Golden Rice-2 Shines in Nutrition Study

"Improving Rice, A Staple Crop Worldwide"
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All across America, rice has a loyal following among those who enjoy crispy rice cereal at breakfast, steamed white rice with a favorite entree at lunch, or a classic rice pudding as an evening dessert.

But America's consumption of rice—about 21 pounds per person each year—is substantially less than that of people who live in the world's "rice-eating regions," mainly Asia, most of Latin America, and much of Africa.

Because vitamin A deficiency—and its harmful impacts on health—is common in some of these overseas areas, scientists in Europe and the United States have worked for more than a decade to genetically engineer white rice so that it will provide beta-carotene. Our bodies convert beta-carotene into retinol, a form of vitamin A.

White rice typically does not have any detectable beta-carotene. But the genetically engineered Golden Rice-2 from Syngenta Corporation does.[1] Until now, however, scientists haven't known how efficiently our bodies can convert the beta-carotene in Golden Rice-2 into retinol.

Research published in a 2009 issue of the *American Journal of Clinical Nutrition* provides a scientifically sound answer. Agricultural Research Service plant physiologist Michael A. Grusak, carotenoids researcher Guangwen Tang, and colleagues reported, for the first time, their findings that one 8-ounce cup of cooked Golden Rice-2 provides about 450 micrograms of retinol. That's 50 to 60 percent of the adult Recommended Dietary Allowance of vitamin A.

Tang, who led the study, is at the ARS Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, Massachusetts; Grusak is with the ARS Children's Nutrition Research Center at Baylor College of Medicine in Houston, Texas.

ARS, the National Institutes of Health, and the U.S. Agency for International Development funded the research.

The scientists based their determinations on tests with five healthy adult volunteers who ate one serving of the rice at the start of the 36-day study. Volunteers' blood was sampled at more than 30 intervals during the research. By analyzing those samples, the researchers were able to determine the amount of beta-carotene (and retinol) that the volunteers absorbed (and then converted to retinol) from the Golden Rice-2.

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[1] Note from the Golden Rice Humanitarian Board: Syngenta has licensed Golden Rice-2 to the inventors of Golden Rice under the terms of a 2001 humanitarian licence agreement.

The efficient conversion of Golden Rice-2 beta-carotene into vitamin A strongly suggests that, with further testing, this special rice might help reduce the incidence of preventable night blindness and other effects of vitamin A deficiency in rice-eating regions. Right now, more than 200 million people around the globe don't get enough vitamin A.

Grusak conducted experiments that made it possible for Tang's group to detect beta-carotene (and resultant retinol) derived from Golden Rice-2, differentiating it from beta-carotene or retinol from other sources.

In his experiments, Grusak determined how to get Golden Rice-2 plants, grown in his rooftop greenhouse at Houston, to take up a harmless tracer and incorporate it into the beta-carotene in the developing grains. The tracer, a rare yet safe and natural form of hydrogen, can be detected by a gas chromatograph-mass spectrometer, the kind of instrument that Tang's team in Boston used to analyze volunteers' blood samples.

The tracer, deuterium oxide, is not new to vitamin A research. But Grusak's studies are the first to show how the tracer can be successfully incorporated into the grains of a living plant for vitamin A investigations.

"It was tricky to determine how much tracer to use and when to add it to the nutrient solution we grew the plants in," says Grusak. His method might be used in other pioneering research geared to boosting the nutritional value of other grains worldwide.—By **Marcia Wood,** Agricultural Research Service Information Staff.

This research is part of Human Nutrition, an ARS national program (#107) described at www.nps.ars.usda.gov.

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