Resistant Starch May Reduce Colon Cancer Risk From Red Meat

By Judy Peres

A diet high in red meat increases risk of colon cancer. But eating resistant starch—a carbohydrate that acts like fiber—may reduce that risk, according to a study in August’s Cancer Prevention Research.

“Red meat and resistant starch have opposite effects on the colorectal cancer—promoting microRNAs,” said first author Karen Humphreys, Ph.D., a research associate at the Flinders Centre for Innovation in Cancer at Australia’s Flinders University.

“This finding supports consumption of resistant starch as a means of reducing the risk.”

In a 2011 study, colon cancer risk increased by 29% for every 100 g of red or processed meat eaten per day, plateauing around 140 g. But no one knew exactly why.

This new study offers insights, said Sonia Kupfer, M.D., director of the Gastrointestinal Cancer Risk and Prevention Clinic at the University of Chicago Medical Center. “It may be that protective factors and risk factors work through the same pathways.” She noted other possible mechanisms: “Heme iron and heterocyclic amines from red meat cooked at high temperature alter gene expression and increase proliferation. Butyrate from microbes decreases proliferation. This paper starts to provide intriguing ways in which we can think about these dietary factors mechanistically altering the colonic epithelium. But there might be other effects as well,” she said. “Dietary substances can be complex.”

Unlike most carbohydrates, resistant starch passes undigested to the colon. There, gut microbes ferment it, yielding short-chain fatty acids, such as butyrate, which promote colon health. Those short-chain fatty acids, the study suggests, also reduce expression of microRNAs that are associated with severe colon cancer and that increase cell proliferation.

The study involved 23 healthy volunteers, aged 50–75 years. Participants were randomly assigned to either a high-red-meat diet (300 g raw per day of lean beef or lamb) or that same diet plus a resistant-starch supplement called StarPlus (40 g per day of butyrylated high-amylose maize starch). After 4 weeks on one diet, participants switched to the other for another 4 weeks. For 4 weeks before each intervention, participants ate normally.

After each phase, researchers took fecal and pinch biopsy samples of rectal mucosa. They measured levels of butyrate and other short-chain fatty acids; proliferation; microRNA expression; and target genes of those microRNAs, including cell cycle inhibitor CDKNI and proapoptotic genes PTEN and BCL2L11. A high-red-meat diet statistically significantly increased cell proliferation in the mucosa. This increase corresponded with higher expression of oncogenic microRNAs (the miR17-92 cluster and miR21). After 4 weeks on the high-red-meat diet, miR17-92 levels increased by a mean of 30%. Adding resistant starch to the meat diet reversed the increase in the miR17-92 cluster, but not in miR21.
In an editorial, Patricia Thompson, Ph.D., of the University of Arizona Cancer Center in Tucson, said this finding suggests that the butyrate effect may be specific to miR17-92 or may take more than 4 weeks to lessen red meat’s ability to cause cancer. Humphreys and colleagues noted that in preclinical studies, butyrate treatment altered the miR17-92 cluster, but not miR21.

The study acknowledged that identifying correlations does not imply cause and effect: “It is unclear what component of red meat is increasing miR17-92 and miR21 levels. It is also not conclusively determined what aspect of the resistant starch is protective”—although preclinical work indicates butyrate.

“More human studies are needed to understand the exact mechanism,” Kupfer said.

The study intrigued Thomas Sherman, Ph.D., associate professor of pharmacology and physiology at Washington, D.C.’s Georgetown University School of Medicine. He teaches the metabolism and nutrition course to first-year students.

“It’s really interesting that eating red meat was so clearly demonstrated to increase this marker [oncogenic microRNAs] and that eating some kinds of starch can decrease the marker. We don’t yet know if it will decrease the incidence of colon cancer, but this is very suggestive,” he said.

Sherman cited epidemiological data showing that people who eat the most red meat might be able to reduce colon cancer risk by eating more vegetables. But no human trial has shown this effect before.

“Fruits and vegetables offer the most solid nutritional advice we can give,” he said. “But we’ve never said it can decrease the risk associated with other foods. This would provide a great incentive to get more people to eat vegetables.”

Sherman said that nutritionists have been disappointed that just eating more fiber doesn’t decrease colon cancer risk. Many health professionals believed it would, he said, perhaps by eliminating waste and potential toxins more quickly from the bowel.

“This paper shows it’s not the bulk fiber—like bran muffins or Metamucil—that’s important for reducing cancer risk,” he said, “but the types of fiber, like resistant starch, that are metabolized by colonic bacteria.”

Resistant starch is in green bananas; peas, beans, lentils, and other legumes; root vegetables (including potatoes that have been cooked and cooled, as in potato salad); whole grains (especially oats); and virtually all other plant foods consumed at room temperature or below. Even pasta made from processed wheat flour contains resistant starch, as long as it is cooked al dente and served cold or at room temperature.

“Scientists have also been working to modify grains such as maize so they contain higher levels of resistant starch,” Humphreys said.

In her editorial, Thompson welcomed the study, saying recommendations to reduce red meat consumption have so far lacked persuasive power.

“Findings from association studies can easily be dismissed,” she wrote, “which becomes particularly appealing with an exposure like red meat that is economically, socially, and culturally important.”

The Humphreys study, therefore, is most welcome: “For the red meat lover,” she said, “resistant starch might be an option.”

So if you’re going to eat a steak, you might want to order a side of potato salad or beans.

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PDQ (Physician Data Query) is the National Cancer Institute’s source of comprehensive cancer information. It contains peer-reviewed, evidence-based cancer information summaries on treatment, supportive care, screening, prevention, genetics, and complementary and alternative medicine. The summaries are regularly updated by six editorial boards. The following PDQ summaries were recently updated:


The PDQ Melanoma Treatment summary was recently updated to include information about pembrolizumab, a human monoclonal antibody that binds to the PD-1 receptor, preventing it from binding its ligands, PD-L1 and PD-L2. The FDA granted accelerated approval in September 2014 for patients with unresectable or metastatic melanoma who have progressed despite therapy with ipilimumab and, if BRAF V600 mutation positive, a BRAF inhibitor. Approval was based on the surrogate endpoint of durable response rate in an international, multicenter, open-label,