



# Boosting Lycopene in the Diet

## *The tomato consumption study*

Chieri Kubota

by Susan McGinley

**A**tomato a day keeps the doctor away” could be the new adage if a University of Arizona study proves the biological value of high lycopene tomatoes in the human diet. These tomatoes could also provide growers with a readily marketable crop.

More than 40 participants are eating two tomatoes a day and having their blood tested to see if it retains high levels of lycopene, the carotenoid pigment that gives tomatoes, pink grapefruit, guava, watermelon and other fruits and vegetables their red color. Although it is not considered an essential nutrient, increased lycopene intake has been associated with reduced risks for certain cancers, including prostate cancer, and for cardiovascular disease.

This collaborative effort between the UA departments of Nutritional Sciences and Plant Sciences uses a cost-effective and easily adaptable greenhouse method for growing a high lycopene tomato. The tomato was developed specifically for this study at the Controlled Environment Agriculture Center in the UA College of Agriculture and Life Sciences. It is not genetically engineered. Rather, simple changes in the hydroponic nutrient solutions of the greenhouse-grown tomatoes induce salt stress in the plants, forcing them to increase the lycopene levels in the fruit to 30 percent higher than normal as well as enhancing levels of other carotenoids and vitamin C. The tomato tastes very similar to a standard tomato, and nothing is added or genetically altered.

“We’ve been able to stress the plant enough that by nature’s design it produces more lycopene to protect and heal itself,” says Cynthia Thomson, assistant professor of nutritional sciences and a registered dietitian. “The lycopene stays in the flesh of the tomato.”

Together with Chieri Kubota, an associate professor of plant sciences who helped develop the greenhouse stress technique, Thomson is conducting a controlled feeding study using the newly developed tomato to find out if it can serve as a nutraceutical vegetable — one that offers additional health benefits beyond basic nutrition.

Study participants simply eat two fresh, raw tomatoes a day for 21 days and keep a log describing what they ate with the tomatoes and how they prepared them. Salads have been most popular. “Cooking would increase the absorption of the lycopene in their bodies but we want to know to what extent nutrient and carotenoid levels increase if the tomatoes are consumed raw,” Thomson says.

For comparison, one group eats high lycopene tomatoes, while a control group consumes standard tomatoes. Each participant receives a plastic bubble tray containing 14 tomatoes for the week, and all the trays are weighed before they leave the greenhouse. The following week the volunteers return what they didn’t eat, and the trays are weighed again. Eventually each participant is crossed over to the alternate tomato feeding for three weeks as well.

“The hard part is that you have to go on a lycopene-free diet for 18 weeks except for these tomatoes,” Thomson says. That means no spaghetti sauce, grapefruit, or other lycopene-containing produce. Periodic blood samples are taken to measure plasma lycopene and other carotenoids. In addition, 24 hour urine samples are collected to measure biomarkers for DNA oxidative damage. Thomson and Kubota hypothesize that the high lycopene tomatoes will increase lycopene levels in blood plasma and reduce DNA oxidative damage (which indicates a potential increased risk for disease.)

Because lycopene is a fat-soluble phytochemical that stays in the body for several weeks, each participant had to fast from lycopene-containing foods at the beginning of the study, and also undergo lycopene-free “wash-out” periods between each tomato feeding. Primarily funded by the UA’s BIO5 Institute, the feeding portion of the two-and-a-half-year study ends December 2006, followed by additional time for blood and urine assay analysis and development of the final report. The goal is to expand evidence regarding the potential health benefits of tomatoes and any added benefit afforded by consuming high lycopene tomatoes, according to Thomson.

Few Americans achieve the recommended nine fruits and vegetables a day currently recommended in MyPyramid, the USDA’s new Food Guide, Thomson notes, but if we were able to eat five to six servings that were more concentrated in disease-preventive nutrients and phytochemicals we could potentially achieve the same outcome — improved health and reduced risk for chronic disease.

“We’re improving human nutrition through nutritionally optimal plants that not only provide nutrients, they also produce carotenoids and other phytochemicals [plant chemicals that impart health benefits] at greater concentration,” Thomson says. Plant foods are a superior “vehicle” to deliver these important health-promoting compounds. “Some people would say ‘just take a lycopene supplement and forget about it.’ But when we consume whole plant foods we get the additional benefit of other phytochemicals and nutrients present in the plant. Risk for overconsumption of a single carotenoid

increases significantly when we reach for the supplement bottle, and our experience with beta-carotene supplementation suggests that some people (in this case smokers) may be placing ourselves at increased risk using this approach.”

The safer and likely more health-promoting route would be to consume the lycopene in a fruit where there is little risk of overeating. “You can pop seven lycopene pills a day,” Thomson admits, “but it would be really hard to eat seven tomatoes. That’s one reason why promoting food sources of nutrients and phytochemicals is so compelling. We want people to improve their diet instead of taking supplements.” The trick is to get the lycopene content in the tomato high enough to have biological importance without providing too much per fruit. The researchers have commissioned independent laboratory analyses to verify that the study tomatoes contain higher levels of lycopene than standard tomatoes, but at biologically appropriate levels.

If the study results bear out their hypotheses, Thomson and Kubota say opportunities will arise to expand collaborative food-related research and to develop significant partnerships

within the produce industry to improve the nutritional and phytochemical quality of other crops within the food supply. They are currently developing a partnership with Eurofresh, a greenhouse tomato producer in southeastern Arizona, to grow the high lycopene tomato and are forming partnerships with Yuma lettuce growers as well.

“We can try to do this with other produce,” Thomson says, “using similar natural techniques to enhance the nutrient and phytochemical content. For example, how about improving the lutein [an eyesight protector] content of spinach grown in Yuma?” ✨

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High lycopene tomatoes harvested from the UA Controlled Environment Agriculture Center’s greenhouse

Chieri Kubota