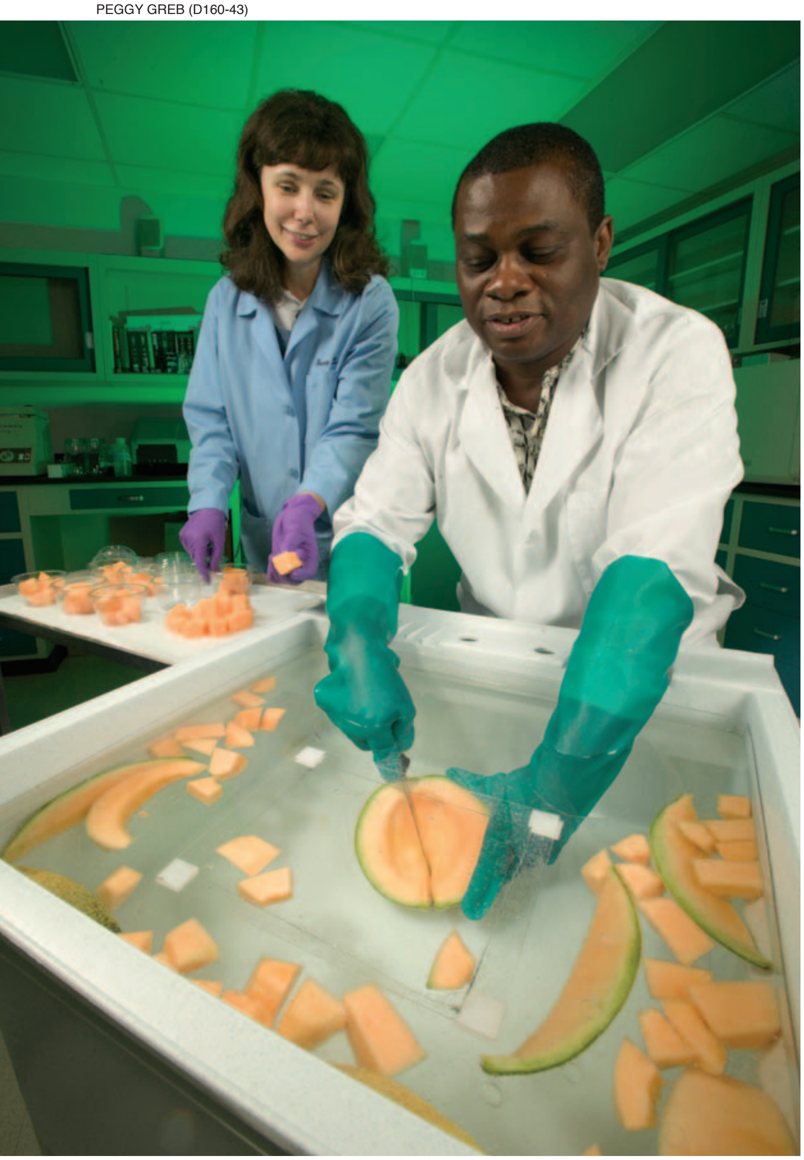
Fresh-Cut Fruit Moves Into the Fast Lane

When it comes to eating, many Americans value convenience—a mentality that can get our waistlines into trouble. Fortunately, the term "fast food" is starting to include colorful, fiber-rich fruits and veggies—already peeled, sliced, and ready to eat.

Think of perfectly ripened pineapple chunks, minus the labor of carving away the tough rind. Or fragrant, sweet cantaloupe presliced and packaged—without the hassle of scooping out slimy seeds from inside the core.

The notion is catching on. According to the International Fresh-cut Produce Association, fresh-cut fruits and vegetables make up one of the fastest growing food categories in U.S. supermarkets. U.S. sales of fresh-cut produce sprang from $3.3 billion in 1994 to $11 billion in 2000 and are projected to reach $15 billion in 2005. Fresh-cut veggies, including ready-to-eat salads, account for most of these sales.

PEGGY GREB (D160-43)



Chemist Olusola Lamikanra cuts a cantaloupe under water while food technologist Karen Bett-Garber prepares the cut samples for analysis.

But Olusola Lamikanra, a chemist with ARS's Food Processing and Sensory Quality Research Unit in New Orleans, Louisiana, is working to get fresh-cut fruits a much larger share of this market—and make them more available to consumers.

"What's holding fresh-cut fruits back," says Lamikanra, "are the physiological and biochemical changes that occur when they're processed and stored. Compared to vegetables, fruits commonly used for the fresh-cut market generally have a higher pH and water content, making them more vulnerable to micro-organisms and enzymatic changes."

That means when fruit is sliced, there's a good chance that sensory qualities—like taste and texture—will be altered, nutrients lost, and bacteria and molds introduced.

So for the last 6 years, Lamikanra has watched fruits—mainly cantaloupe melons—be cut, quartered, sliced, and diced. He understands how plant tissues respond to the stresses of processing and has now figured out ways to manipulate a fruit or vegetable's alert system when it is cut.

Mixing the Signals

Most of us don't think very much about the act of slicing an apple. But the moment a knife pierces the skin of a piece of fruit, a series of physiological events is set off.

"When fruit is cut, electrical, chemical and hormonal signals are sent right through the plant's tissues," says Lamikanra. "It's like a death message is sent, and the plant has to make adjustments for that."

These signals, which can be transmitted within seconds, initiate defense responses that promote wound healing, guard against bacterial attack, and generally protect plant cells from further stress.

Lamikanra has devised ways to use this plant biology to his advantage. "The critical moment is when the plant tissues are cut," he says. "It's at this point that I'm trying to alter plant signals and change how they would normally respond."

Plant cells will communicate stress signals if something changes the turgor (fluid) pressure within their tissues. Slicing through a piece of fruit—like popping a balloon—will certainly cause a change in pressure. So to keep the signals from firing, Lamikanra has tried cutting fruit while it's submerged in water.

"By slicing the melon under water," says Lamikanra, "we can control turgor pressure, because water forms a barrier that prevents movement of fruit fluids while the melon's being cut."

The watery environment also helps to flush potentially damaging enzymes away from plant tissues. When fruit is cut, enzymes, which are normally isolated from other plant cell components, are forced to interact with plant substrates (chemical substances the enzymes act on). This mingling can lead to destructive chemical reactions—as happens when a freshly cut apple turns brown.

"With underwater processing, we can add compounds, such as calcium, that can further suppress wound-signaling mechanisms," says Lamikanra. Antimicrobial agents can also be mixed into the water.

Lamikanra is still working to improve the engineering designs surrounding his submerged-processing technology. He says this approach also works well for vegetables, since they don't require as much peeling and separating—tasks more difficult to do under water.

Heat and Ultraviolet Light

Lamikanra is using another cue from the outside environment to trick plant tissues: heat. By submitting cantaloupes to temperatures 50˚F above their normal growing temperature for a period of time, he causes the fruit's tissues to produce a unique set of proteins.

"This response is ubiquitous across microorganisms, plants, and even animals," says Lamikanra. "The plant produces heat-shock proteins, which prevent wound proteins from forming and protect the shocked tissue from later stress."

For instance, a heat shock of about 115˚F for about 3 minutes keeps lettuce leaf tissue from producing certain enzymes that would eventually cause it to turn brown. This mild heat treatment is enough to produce heat-shock proteins without harming quality.

For his studies, Lamikanra heated whole cantaloupes, previously stored at 40˚F, inside a water bath at 144˚F for 1 hour. The melons were then cooled back to 40˚F overnight before cutting. The cut fruit stayed fresher and crisper during storage at 50˚F.

"There's also interest in using this heating treatment for quarantine purposes. It would be an ideal approach for cantaloupes, since so many are imported into this country," says Lamikanra.

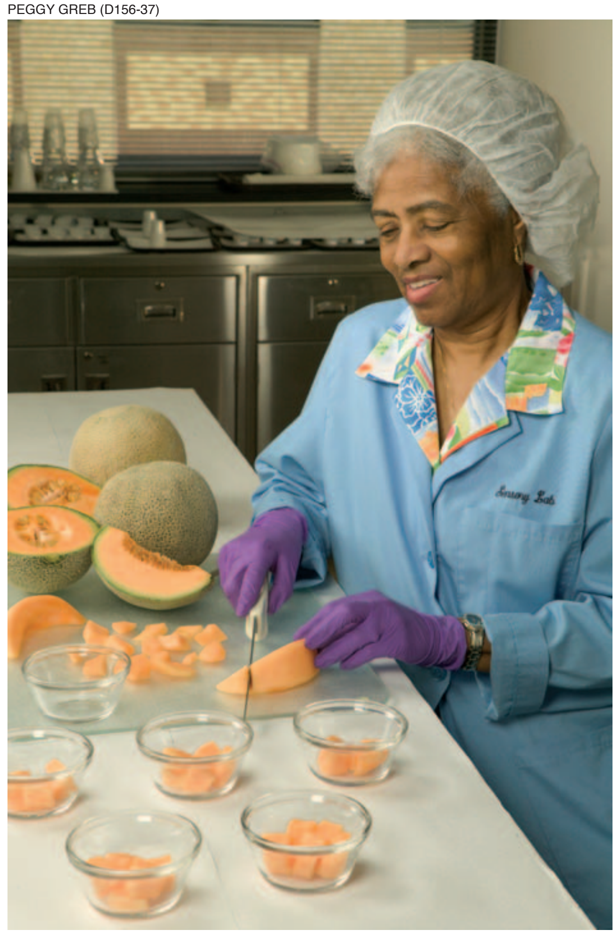
Hoping to provide as many options as possible to food processors, Lamikanra has tested another technology to extend the shelf life of cut fruits. While it's traditionally been used to sterilize foods, ultraviolet (UV) light can also be used to trip up a plant's classic stress response.

"Cutting a cantaloupe under UV light," says Lamikanra, "causes a hypersensitive defense response to take place within its tissues." As part of this response, the plant produces certain peroxidase enzymes, which Lamikanra says function as protective antioxidants. He compares this plant reaction to the way our bodies create antibodies when confronted with environmental stresses. Cut fruit from melons processed under UV light also stayed fresher a few days longer.

Testing Our Senses—and Sensibility

What sets his work apart from others in his field is that Lamikanra is working alongside a food sensory expert—Karen Bett-Garber—to see whether fruits cut with his novel process-

PEGGY GREB (D156-37)



Laboratory support worker Myrna Franklin prepares cantaloupe samples for sensory evaluation (taste testing) by trained panelists.

PEGGY GREB (D157-42)

Food technologist Daphne Ingram (standing) works with panelists (from left) Felice Fowler, Rupert Gwaltney, and Stella Dabbs to evaluate reference samples of flavor attributes found in fresh-cut cantaloupe.

ing methods actually taste fresh longer. Bett-Garber oversees activities at the sensory lab at the Southern Regional Research Center (SRRC) in New Orleans. She conducts studies with trained panelists to see whether food-processing technologies being developed by SRRC scientists are truly improving quality from a human sensory standpoint.

And Lamikanra's technologies are doing just that.

"We've seen an improved duration of the fruity flavors in melons processed with his methods," says Bett-Garber. "And that's our goal—to keep those desirable flavors lasting longer."

Panelists are carefully selected to participate in the sensory evaluations. "First, we screen individuals for normal tasting and smelling abilities," says Bett-Garber. "People can lose some sensitivities with age but still remain in the normal range."

Fundamental to the sensory evaluation approach is language that panelists can use to systematically describe their sensory experiences. For the cantaloupe research, terms selected to describe aroma include "sweet aromatic," "chemical," "musty," "fruity melon," "rancid," and "painty."

"Melon is a very complex flavor," she says. "We want cantaloupe to have a distinct cantaloupe flavor—distinguishable from honeydews, for instance."

And what constitutes a "rancid" or "painty" aroma? According to Bett-Garber, it's associated with immature melons. "Interestingly, the compounds responsible for imparting this aroma are the same ones that come up when our volunteers smell rancid peanuts," she says.

Bett-Garber has developed and refined flavor "lexicons"—groups of terms—not only for cantaloupes, but also for honeydews, watermelons, apples, and peaches.

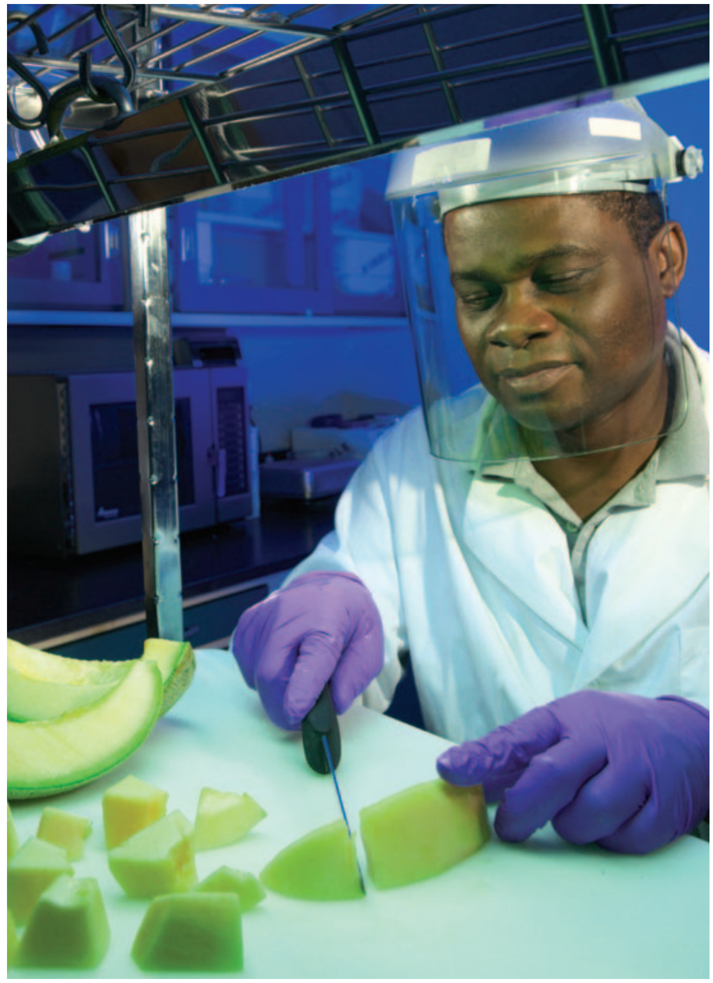
To develop the cantaloupe lexicons, for example, she brought in panelists and presented them with a range of melons, some that were underripe, mature, very mature, and so on. "The panelists then described the various samples," she says. "The terms they used helped us develop a lexicon reflecting all flavor and taste aspects of the melon samples.

"In this way, we're taking advantage of the panelists' sensory abilities and their life experiences, since smell is linked to so many of our memories."—By **Erin Peabody,** ARS.

This research is part of Quality and Utilization of Agricultural Products, an ARS National Program (#306) described on the World Wide Web at www.nps.ars.usda.gov.

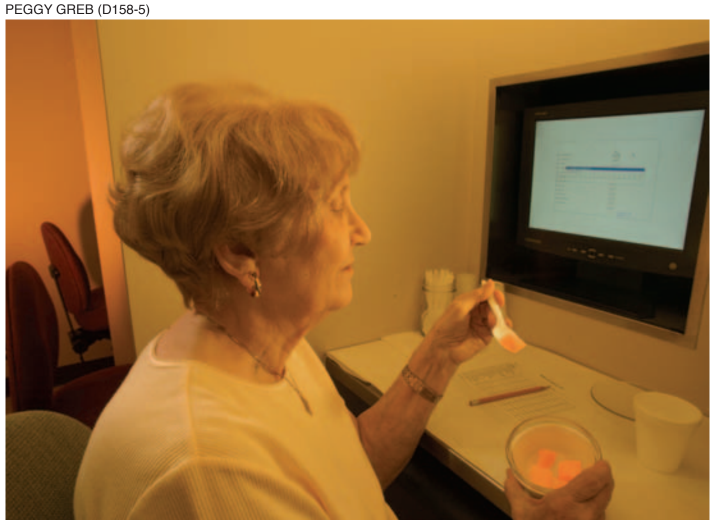
Olusola Lamikanra and Karen Bett-Garber are in the USDA-ARS Food Processing and Sensory Quality Research Unit, Southern Regional Research Center, 1100 Robert E. Lee Blvd., New Orleans, LA 70124; phone (504) 286-4278 [Lamikanra], (504) 286-4459 [Bett-Garber], fax (504) 286-4419, e-mail sola@srrc.ars.usda.gov, kbett@srrc.ars.usda.gov. ✷

PEGGY GREB (D159-43)



Chemist Olusola Lamikanra slices a cantaloupe under ultraviolet light, which causes a defensive response in the fruit tissues.

PEGGY GREB (D158-5)



Panelist Dorothy Duplantier tastes a cantaloupe sample under yellow lights, which mask color differences in the samples. Using specific terms, she'll describe the melon's flavor.