given degree in a shorter time than the hot air will. A percentage of the oil will get absorbed into the product, so the flavor profile of oil-roasted almonds will be slightly different. There will also be texture and color differences that will depend on the roast temperature and time, and on the type of oil.

Dry roasting is the more common method for the snack and retail sectors; because you're not adding oil to the product, there are fewer concerns about oil quality, flavor and the potential for residual oil oxidation.

Q Regardless of method, what, precisely, happens to an almond when we roast it?

HUANG | The first thing that happens during roasting is that the almond kernel heats up, and once the temperature approaches the boiling point it loses moisture from evaporation.

After the kernel is dehydrated and its temperature reaches above 250°F, that's when the Maillard reaction occurs between amino acids and reducing sugars naturally occurring in the almond. This generates a desirable darker color—what's known as non-enzymatic browning—and flavor compounds, like short-chain aldehydes and heterocyclic pyrazines. These compounds give the roasted almond a nutty flavor, while other chemical reactions break down fatty acids into a completely different set of volatile flavor and aroma compounds, like short-chain aldehydes. These compounds give the roasted almond a nutty flavor.

Q How do we know the proper temperature at which to roast almonds, and for how long?

HUANG | While a higher temperature will produce a stronger flavor in less time, those flavor compounds can dissipate or fade quickly. Because higher roasting temperatures cause quick moisture eruption from the almond kernel and thus greater damage to the cellular structure, this tends to shorten the roasted almond's shelf life.

So, we encourage processors to roast almonds at the lowest possible temperature, for as long as possible, to achieve a light roast. The flavor from a light roast can last longer, and the shelf life of the finished product can extend longer.

Q Are there any other factors to account for in the roasting process?

HUANG | If the roaster has issues with even heat distribution, the processor needs to make modifications to ensure that the heat distribution becomes as even as possible. That's because inconsistent roasting is a big concern. If there are zones within the roaster where some almonds are at a higher or lower temperature—sometimes a 10- to 20-degree difference—that portion of the product on the conveyor may be over- or under-roasted.

Again, over-roasting is a particular concern because it reduces the almonds' shelf life, usually through oxidation and rancidity.

Processors also look at air-flow rate because that affects heat penetration into the almond. When processors determine time and temperature roasting parameters, they consider the initial moisture content and temperature of the almonds.

Q How should processors handle almonds following roast?

HUANG | After roasting, almonds should be cooled quickly but gently with slightly lower-temperature air. The key is not to let residual heat continue to raise the product's temperature, causing unexpected and unwanted quality changes—and that can happen without proper cooling and without sufficient air circulation. You don't need forced-air circulation, but just a flow of cooling air.

Then package the almonds properly. Roasting alone initiates some degree of oil oxidation—and we want to stop the propagation of that oxidation by removing oxygen from the packaging environment, either through nitrogen flushing or vacuum. Pack the product in high-oxygen-barrier materials like aluminum pouches or metal-coated plastic bags that provide good oxygen barriers. This provides a much longer shelf life.

Q I've heard talk of something called two-step roasting. What is it, and what advantages does it bring?

HUANG | Two-step roasting first applies a lower temperature just hot enough to heat the almond kernel slowly and allow water to evaporate gently—preserving that important cellular structure. Then, when the moisture level falls to 2.5 to 3 percent, the process uses a higher temperature to get the Maillard reaction going to generate the desired flavor, color and aroma.

In the end, you have an almond with the characteristics consumers want, but with a longer shelf life. Remember: Everything's tied to how the roasting process maintains or keeps the integrity of the cellular structure of the kernel. This all helps to maintain a longer shelf life.

Understanding almond shelf life

When it comes to nuts, almonds are marvels of longevity. According to Guangwei Huang, principal scientist at the Almond Board of California, raw almonds can live a palatable life of up to two years if stored at ideal conditions. What are those optimal conditions, and what can be done to maximize them for almond longevity? We asked Huang to discuss what impacts almonds' lifespan.

Q To start, why is it important to understand almond shelf life?

HUANG

Manufacturers and processors need to pay attention to almond shelf life because they need to maintain the integrity of their product and its reputation with consumers. Consumers can use their own taste buds to tell if an almond is at the end of its life. So we want almond users to pay attention to shelf life preservation so they'll always have the best-quality almonds to present to consumers.

Q What threatens almond shelf life?

HUANG

Oxidation is the major concern. Like all nuts, almonds are high in oil, and any food containing high levels of oil can be vulnerable to lipid oxidation, especially when exposed to high temperatures or a high-oxygen environment. Lipid oxidation starts with the release of fatty acids, and later, if the free fatty acids become exposed to oxygen or free radicals, they oxidize and generate intermediary compounds that gradually break down into volatile compounds, like aldehydes, that produce rancid notes.

Q What conditions hasten oxidation?

HUANG

It's important to remember that the almond is a living kernel—a seed. So it interacts with its environment. High humidity, for example, accelerates the release of fatty acids. High temperatures accelerate it even more. So both high temperatures and high humidity work together to increase the release of free fatty acids that become oxidized if exposed to oxygen.

Q How can we counteract these factors?

HUANG

If the almond's moisture content stays below 6 percent—ideally between 3.5 and 5.5 percent—almonds can remain stable and have a long shelf life of up to two years. But for that to happen, it's important to maintain a storage environment that's between 50 and 60 percent relative humidity. As I mentioned, temperature can also impact both fatty-acid release and oxidation. One study we conducted found that storage temperatures below 59°F can protect almonds. And ideally, sealed plastic bags or tightly sealed storage containers serve as decent water and air barriers.

Q What role does packaging play in shelf life?

HUANG

Packaging is especially important with roasted almonds, because high roasting temperatures initiate some lipid oxidation. So packaging that provides a better oxygen barrier— particularly nitrogen flushing or vacuum packaging—keeps oxygen away and slows down oxidation. Packaging also prevents or slows down product water absorption from humid environments to further extend shelf life.

Q You've described actions we can take to optimize almonds' quality life. But what "built-in features" help almonds protect themselves?

HUANG

First, almonds are low in moisture—around 3 to 6 percent. Second, almonds' lipids are primarily monounsaturated and more stable than the polyunsaturated fats in other nuts. At the same time, almonds are high in vitamin E, which is a natural antioxidant that defends against oxidation. Almond skins contains another group of antioxidants called polyphenols, which also protect against oxidation. And most importantly, almonds have a strong cellular structure that protects oil droplets in a honeycomb-type network. So, almonds' built-in protections that give them a naturally long shelf life include their low moisture, proper fatty-acid profile, vitamin E, skin polyphenols and a protective cellular structure.

Q ABC funds extensive almond research and the Board has invested $6.5 million in studying almond quality and safety since 2001. What are the latest findings you've uncovered?

HUANG

We just completed two shelf life studies, one at the University of Georgia and one in China. We looked at raw and roasted nonpareil almonds under different storage and packaging conditions to understand how different combinations of humidity, temperature and packaging affect shelf life. Every two months we took samples for analytical testing and consumer-panel evaluations, and we found that consumer rejection is driven more by texture changes.[1] So if humidity and temperatures increase, the almonds' crunchy texture deteriorates, and that plays a greater role in consumers' responses than the chemical changes associated with rancidity. We found that packaging can extend shelf life by four to 18 months, depending on the conditions.[2] And, we're continuing to fund research on almond quality and safety – visit www.almonds.com/food-professionals to learn more, or contact foodprofessionals@almonds.com.

References:

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