OARDC News

Recent News - Archive - Search News

08/21/2008

Turning Up the Heat on Tomatoes Boosts Absorption of Lycopene

Editor: This article was also distributed by Ohio State's Office of Research Communications, researchnews.osu.edu/.

COLUMBUS, Ohio -- Turning up the heat on the red tomato during processing has the potential to give the popular garden staple added disease-fighting power, Ohio State University research suggests.

Scientists have found that lycopene molecules in tomatoes that are combined with fat and subjected to intense heat during processing are restructured in a way that appears to ease their transport into the bloodstream and tissue. The tomato is the primary food source of lycopene, a naturally occurring pigment linked to the prevention of cancer and other chronic diseases.

In its standard structure in the average red tomato, the lycopene molecule is laid out in a linear configuration. That structure seems to hinder the molecule's absorption through intestinal walls and into the blood, said Steven Schwartz, an investigator in Ohio State's Comprehensive Cancer Center and a professor of food science and technology at Ohio State.

Meanwhile, most of the lycopene that is found circulating in human blood is configured in a bent molecular form. This means that either the human body somehow transforms lycopene molecules through reactions that have yet to be identified, or that the bent molecular structures of lycopene are much more likely to be absorbed into the blood and transported to tissue -- a necessary step in preventing disease.

Assuming the latter is true, Schwartz and colleagues have devised a way to process red tomatoes -- the variety preferred by American consumers -- into a sauce that contains bent molecular forms of lycopene. A clinical trial conducted in collaboration with Steven Clinton, a medical oncologist and physician scientist in Ohio State's Comprehensive Cancer Center, showed that people had more lycopene in their blood after eating the specially processed sauce than they did after eating regular red tomato sauce.

Schwartz, who is also a researcher with the Ohio Agricultural Research and Development Center, described the research on Aug. 20 at the American Chemical Society meeting in Philadelphia.

In the food science world, processing gets a bad rap for its tendency to deplete vegetables of nutrients, change their color and often negatively affect how they taste.

"Instead, here is a case where processing is positive in terms of enhancing absorption of lycopene," said Schwartz.

Lycopene belongs to a family of antioxidants called carotenoids, which give certain fruits and vegetables their distinctive colors. Carotenoids' antioxidant properties are associated with protecting cells and regulating cell growth and death, all of which play a role in multiple disease processes.

In its natural state, lycopene in a red tomato is in what is called an all-trans configuration, characterized by its linear form. The molecular structure of lycopene circulating in human blood is in what is called a cis-isomer configuration, or a bent form. The chemical properties are the same -- only the configuration differs.

"What we have found is we can take the red tomato molecular form of lycopene and by processing it and heating it in combination with added oil, we can change the shape of the molecule so it is configured in this bent form," Schwartz said.

Heat is essential to the process, but so is adding some fat, Schwartz said. In previous work, he and colleagues determined that consuming fat and carotenoids simultaneously improved absorption of lycopene and other compounds, but the scientists weren't sure exactly why.

When humans eat fats, or lipids, the body produces tiny droplets of fat called lipid micelles during digestion

that are easily taken up through the intestinal wall and absorbed into the bloodstream.

Continuing research has led Schwartz to hypothesize that lycopene in its linear form tends to stack and become crystallized, which lowers, but does not eliminate, its absorption potential. But the bent forms of lycopene are able to more easily find their way into the lipid micelles during digestion, and increasing amounts of the antioxidant in that form are more likely to be transported to the blood along with the fats.

Taking all this into consideration, the researchers processed red tomatoes into two kinds of sauce: a sauce rich in cis-lycopene, the bent configuration, and a sauce containing mostly all-trans-lycopene, the linear form. Both sauces were flavored similarly and initially heated using the same methods. Corn oil was added to both sauces as well. But the sauce designed to produce lycopene in the bent molecular forms was subjected to a second round of heating at 260 degrees Fahrenheit for 40 minutes. The resulting sauce contained nine times more cis-isomers than the regularly processed sauce.

Twelve people participated in a study of the sauces, and all ate both kinds of sauce over the course of the study. After each meal, researchers took samples of participants' blood seven times during the following 9 1/2 hours to measure lycopene levels. The scientists used a special testing method to analyze lycopene levels in the blood associated only with the tomato sauce meal, avoiding any other possible sources of those compounds in the bloodstream.

Research participants had a 55 percent increase in total lycopene absorption after eating the specially processed sauce when compared to their lycopene blood levels after eating the regular sauce. This finding reinforced the expectation that the bent forms of lycopene are more easily absorbed into human blood, Schwartz said.

Details of this study were first published in the *British Journal of Nutrition* in 2007. Additional clinical trials are ongoing.

Schwartz said most currently available commercial products don't contain the bent forms of lycopene molecules. But he noted that some home cooking practices might be able to produce the same results as the special processing method he and colleagues designed.

"Some people like to cook tomato sauce for prolonged periods, sometimes reheating it day after day, because it tastes better on the second and third day. They add fat by using oil or meat, and that's going to start to induce cis-isomers of lycopene if fat is present and the cooking continues," Schwartz said. "So it's possible people could induce this process and increase lycopene absorption by routine food preparation procedures, as well."

Much of this research is supported by the Ohio Agricultural Research and Development Center Competitive Grants Program, the National Center of Research Resources of the National Institutes of Health, the National Cancer Institute, and the U.S. Department of Agriculture Initiative for Future Agricultural & Food Systems.

#

Writer:

Emily Caldwell
Caldwell.151@osu.edu
(614) 292-8310

Source:

Steven Schwartz, Food Science and Technology
Schwartz.177@osu.edu
(614) 292-2934

Recent News - Archive - Search News