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Study links carcinogens to cancer stem cells -- but spinach can help

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Researchers at Oregon State University for the first time have traced the actions of a known carcinogen in cooked meat to its complex biological effects on microRNA and cancer stem cells.

The findings are part of a growing awareness of the role of epigenetics in cancer, or the ways in which gene expression and cell behavior can be changed even though DNA sequence information is unaltered.

The scientists also found that consumption of spinach can partially offset the damaging effects of the carcinogen. In tests with laboratory animals, it cut the incidence of colon tumors almost in half, from 58 percent to 32 percent.

The research at OSU's Linus Pauling Institute was recently reported in the journal *Molecular Nutrition and Food Research*, in work supported by the National Institutes of Health.

"Cancer development is a complex, multi-step process, with damaged cells arising through various means," said Mansi Parasramka, a postdoctoral scholar with LPI. "This study showed that alterations of microRNAs affect cancer stem cell markers in colon cancer formation.

"MicroRNAs are very small factors that do very big things in cells," she said.

Traditionally, cancer was thought to be caused by changes in DNA

sequence, or mutations, that allowed for uncontrolled cell growth. That's still true. However, there's also increasing interest in the role played by epigenetics, in which such factors as diet, environmental toxins, and lifestyle affect the expression of genes – not just in cancer, but also cardiovascular disease, diabetes, and neurological disorders.

Included in this epigenetic equation is the formation of microRNAs – once thought to be "junk DNA" - which researchers were at a loss to understand. It's now known that they influence which areas of DNA get expressed or silenced.

There are hundreds of microRNAs, and the OSU scientists monitored 679 in their experiments. When they don't work right, bad things can happen, including abnormal gene expression leading to cancer.

"Recent research is showing that microRNAs are one of the key epigenetic mechanisms regulating cellular functions in normal and diseased tissues," said Rod Dashwood, the Helen P. Rumbel Professor for Cancer Prevention and director of LPI's Cancer Chemoprotection Program.

"But unlike mutations which are permanent genetic changes in DNA," he said, "the good news about epigenetics and microRNA alterations is that we may be able to restore normal cell function, via diet and healthy life style choices, or even drug treatments."

Epigenetics essentially makes every person biologically unique, Dashwood said, a product of both their genetics and their environment. That includes even identical twins.

The findings of the new study should lead to advances in understanding microRNAs, their effects on cancer stem cells, and the regulatory processes disrupted in disease development, the OSU scientists said.

This might lead one day to tailored or "patient specific" therapies for cancer, Dashwood said.

Provided by Oregon State University