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Compounds that Color Fruits and Veggies May Protect Against Colon Cancer

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COLUMBUS, Ohio -- Understanding the molecular structures of compounds that give certain fruits and vegetables their rich colors may help researchers find even more powerful cancer fighters, a new study suggests.

Evidence from laboratory experiments on rats and on human colon cancer cells also suggests that anthocyanins, the compounds that give color to most red, purple and blue fruits and vegetables appreciably slow the growth of colon cancer cells.

The findings also bring scientists a step closer to figuring out what exactly gives fruits and vegetables their cancer-fighting properties.

"These foods contain many compounds, and we're just starting to figure out what they are and which ones provide the best health benefits," said Monica Giusti, the lead author of the study and an assistant professor of food science in the College of Food, Agricultural, and Environmental Sciences at Ohio State University. Giusti also has a research appointment with the college's Ohio Agricultural Research and Development Center.

Giusti presented the findings, which represent the collaborative efforts of Giusti and her colleagues, on Aug. 19 at the national meeting of the American Chemical Society in Boston.

Giusti and her colleagues found that in some cases, slight alterations to the structure of anthocyanin molecules made these compounds more potent anti-cancer agents.

In their studies on human colon cancer cells grown in laboratory dishes, the researchers tested the anti-cancer effects of anthocyanin-rich extracts from a variety of fruits and vegetables. They retrieved these anthocyanins from some relatively exotic fruits and other plants, including grapes, radishes, purple corn, chokeberries, bilberries, purple carrots and elderberries.

The plants were chosen due to their extremely deep colors, and therefore high anthocyanin content. Some of these plants are also used as a source of food coloring.

The researchers determined the amount of extract needed from each plant to cut the growth of human colon cancer cells in half. Altering pigment structures slightly by adding an extra sugar or acid molecule changed the biological activity of these extracts.

The researchers added different extracts to flasks that contained colon cancer cells. They used an analytical technique called high-performance liquid chromatography-mass spectrometry in order to determine the exact chemical structure of each compound. They used biological tests to determine the number of cancer cells left after anthocyanin treatment.

The researchers found that the amount of anthocyanin extract needed to reduce cancer cell growth by 50 percent varied among the plants. Extract derived from purple corn was the most potent, in that it took the least amount of this extract (14 micrograms per milliliter of cell growth solution) to cut cell numbers in half. Chokeberry and bilberry extracts were nearly as potent as purple corn. Radish extract proved the least potent, as it took nine times as much (131 micrograms per milliliter) of this compound to cut cell growth by 50 percent.

"All fruits and vegetables that are rich in anthocyanins have compounds that can slow down the growth of colon cancer cells, whether in experiments in laboratory dishes or inside the body," Giusti said.

In additional laboratory studies, she and her colleagues found that anthocyanin pigments from radish and black carrots slowed the growth of cancer cells anywhere from 50 to 80 percent. But pigments from purple corn and chokeberries not only completely stopped the growth of cancer cells, but also killed roughly 20 percent of the cancer cells while having little effect on healthy cells.

In animal studies, rats induced with colon cancer cells were fed a daily diet of anthocyanin extracts either from bilberries and chokeberries, which are most often used as flavorings or to make jams and juices. The dietary addition of the anthocyanin extracts reduced signs of colon tumors by 70 and 60 percent, respectively, when compared to control rats.

Giusti says the results suggest that anthocyanins may protect against certain gastrointestinal cancers.

"Very little anthocyanin is absorbed by the bloodstream," Giusti said. "But a large proportion travels through the gastrointestinal tract, where those tissues absorb the compound."

In fact, other researchers at Ohio State have found that black raspberries may help reduce the growth of esophageal and colon cancers tumors.

Still, Giusti stops short of recommending one kind of fruit or vegetable over another. She and her colleagues are continuing to study how the chemical structure of anthocyanins contributes to the potential health benefits of food as well as how changes to these structures may affect the body's ability to use the compounds.

"There are more than 600 different anthocyanins found in nature," she said. "While we know that the concentration of anthocyanins in the GI tract is ultimately affected by their chemical structures, we're just beginning to scratch the surface of understanding how the body absorbs and uses these different structures."

She pointed out that her team is also evaluating how these pigments interact with other compounds in foods -- such interactions could ultimately affect the health benefits of the food or the anthocyanin itself.

"It is possible to use natural, anthocyanin-based food colorants instead of synthetic dyes," Giusti said. "Doing so still maintains the wonderful colors of foods while enhancing their health-promoting properties."

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