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Fighting cancer with folate

Investigating the link between nutrients and disease

by Amy Oprean

Over the past decade, a growing body of literature has emerged suggesting that nutrients play an important role in regulating gene expression, particularly as it relates to the development of disease. Ahmad Heydari, Ph.D., professor of nutrition and food science, is at the forefront of this growing field with his investigation of the link between folic acid and gastrointestinal cancer prevention and treatment.

“Powerful developments in genetics research have uncovered the potential of nutrients in controlling gene expression and even preventing DNA damage,” Heydari said. “In terms of cancer, a disease caused primarily from DNA damage, the potential for improvements in prevention and treatment is huge.”

Different effects of folate

Funded by the National Cancer Institute, Heydari’s research is a continuation of several years of studies by his lab that uncovered the link between cancer and folate – a form of vitamin B found in leafy vegetables, beans, peas, liver products and some breakfast cereals. In these studies, Heydari’s lab showed that a folate deficiency can induce the development of gastrointestinal cancer tumors, with one hypothesis suggesting that folate deficiency assembles the wrong “recipe” of DNA building blocks, raising the risk of cancer development.

The lab has also uncovered evidence that a folate deficiency inhibits the base excision repair (BER) DNA pathway, one of the body’s mechanisms for fighting cancer once it has begun to develop. “We

have data to show that a folate deficiency can not only raise the risk for developing cancer, but accelerate tumor progression by inhibiting one of the pathways designated for fighting cancer,” Heydari said.

Yet Heydari’s lab has also shown that in other situations, a folate deficiency can prevent cancer. In studies where animal models with damaged BER pathways underwent heavy exposure to carcinogens, Heydari’s found that folate deficiency actually decreased instances of cancer. One possible explanation is that the combination of a BER deficiency and a folate deficiency damaged cells beyond repair, causing the body to move to plan B – programmed cell death. Since cancer cells were completely wiped out, they were not able to divide and spread to other areas of the body.

“The findings of these studies were very exciting because they backed something we already suspected – that the effect of a nutrient can be very different depending on the environment and genetic makeup,” Heydari said.

In his current study, Heydari aims to determine the causes behind the varied effects of folate deficiency on cancer development. He will use different enzymes and amino acids to mimic the effects of folate deficiency on an animal model that lacks a BER pathway. He hopes to determine the mechanisms by which folate deficiency aids and hinders cancer development and characterize the genetic and environmental factors that determine which role a deficiency will have.

“The goal of this research is to achieve a better understanding of why a folate deficiency is good in



About Dr. Ahmad Heydari:

Dr. Heydari received a B.S. in microbiology and an M.S. and Ph.D. in biological sciences from Southern Illinois University. He joined Wayne State University in 1997.

some cases and bad in others,” he said. “Once we understand this on a deeper level, we will be able to use folate as a tool for gastrointestinal cancer prevention and treatment in at-risk populations.”

Personalized nutrition

Eventually, Heydari sees the knowledge gained from his research leading to personalized nutrition plans that lower the risk and increase survival rate of people with gastrointestinal cancers. Such breakthroughs would contribute to the growing field of nutrigenomics, the study of the effects of food and food constituents on gene expression. Nutrigenomics aims to create a knowledge base for personalized nutrition, with the ultimate goal of developing specific plans based on an individual’s genotype and life circumstances.

“The most exciting part of this research is that it is making us see human nutrition in a whole new light,” he said. “Where traditionally it has been associated with weight loss and metabolism, nutrition is now a powerful tool in controlling gene expression. The next decade of research will be monumental in transforming this basic research into clinical applications that could save people’s lives.”

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