

Cranberry sauce: good for what ails you

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Cranberry sauce is not the star of the traditional Thanksgiving Day meal, but when it comes to health benefits, the lowly condiment takes center stage. In fact, researchers at Worcester Polytechnic Institute (WPI) have found that compounds in cranberries are able to alter *E. coli* bacteria, which are responsible for a host of human illnesses (from kidney infections to gastroenteritis to tooth decay), in ways that render them unable to initiate an infection.

The findings are the result of research by Terri Camesano, associate professor of chemical engineering at WPI, and a team that includes graduate students Yatao Liu and Paola Pinzon-Arango. Funded, in part, by the National Science Foundation and the Cranberry Institute and Wisconsin Cranberry Board, the work has been reported in a number of publications and presentations, including FAV Health 2007 (The 2nd Annual Symposium on Human Health Effects of Fruits and Vegetables), the annual meeting of the American Chemical Society in September 2006, and the January/February 2007 issue of the Italian publication *AgroFOOD* industry hi-tech.

For the first time, the research has begun to reveal the biochemical and biophysical mechanisms that appear to underlie a number of beneficial health effects that have long been ascribed to cranberries and cranberry juice—in particular, the ability of cranberry juice to prevent urinary tract infections (UTIs). The mechanism by which cranberry juice prevents such infections has not been clear, though scientists have suspected that compounds in the juice somehow prevent bacteria from adhering to the lining of the urinary tract.

Camesano and her students have used the atomic force microscope and other sophisticated tools to study how a group of tannins (called proanthocyanidins or PACs) found primarily in cranberries interact with bacteria at the molecular level. They have found that the compounds prevent *E. coli* from adhering to cells in the body (a necessary first step in infections) in several ways:

- The chemical changes caused by cranberry juice create an energy barrier that keeps the bacteria from getting close to the urinary tract lining.
- Direct measurements show that the adhesive forces between *E. coli* and cells of the urinary tract are greatly reduced when at least a 5 percent solution of cranberry juice cocktail is present.
- Cranberry juice causes tiny tendrils (known as fimbriae) on the surface of the type of *E. coli* bacteria responsible for the most serious types of UTIs to become compressed, reducing the bacteria's ability to latch onto the lining of the urinary tract.
- *E. coli* grown in cranberry juice or the isolated PACs are unable to form biofilms. Biofilms, clusters containing high concentrations of bacteria, are required for infections to develop. Biofilms are the source of infections associated with indwelling catheters and other biomedical devices.
- When *E. coli* are cultured over extended periods in solutions containing various concentrations of either cranberry juice or PACs, their cell membranes undergo changes that hinder the bacteria's ability to attach to cells of the urinary tract.

Camesano and her team have also noticed that cranberry juice inhibits the ability of *E. coli* to produce IAA, a molecule involved in a

phenomenon known as quorum sensing. Bacteria produce IAA to let other bacteria know they are there. Quorum sensing enables bacteria to sense that their population is large enough to initiate an infection, or to form a biofilm. Keeping bacteria from producing IAA may be another way that cranberry compounds can hinder their ability to cause serious infections.

Some of Camesano's current work is aimed at assessing the minimum effective dose of cranberry juice (or tannins) and the optimum frequency to ward off infections. In addition, she is working to test whether the urine of patients who have consumed cranberry juice still contains anti-adhesive properties. The clinical portion of the work is being done in collaboration with Amy Howell, associate research scientist at the Philip E. Marucci Center for Blueberry and Cranberry Research at Rutgers University.

Camesano says her work to date indicates that the benefits increase the more juice or cranberry products one consumes. So when it comes to this year's Thanksgiving feast, don't spare the cranberry sauce.

Source: Worcester Polytechnic Institute

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