Calculating the Carotenoids in a Fall Favorite

Rich, creamy pumpkin pie, still warm from the oven and topped with a dollop of chilled whipped cream, may be the best known way to enjoy this colorful veggie. Besides being the star of that traditional dessert, pumpkin can add a pleasing taste and texture to everything from appetizers to soups, stews, and even chili!

But there's a serious side to this jolly member of the squash family. Those cans of cooked, pureed pumpkin on your pantry shelf probably have more of a healthful phytonutrient called beta-carotene than any other food in your cupboard. Our bodies can convert beta-carotene, a carotenoid and antioxidant, into vitamin A—a nutrient essential for good eyesight and proper growth.

Until now, there hasn't been a fast, simple, and environmentally friendly way to precisely measure the beta-carotene and other carotenoids in pumpkin. A study led by ARS chemist Betty J. Burri has filled that technology gap, yielding guidelines for an approach that's rapid, reliable, and reproducible. Another plus: The test doesn't require harsh chemicals. That makes it a much better choice than today's other options, says Burri. She's based at the ARS Western Human Nutrition Research Center in Davis, California, about 70 miles north of San Francisco.

Though developed from their experiments with *Cucurbita moschata,* or Asian pumpkin—the kind you'll find in cans at your local supermarket—the technique should also be applicable to other members of the squash family, known to scientists as Cucurbitaceae, or cucurbits.

Carotenoids: What We Still Don't Know

Why do we need to measure carotenoids more precisely? These natural plant compounds, responsible for the orange hues of pumpkins and carrots and the deep reds of tomatoes, continue to capture the attention of nutrition and public health researchers worldwide. That's because these specialists are eager to discover more about carotenoids' health benefits. Some carotenoids are thought to help reduce incidence of cataracts, cardiovascular disease, and particular kinds of cancer, explains Burri. And although beta-carotene is still the most studied type, the importance of other carotenoids, such as cryptoxanthin, lutein, and lycopene—and the amounts in which they occur—may become clear as more is learned about them.

Today, the exact sequence of steps that our bodies use to take up beta-carotene and convert it to vitamin A remains mostly mysterious. But it's thought that other carotenoids may play a role.

Burri's earlier work with healthy men and women volunteers confirmed that individuals vary widely in their ability to absorb beta-carotene from food and convert it into vitamin A. Do the amounts or ratios of certain lesser known carotenoids in foods influence that ability? If so, the measurement approach Burri's team developed should be of great use to nutrition and public health researchers. Plant breeders trying to develop superior crops for the future could also put the assay to work when they're evaluating their most promising new pumpkins, says Burri.

PEGGY GREB (K11957-1)

Biologist Terry Neidlinger prepares pumpkin for freeze-drying.

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Can Pumpkin Prevent Blindness and Infant Deaths?

Better pumpkins could be especially helpful to people living in areas of Africa, Southeast Asia, or South and Central America where vitamin A deficiency is the leading cause of preventable blindness and a major cause of infant deaths. "Although fresh mangoes, also rich in beta-carotene, are being promoted in some nutrition programs in those areas," says Burri, "they're only available as a fresh product in the spring and summer. They don't ship very well and have a relatively short shelf life."

Pumpkin, harvested in fall and early winter, might help fill the nutrition gap when mangoes are out of season. Pumpkins store well and don't require the refrigeration that's simply too costly for millions of people. What's more, pumpkin is easy to grow.

Though foods like liver, whole milk, and eggs provide vitamin A to the body with no need for beta-carotene conversion, these foods are typically more expensive than locally grown pumpkins.

Pumpkin's largely untapped potential led the Korean Science and Engineering Foundation to help fund the carotenoid-calculating experiments at Burri's laboratory. She did the work with chemist Terry R. Neidlinger of the Western Human Nutrition Research Center and with Jung Sook Seo and Zhejiu Quan of Yeungnam University, Gyeongsan, South Korea.

Notes Burri, "Just as in North America, there are pockets of vitamin A deficiency among South Korea's poor. Pumpkin is already popular in traditional Korean dishes, so making it possible for people to eat more of it, more often, may help overcome the deficiency."

Her team showed that a process known as supercritical fluid extraction, or SFE, efficiently draws out significant amounts of carotenoids from pumpkin samples. Pairing that with reversed-phase liquid chromatography—to identify and measure the extracted compounds—is less labor intensive than liquid-liquid extraction, the technique they used as a comparison.

In addition, SFE doesn't require harsh chemicals that are either a problem to dispose of properly or that can alter the carotenoids, thus skewing test results. Too, processing the samples doesn't require a 12-hour wait, as can happen with liquid-liquid extraction of vegetables.

Neither SFE nor reversed-phase chromatography is new. SFE has been used for decades to remove caffeine from coffee beans. But Burri and colleagues are apparently the first to provide detailed guidelines for using SFE and reversed-phase liquid chromatography to more precisely measure carotenoids in *C. moschata*—one of the world's most widely consumed species of pumpkin—and its squash family relatives. The researchers describe the procedure in a 2005 issue of the *Journal of Chromatography.*

The ease, speed, and precision of this technique could quicken development of new, super-healthful pumpkins here and in other parts of the world. In coming years, the convenient canned pumpkin on supermarket shelves may pack a nutrition punch that's more powerful than ever.—By **Marcia Wood,** ARS.

This research is part of Human Nutrition, an ARS National Program (#107) described on the World Wide Web at www.nps.ars.usda.gov.

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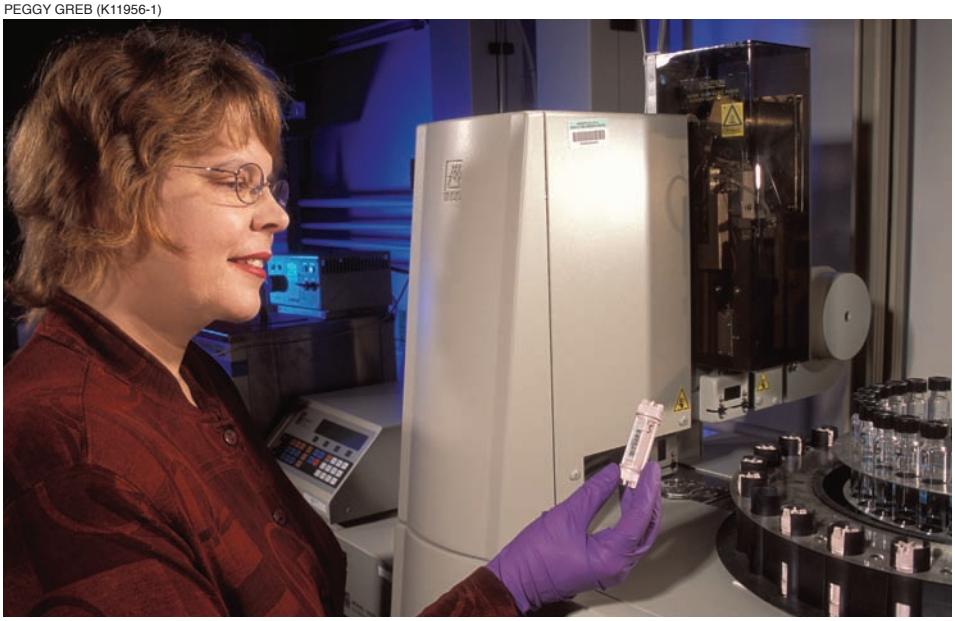

Chemist Betty Burri loads homogenized freeze-dried pumpkin samples into a supercritical fluid extractor for carotenoid analysis.