

Probing Question: How do antioxidants work?

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Blueberries, pomegranates, green tea and dark chocolate -- these are just some of the antioxidant-rich "superfoods" found in almost any supermarket today. As well as improving our general health, there is growing evidence that diets high in antioxidants may confer some protection against a long list of chronic diseases, including Alzheimer's disease, cancer and even HIV. Given their increasing popularity, the fundamental question bears asking: What exactly are antioxidants, and how do they work in our bodies?

Antioxidants come in several forms, including the vitamins A, C and E; plant-derived polyphenols, found in colorful fruits and vegetables; and also the element selenium, found in nuts and broccoli. "What these compounds share," explained K. Sandeep Prabhu, Penn State assistant professor of immunology and molecular toxicology, "is the ability to neutralize harmful molecules in our cells."

These harmful molecules, known as free radicals, contain unpaired electrons -- which is unusual because electrons typically come in pairs. "The unpaired electrons make free radicals highly reactive, and in this state, they can cause damage by attacking the components of our cells, and can even cause cancer," Prabhu said.

So where do free radicals come from? Some are created as a natural by-product of reactions in our cells, said Prabhu. Other sources of free radicals include cigarette smoke, air pollution and exposure to UV light or radiation. Once free radicals are formed, they can make more free

radicals by scavenging electrons from other molecules, "creating a domino effect," he added.

Antioxidants neutralize free radicals either by providing the extra electron needed to make the pair, or by breaking down the free radical molecule to render it harmless. "Antioxidants stop the chain reaction of free radical formation and benefit our health by boosting our immune system," explained Prabhu. Because antioxidants are used up in the process of free radical neutralization, a diet rich in antioxidants is essential to ensure a constant supply.

Research has shown that antioxidants can have an important impact on serious diseases. In one recent study, the addition of a polyphenol-rich blueberry gel to the diet of oral cancer patients prevented recurrence of the cancer. Another experiment demonstrated that increased levels of selenium in the diets of a group of HIV-positive patients significantly delayed progression of the disease.

In light of these impressive results, should everyone be taking antioxidant diet supplements? Prabhu warned that there can be too much of a good thing: "As with most things, excessive levels of antioxidants can be toxic." Furthermore, he stressed, "We don't yet fully understand the mechanisms by which selenium and other antioxidants work, and so we must be cautious about prescribing diets high in these elements." In the Prabhu Lab, work is currently under way to discover how selenium works, with the goal of introducing selenium as a therapy for HIV.

The take-home message? A diet containing a balance of the various forms of antioxidants will maintain overall good health, and could even impact serious diseases. For instance, the American Cancer Society encourages people to eat five servings of fruits and vegetables per day, and emphasizes the benefits of getting antioxidants through foods rather than supplements. Prabhu himself makes sure he gets the recommended

daily allowance of selenium by eating a few brazil nuts everyday. "The key," said Prabhu, "is to eat a variety of fruits, vegetables, and nuts to ensure that we are taking advantage of all the health benefits that antioxidants can provide."

Source: Penn State, By Solmaz Barazesh

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