



Focus on Ecogenetics #2

UW Researchers Find Eating Broccoli May Protect Against Cancer

Summary of the Science

Researchers at the University of Washington's Center for Ecogenetics and Environmental Health are finding another very good reason to eat your vegetables. Center researchers **Dave Eaton, Theo Bammler, and Ken Thummel** are studying compounds called **phytochemicals** that lower the risk for certain types of cancers. Recently they looked at phytochemicals called isothionates to find out whether isothionates could reduce DNA damage that can lead to cancer. The scientists studied one type of isothionate, a compound called **sulforaphane** that is found naturally in **cruciferous vegetables**. Sulforaphane becomes biologically active when we chew the vegetables.

In their experiment, the researchers added sulforaphane to human liver cells. Next they added a natural toxin or poison, **aflatoxin**, which is found in some fungi. Aflatoxin causes genetic damage by physically attaching to DNA molecules and bending them out of shape, preventing the DNA from working. This type of DNA damage can cause cancer.

Here is what the researchers found: When sulforaphane was added to the liver cells first, then aflatoxin was added, there was significantly less DNA damage. With further study, they found that sulforaphane decreased the activity of a gene called Cytochrome P450. Cytochrome P450 contains the instructions to make the **enzyme** that breaks down drugs and toxic chemicals in the body. In this experiment, it appears that when sulforaphane was added to the liver cells, Cytochrome P450 did not **metabolize** the aflatoxin and the aflatoxin was unable to attach to the DNA and cause damage.



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The researchers also looked at a large family of genes called Glutathione S-transferase (GST). These genes contain the instructions to make enzymes that break down drugs. It was already known that one member of the GST family, GSTM1, has different forms. Some forms of GSTM1 work and people with those forms make the GSTM1 enzyme; one common form of GSTM1 does not work and people with that form do not make the GSTM1 enzyme. The researchers found that in the liver cells with DNA that had the working form of GSTM1, there was 75% less DNA damage than in liver cells that had the form of GSTM1 that did not work.

There are two conclusions from this research. First, some forms of the GSTM1 gene protect cells from DNA damage. People who have the form of the GSTM1 gene that works may be less likely to get some types of cancer. Second, eating cruciferous vegetables provides the compound sulforaphane which appears to prevent DNA damage and thus reduce the risk of getting cancer. Broccoli and cauliflower are particularly high in sulforaphane. Parents now have Center research on their side when they tell their kids to eat their vegetables!

Exploring Ethics

What we are learning about genetic and dietary factors in cancer raises ethical issues, such as:

- If knowing which form of GSTM1 gene we have would tell us whether we have a higher or lower risk of getting cancer, should there be a genetic test to find out?
- Should everybody be able to get a genetic test for GSTM1? Should health insurance pay for it?
- If sulforaphane protects people from getting cancer, should there be a sulforaphane supplement in pill form?
- Children may not like vegetables, especially cruciferous vegetables that have a strong flavor and are hard to chew. How important is it for children to have sulforaphane in their diets?
- In some low-income neighborhoods, there are few supermarkets but many fast food restaurants. These areas are called food deserts. Food deserts are associated with health problems related to eating an unhealthy diet. People who live in these neighborhoods may have a hard time getting cruciferous vegetables to eat. Is it fair or just that people who are disadvantaged don't have access to broccoli and other cruciferous vegetables that might help protect them from getting cancer?

References

1. *Sulforaphane- and phenethyl isothiocyanate-induced inhibition of aflatoxin B1-mediated genotoxicity in human hepatocytes: role of GSTM1 genotype and CP3A4 gene expression.* Center researchers Eaton and Bammler. PMID 20442190.
2. *The dietary isothiocyanate sulforaphane is an antagonist of the human steroid and xenobiotic nuclear receptor.* Center researchers Eaton, Bammler and Thummel. PMID 17028159.

Glossary of Terms

- **Ecogenetics:** the study of how genetics and the environment interact to influence human health.
- **Phytochemicals:** chemicals naturally found in fruits, vegetables, nuts and legumes that may have a positive impact on health.
- **Cruciferous vegetables:** A family of vegetables that includes broccoli, cabbage, cauliflower, brussel sprouts, and mustard greens.
- **Metabolize:** the process of breaking down specific compounds into smaller parts to use for energy, and also the process of building new compounds.
- **Enzyme:** a protein that produces chemical changes in the body.
- **Sulforaphane:** a phytochemical found in cruciferous vegetables that protects cells from DNA damage.
- **Aflatoxin:** a toxin or poison found naturally in some mushrooms and other fungi that attaches to DNA molecules and causes damage that can lead to cancer.

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